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The Late Quaternary History of Denmark

The Weichselian Icesheets and Land/Sea Configuration in the Late Pleistocene and Holocene

by KAJ STRAND PETERSEN

INTRODUCTION

Danish geologists have studied Late Quaternary stratigraphy for many years. Compared with our Scandinavian neighbours Denmark has an advantage in that the country covers part of the North Sea depression, in the central part of which some 1000 m of quaternary sediments have accumulated. The country also lies in the submarginal zone of the areas covered by icesheets during the Quaternary. The northern and eastern parts of Denmark thus contain up to 200 m of quaternary deposits laid down during and after the last interglacial, the Eemian. Southwestern Denmark, beyond the limits of glacial advance, has not been covered with ice within the last 100,000 years.

My aim will be to locate the ice masses during the last glacial, the Weichselian. It will emerge that these ice masses were only present for relatively short periods. The changing land/sea configurations for this period will show some features which also characterize the subsequent Holocene period. In the postglacial the raised temperatures led to the re-establishment of the marine fauna known from the last interglacial. A global eustatic rise in sea level took place in the Holocene, just as in the Eemian interglacial.

In advance of the following sketch of the stages of palaeogeographic development, I must state that not all Danish quaternary geologists share all my views, and there are also differences of view among colleagues in neighbouring countries. This is due to the poor dating information hitherto available for the earlier part of the period – which cannot be covered by radiocarbon dating. In the last few years, however, we have managed to date the earlier deposits by other means, such as thermoluminescence (TL) and amino acid analyses. In combination with traditional lithostratigraphic and biostratigraphic methods, these datings have allowed the chronological fixing of the various horizons which has so far been lacking. A short review of this discussion can be found in the Uppsala Symposium, "Ten Years of Nordic Till Research" (Petersen 1984a).

For the late Pleistocene the discussion will be based on certain key localities in Denmark. These are shown in the review of late Pleistocene conditions (Petersen 1984a, fig. 2). According to position, they will in the following be described as representatives of the northern, southeastern and southwestern parts of Denmark. For the exact locations see fig. 1.

LATE PLEISTOCENE

The Eemian

Eemian interglacial deposits occur at sites in southern Denmark; both in the west, the classic Eemian occurrences in the South Fyn Archipelago (Madsen et al 1908) with a rich fauna indicating shallow marine conditions; and in the east, sites in south Sjælland and Møn having a deeper water fauna characterized by the snail *Turritella communis* (Ødum 1933). It was biostratigraphically difficult to demonstrate the contemporaneity of these deposits, as the faunal elements are so different – *Turritella communis*, for example, was absent from the southwest Danish Baltic regions in the Eemian.

Also available were the very important deep borings Skærumhede I and II (Jessen et al 1910; Bahnson et al 1974), through the very thick layers of marine sediments in Vendsyssel, northern Jutland. *Turritella communis* was indeed present, but it was difficult to determine whether the marine sequence did in fact include the Eemian.

Recent stratigraphic studies of foraminifera from Skærumhede I and II and the island of Anholt in the Kattegat have demonstrated that a deeper facies of the Eemian Sea is found from the area around Anholt, and

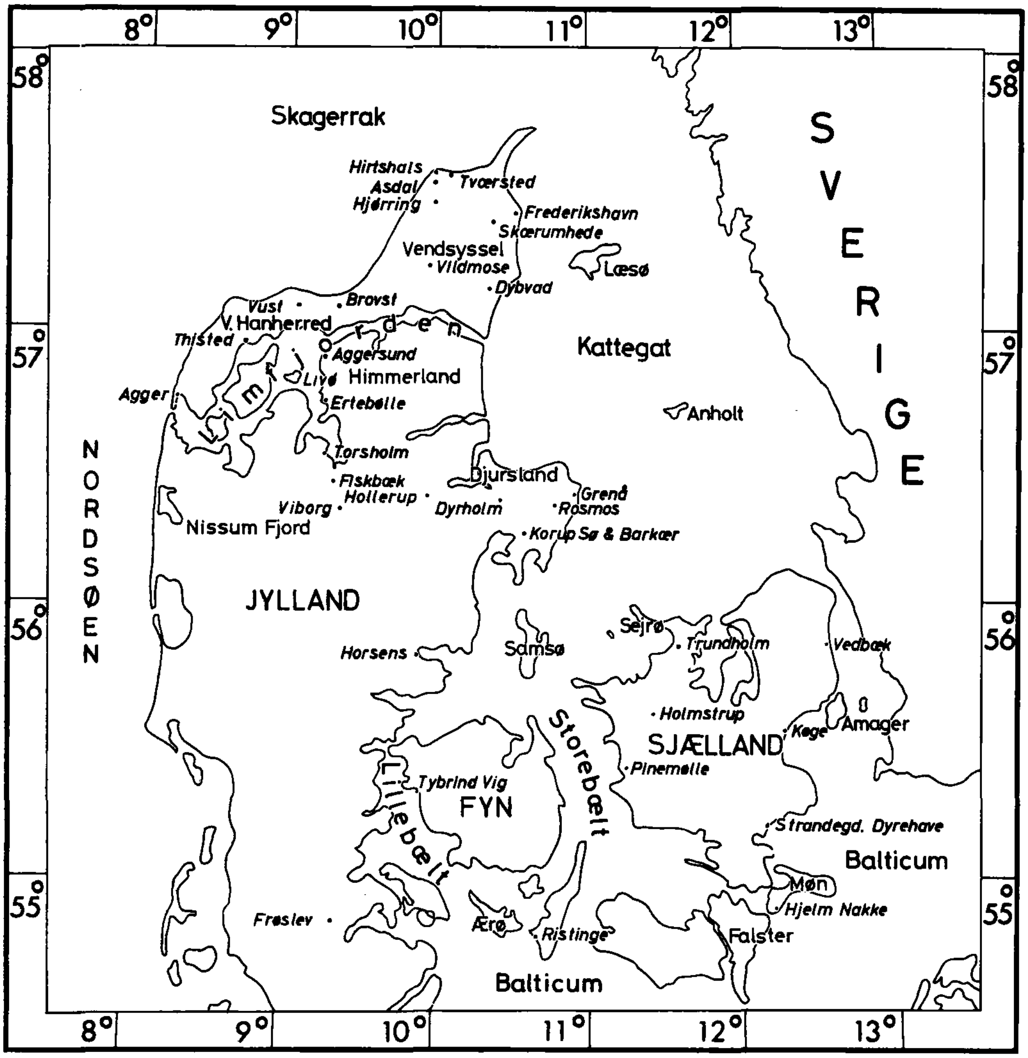

Fig. 1. Map showing places and coastal waters named in the text.

across Vendsyssel to the Skagerrak (Knudsen and Lykke-Andersen 1982). A long series of amino acid datings, carried out in the USA by Gifford Miller in cooperation with Jan Mangerud of Norway (Miller and Mangerud in press) has furthermore shown that the southern Danish locations discussed are indeed contemporary – from the Eemian – and also that the east Danish sediments (dated on *Turritella communis*, the same species found in the deeper part of the Skærumhede sequence in Vendsyssel) can be correlated with these.

The conclusion of this is that in the Eemian there was a palaeo-Kattegat of greater extent than at present, in that it covered large parts of Vendsyssel as well as the western part of the Baltic, with a littoral fauna (Konradi 1976) in the area south of Fyn and southeast Jutland, and with a deeper water fauna in south Sjælland and the Islands (Petersen and Konradi 1974).

Many studies of vegetational development in Jutland (Jessen and Milthers 1928; Andersen 1975) have shown that there are many lacustrine Eemian localities, from southern Jutland as far as Hollerup in the north. This area was therefore dry land in the last interglacial (fig. 2).

In the southern coastal zone of West Jutland marine deposits of Eemian age have been found, and south of the German border there were true fiords stretching in to the east. No marine connection has, however, been

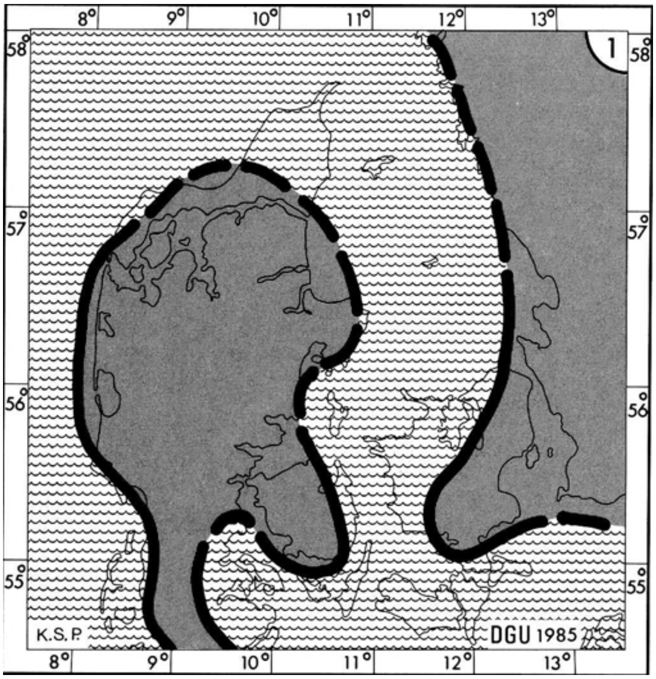

Fig. 2. Land-sea configuration in the Eemian. First scenario in the palaeogeographic suite of 6 for the Pleistocene part of the Late Quaternary.

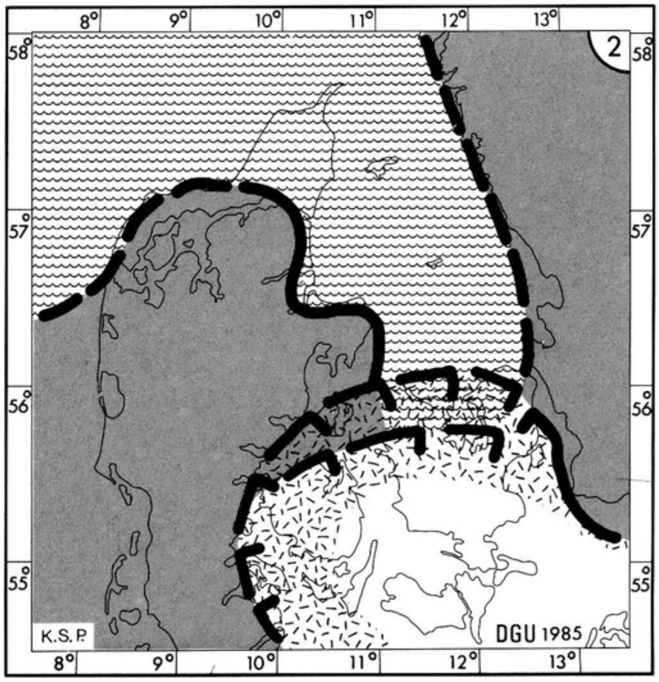

Fig. 3. Land-sea-ice configuration in the Early Weichselian. Second scenario, older than 50,000 BP.

demonstrated between the Baltic and the North Sea across the Jutland peninsula in the Eemian (Königsson 1979).

The Early Weichselian

From the Eemian-Weichselian transition, continuity in the marine deposits is seen only in the northernmost part of Denmark, namely Vendsyssel. In this area deep water formations continue, characterized by the following mollusc succession: *Turritella communis* and *Abra nitida* going over into the Arctic *Turritella erosa*. Within the *Turritella erosa* zone (Bahnson et al 1974) there are ice-transported stones, a phenomenon not unknown in Arctic regions when icebergs break off glaciers.

Norway and Sweden provide evidence of glacial advance during an early part of the Weichselian, dating to older than 50,000 years. In Norway this reaches the coastal zone (Mangerud 1983). In Sweden, however, ice cover has only been demonstrated in the far north (Lundqvist 1983); further south in the east Baltic region opinions differ as to the extent of ice cover in this early phase. Andersen et al. (1982) sum up this discussion by saying that evidence of cold phases of early Weichselian date with evidence of glacial advance is found in several places, but that it is difficult to pinpoint these in time due to a lack of good dates. In northern Poland, however, three till deposits of Weichselian age have been recognized (Mojski 1982, fig. 9), the oldest of which has been dated by C-14 and thermoluminescence to older than 50,000 years (Drozdowski 1980).

It has been suggested (Andersen et al. 1982) that till-like glaciomarine deposits at Hirtshals (Lykke-Andersen 1981) indicate glacial advance. All that is visible, however, is a deposit comparable to the drop till sequence in the Skærumhede boring (Bahnson et al 1974).

Recent examination of material from borings near Frederikshavn also shows continuous *marine* sedimentation in the time period (Knudsen 1984).

Regardless of the differing opinions concerning the extent of ice cover in northern Denmark, an Old Baltic ice sheet has been demonstrated lithologically between Eemian deposits and later Weichselian moraines at several sites in southern Denmark. These are: Strandegård Dyrehave (Petersen and Konradi 1974), Hjelm Nakke (Berthelsen et al 1977) and Ristinge (Sjørring et al 1982). The site of Holmstrup on Sjælland (Petersen

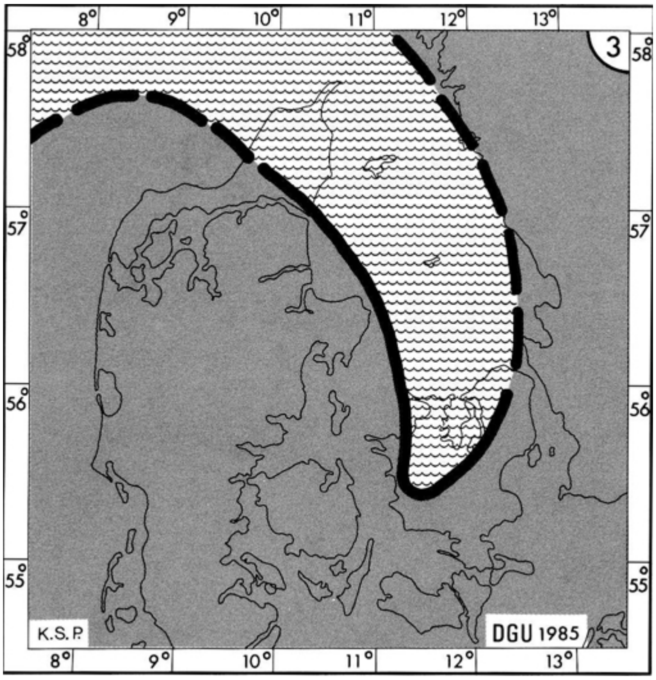

Fig. 4. Land-sea configuration in the Middle Weichselian. Third scenario, 45,000 – 35,000 BP.

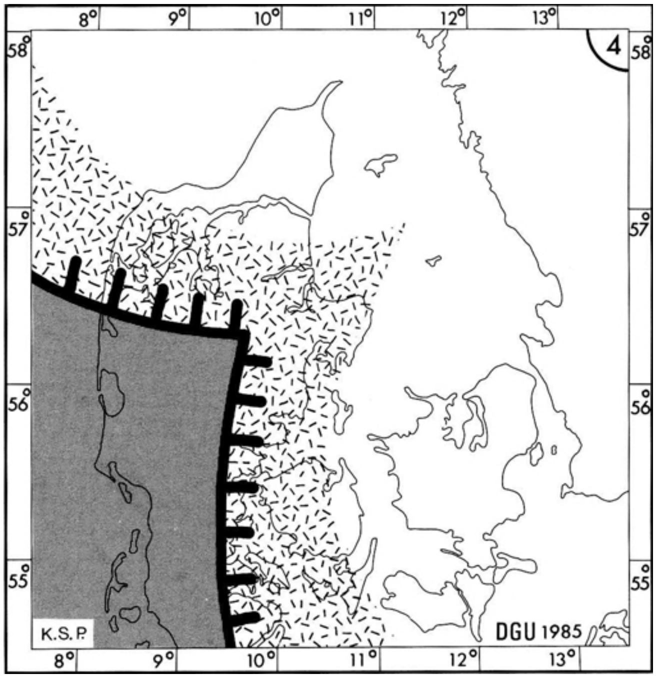

Fig. 5. Land-sea-ice configuration in the Late Middle Weichselian. Fourth scenario, 22,000 – 16,000 BP.

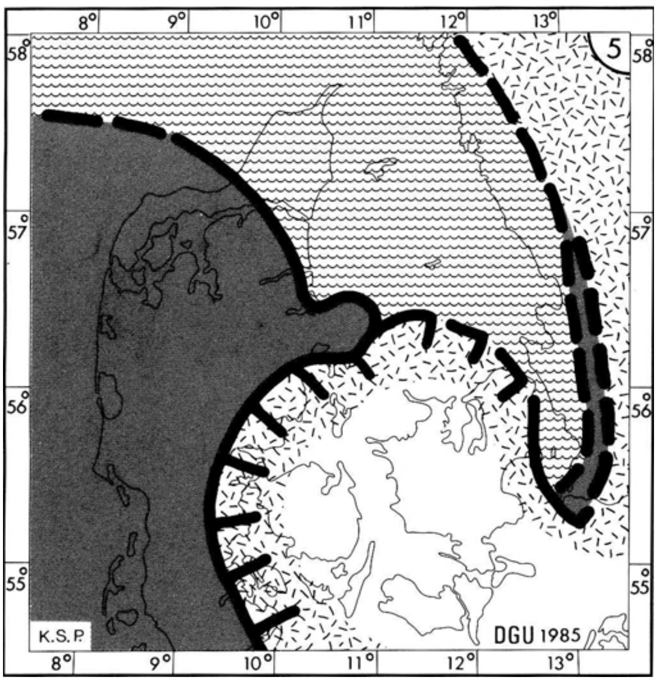

Fig. 6. Land-sea-ice configuration in the Late Middle Weichselian. Fifth scenario, 16,000 – 13,000 BP.

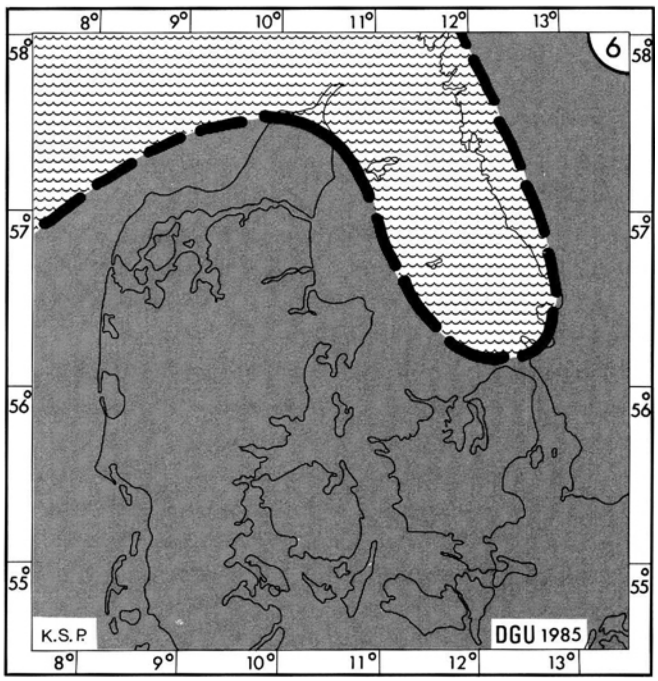

Fig. 7. Land-sea configuration in the Late Weichselian. Sixth scenario, around 11,000 BP.

and Buch 1974) has a Baltic moraine at the base of the quaternary succession, overlain by a marine Arctic sequence of Middle Weichselian age.

The suggestion of a Baltic ice sheet in the Early Weichselian is also supported by a thermoluminescence date of 75,000 BP from meltwater deposits overlying the Eemian interglacial diatom site at Hollerup. This is also the site of the oldest safe evidence of human population in Denmark (Møhl-Hansen 1955). Thermoluminescence dates from the lake sediments and the overlying meltwater deposits are 87,600, 80,000 and 74,800 years respectively (Kronborg 1982, table 1).

The deposition of this meltwater sand could therefore very well have occurred in connection with an Old Baltic glacial advance.

An alluvial cone at Frøslev in Southern Jutland (Kolstrup and Havemann 1984) contains a buried soil horizon with *Juniperus* dated to about 50,000 years. The alluvial cone, which was earlier believed to have been formed in connection with Late Weichselian ice sheets, is thus more likely to have been formed during an Early Weichselian glacial advance (fig. 3) resting on Eemian deposits.

All this suggests a Weichselian landscape before 50,000 years BP with an icesheet in southern Denmark. Meltwater from it was affecting parts of Jutland, and icebergs were breaking off into the palaeo-Kattegat which still covered Vendsyssel. No marine deposits have been documented in southwestern Jutland, and it must be assumed that the sea level had undergone a eustatic fall so that large areas towards the North Sea were uncovered.

The Middle Weichselian

Marine deposits dating from the period 45,000 – 35,000 BP are found at Hirtshals (Lykke-Andersen 1981), which are correlated with the Skærumhede sequence in eastern Vendsyssel. The marine deposits mentioned above at Holmstrup on Sjælland (Petersen and Buch 1974) can be biostratigraphically correlated (by means of foraminifera) with these North Jutland sites. Amino acid dates on *Macoma calcarea* also correspond. This macrofossil characterizes the deposits at Holmstrup, and have been used to name the uppermost zone in the Skærumhede II cold sequence. The extent of the Older Yoldia Clay has also been established by Anne-Lise Lykke-Andersen, on the basis of recent borings in the Sjælland region (1979, fig. 3). Lykke-Andersen's work shows that the Older Yoldia Clay on Sjælland does not overlie Eemian marine deposits; this supports the idea of an Early Weichselian ice sheet in these areas which truncated the earlier Eemian marine deposits.

The conclusion from this is that a palaeo-Kattegat continued to exist, stretching down from the north to cover northwestern Sjælland (fig. 4).

C-14 dated peats on Sejrø, aged to around 36,000 BP (Houmark-Nielsen and Kolstrup 1981), indicate that Denmark was free of ice at this time. Lake sediments from the same deposits on Sejrø have been TL dated to 35,200 BP (Kronborg 1982). The meltwater deposits overlying these lake sediments have furthermore been dated to 31,200 BP, but it is regarded as certain that Denmark was not covered by ice at this time. This is because the dates of many finds of mammoths in this period – running up to 21,000 BP – make it probable that Denmark and the adjacent areas to the north and east were free of ice, and formed a great "mammoth steppe" (Petersen 1984a).

The Late Middle Weichselian

The marine sequence at Skærumhede in northern Jutland, which we have been able to follow from the Eemian and which has been central to interpretations of the palaeo-Kattegat, reaches its conclusion during the maximal advance of the Weichselian ice sheet. Only southwestern Jutland remained free of ice, leading to the formation of the large heath areas there (fig. 5).

The chronology of the glacial movements is that a Norwegian ice sheet is replaced by a so-called Northeast ice sheet, which is followed by a final Late Baltic advance. The last-named will be discussed later, in connection with recent marine formations in northern Denmark.

Thermoluminescence determinations (Kronborg 1983) on meltwater deposits from Livø and Viborg have dated the start of the spread of ice in the Late Middle Weichselian to between 22,000 and 20,000 BP. In the period through to 15,000 BP, when C-14 dates of marine deposits in north Jutland show the ice to be melting, the land area of Denmark was thus limited to the areas beyond the edge of the ice and further west in the present North Sea.

Late Middle Weichselian – Late Weichselian

During the final phase of the Weichselian, consisting of the Late Middle Weichselian and the Late Weichselian (from 13,000 BP), the northern part of Denmark was free of ice, but large areas of the northeast were covered by an Arctic Sea, the Younger Yoldia Sea. The deposits of this sea are well dated by C-14 (Krog and Tauber 1974), and the molluscan fauna is so well documented that shallow and deep water deposits can be fitted into a scheme based on these dates. This scheme shows that the maximum marine transgression was reached in Vendsyssel between 14,000 and 13,000 BP (Petersen 1984b).

Deposits from the Younger Yoldia Sea are known from the island of Læsø in the Kattegat (Michelsen 1967), with C-14 dates of around 13,000 BP. The extent of the Younger Yoldia Clay further south has been documented by marine geological studies (Konradi pers. comm.), which demonstrate that it extended north of Sjælland and east of the Djursland peninsula.

The east Jutland ice limit (line D) is dated to 13,240 +760/÷690 BP (K-3697B), the date being on a mammoth tusk found in the extramarginal formations at Rosmos on Djursland. Thus the Late Baltic glacial advance, represented by the east Jutland ice limit and a glacial edge breaking up into icebergs east of the Djursland peninsula, may have reached the later palaeo-Kattegat (Petersen 1984b, p. 67) (fig. 6).

The Late Weichselian

The ice retreat from southern Denmark took place before 13,000 BP. The existence of a new mammoth steppe at this time is possible, because a mammoth from southern Sweden has been dated to 13,200 BP. The Lockarp mammoth (Lagerlund et al 1983) should date the ice limit at Hallandsåsen (Mörner 1969). It is not likely that an ice-cover should have lasted after 13,000 BP in Denmark according to investigations by Kolstrup (1982) and Ussinger (1978) on Møn and Bornholm respectively.

The late glacial environment was very rich, over and above the presence of mammoths and the Arctic sea, as investigations from Vendsyssel show. The old find of a polar bear from Asdal, north of Hjørring, has been dated to 11,100 BP (Aaris-Sørensen and Petersen 1984). The polar bear was thus present contemporary with brown bear, desman (Bondesen and Lykke-Andersen 1978) and some of the first traces of human occupation in Denmark after the glacial (Krog 1978). The first Danish site is known from Jels representing the Hamburgian Culture (Holm and Rieck 1983).

By 11,000 BP there are no further traces on dry land of marine deposits of the Younger Yoldia Sea, and since 13,000 BP the littoral molluscan fauna had become dominated by boreal species, the so-called *Zirphaea* fauna. The earliest dated find of *Zirphaea crispata* is as early as 12,700 BP, i.e. belonging to the Bølling, the first warm phase following the Middle Weichselian. The start of this is placed at 13,000 BP (Mangerud et al. 1974). Other boreal species can be mentioned from the Late Weichselian, such as *Cyprina islandica*, *Mytilus edulis*, *Macoma balthica* and *Lacuna vincta*. A similar development, with a distinct change from an arctic to an arctic-boreal molluscan fauna, was taking place on the Swedish Kattegat coast (Berglund and Mörner 1983). Borings in the present Kattegat have yielded a succession of foraminifera showing a change from a purely arctic composition to an association similar to that known from the Holocene (Konradi pers. comm.) (fig. 7).

Late Weichselian – Holocene

The continental period in Denmark, except for a part of the Kattegat, is defined as beginning at the end of the Allerød interstadial (11,000 BP), lasting into the Holocene (7500 BP), when the early Atlantic transgression created the archipelago that comprises Denmark today. These developments will be discussed below.

HOLOCENE

Isostasy and Eustasy

The development of land-sea configurations in the Holocene is closely connected with the events of the preceding 100,000 years.

Far into our own epoch the depression of the earth's surface by the Late Middle Weichselian ice masses has resulted in isostatic uplift. The area of this uplift fits very closely with the area covered by the last maximum of glacial advance (Mörner 1979).

Neotectonic movements, which can be linked to larger phenomena (such as the Fennoscandian Border-zone near Læsø: (Hansen 1980); and generally (Lykke-Andersen 1979)), cannot be excluded in certain areas; nor can movements connected with both the northern and southern Danish salt structures, e.g. the Thisted structure (Hansen and Håkansson 1980).

In northern Denmark the Older Yoldia Clay and interglacial marine clay of Eemian date have a thickness of up to 150 m. The highest part of this is found at the –25m contour. The Younger Yoldia Clay is found up to +60m, while the Holocene marine deposits are found up to 13 m above sea level in northern Jutland.

The demonstration of sea level changes through this long time span, resulting from the interplay of isostatic and eustatic factors, could be approached through an evaluation of the faunal composition and its variations at different depths. This is suggested in studies of marine deposits from the Weichselian and Holocene in northern Jutland (Petersen 1984b, 1985a).

On the basis of data from the Kattegat compared with that from the rest of western Europe, Mörner (1980, fig. 8) has established a regional northwest European eustatic curve.

It can be seen from this that at 20,000 BP, when the Scandinavian ice sheet reached its line of maximum advance in Jutland, sea level had fallen to a point near 90 m below present levels.

Through to around 10,000 BP (the beginning of the Holocene), there was a eustatic rise in sea level of 60 m. It is this rise which, in conjunction with the depressing of northern Denmark under the weight of ice, allowed the deposits of the Younger Yoldia Sea to be laid down in the period 15,000 – 11,000 BP. Shorelines at +60 m were formed in Vendsyssel between 14,000 and 13,000 BP (Petersen 1984b).

In the millennia from 13,000 to 10,000 isostatic uplift of the land *predominates*, because at the same time there is a diminution in the eustatic rise.

Shorelines were formed at ever lower levels, the latest dated example within the present Danish area being at 11,000 BP, the end of the Allerød.

In the periods of the Younger Dryas and the Preboreal there are no dated marine deposits in Denmark. This period is often described as the continental period. The greater extent of dry land is shown by the innumerable finds of terrestrial and lacustrine deposits under the seas round Denmark (Krog 1973). Archaeological data in the form of cultural materials from the seabed add to this (Fischer and Sørensen 1983).

The Boreal-Early Atlantic Transgression

The first demonstration of the rise in sea level in the Holocene was in the Great Belt region, using pollen analytical and radiocarbon datings (Krog 1960, 1973). A transgression to –30 m level can be dated to around 8000 BP. Later investigations in the same area have established the steepness of the eustatic sea level curve (Petersen 1978, fig. 5). It emerges that there was a 20 m rise in sea level in the Late Boreal and Early Atlantic periods.

It has also been possible to establish an Early Atlantic transgression to a height of –25 m at around 7800 BP in the Limfiord region in northern Denmark. It has furthermore been possible to establish the steepness of the sea level curve by considering dates of marine deposits in the immediate vicinity laid down in shallow water and above present sea level (Petersen 1981, fig. 3).

The results achieved support to that part of Mörner's curve covering eustatic fluctuations since 9000 BP. The rise is particularly marked in the first two millennia, up to 7000 BP.

It is calculated from the Limfiord data that sea level rise was 28 m in 880 C-14 years, or 32 m per C-14 millennium. If this is recalculated using calibrated ages, then the curve in this period is still steeper, as has been calculated by Mörner (1976, fig. 1). When speed of sedimentation is to be calculated, calibrated ages must be used (Petersen 1981).

Sea Level Changes in the Atlantic and Subboreal

The question of later changes in sea level has particularly interested Danish researchers. One can point to the date 1937 as the start of these investigations (Iversen 1937; Jessen 1937; Troels-Smith 1937, 1939, 1942; Iversen 1943).

In general these studies, especially through the work by Iversen, succeeded in showing 4 Littorina transgressions: the Early Atlantic, the High Atlantic, the Late Atlantic and the Early Subboreal.

These are depicted by Jacobsen (1982) in his preliminary study of the Littorina transgressions in Trundholm Mose in northwest Sjælland.

For the Vedbæk area in northeast Sjælland, Christensen (1982) has shown sea level changes covering 3000 years from 7500 BP, i.e. including the Early Atlantic

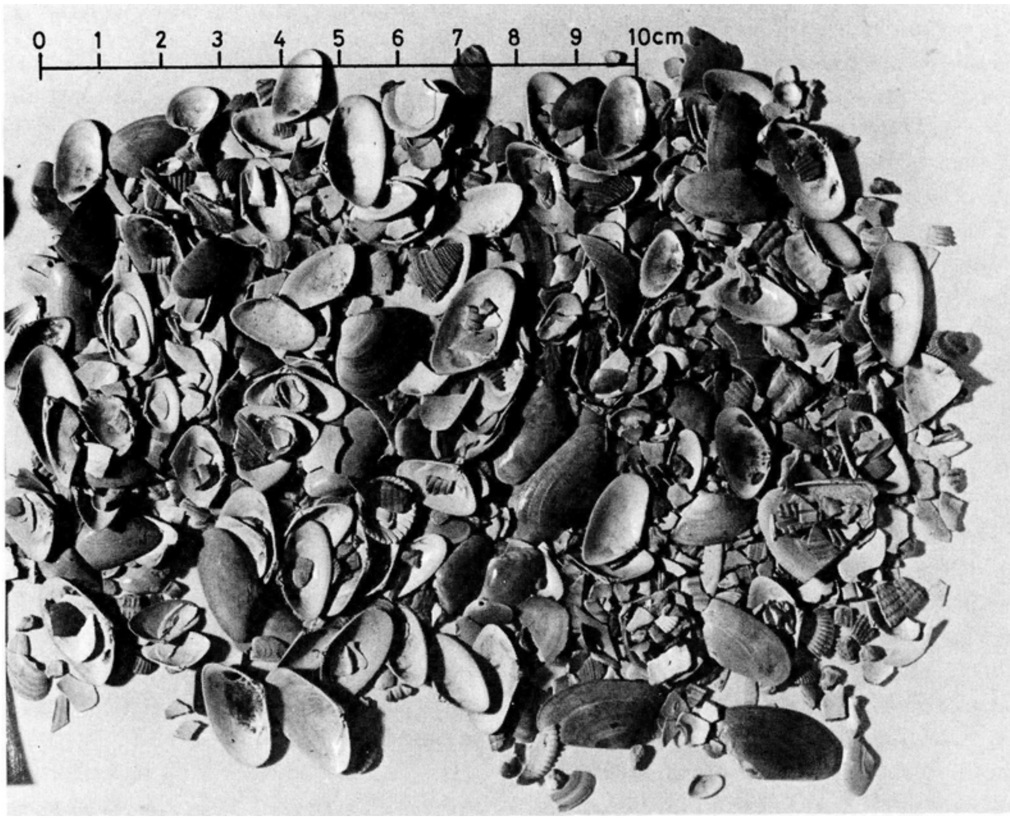

Fig. 8. C-14 dated shells from 1910±100 before 1950 (BP). The wedge shaped *Donax vittatus* predominates. The sample is taken from 6 km south of the present coast of Vester Hanherred, from the ±0 m contour. As *Donax vittatus* has never occurred *in* the Limfiord, the find demonstrates that this part of the country was built up from the Skagerrak side. The area is palaeogeographically called the Donax Sea after this mussel.

transgression. It is, however, stated by Christensen (op. cit. p. 101) that the reason for the presence of 3000 years record of sea level changes is due to Vedbæk's location in an area of favourable conditions between the isostatic uplift of the land and the eustatic rise of the sea.

One must, however, stress that the drawing of sea level curves covering the 3000 years from the Early Atlantic also requires very detailed methods, because one is measuring changes of as little as 0.5 m.

It would not be possible to establish the depth tolerances of marine invertebrates (particularly molluscs) used as shoreline indicators (Petersen in press) to within such narrow limits. Their depth interval can rarely be given more precisely than to the nearest 2 m, which is the amplitude one operates with for eustatically determined changes (Blake 1975) in the Holocene after the Early Atlantic transgression.

Of the above-mentioned investigations of the Littorina transgressions, those of Troels-Smith at Amager (1939) and Dyrholm (1942) are also related to coastal settlements. Iversen's studies (1937, 1943) were based on diatoms, pollen and Hystrix in fiords, where height of the threshold is crucial for the transgressional history.

Korup Lake on the Djursland peninsula was one of the fiords Iversen investigated. The whole series of layers is marine, and according to Iversen only the quantity of Hystrix indicated the transgression. These Hystrix (Hystrichosphaerids) are the remains of organisms many of which also live in Danish waters today. It was Iversen's belief, as Christensen (1982) writes, that these Hystrix were washed out of late glacial deposits during periods of transgression. As they are found in Danish waters today, however, one must go further, and to follow up Iversen's idea it is necessary to establish which of these organisms derive from the late glacial deposits.

Recent investigations at Korup Lake by Harald Krog (pers. comm.) have also shown that the Hystrichosphaerid curve is more complex than Iversen's investigations suggested.

What is at stake here is the maximum connection with open water, and thus higher salt content in the water. Maximum values of the molluscan fauna could therefore also be used. In this connection *Ostrea edulis* appears in Korup Lake around the High and Late Atlantic transgressions in a rich faunal association, which is contemporary with the date for the site of Barkær next to Korup Lake in the Late Atlantic (Troels-Smith 1982).

In the faunal succession off the Dyrholm settlement on Djursland there is also a level with *Ostrea edulis* and *Tapes aureus* (a few finds) dated to the High Atlantic.

It ought therefore to be possible to establish some of the above mentioned transgression maxima by purely faunal means.

This leads on to the question of when the highest marine limit was reached in various parts of the country. A distinction must be made here between those parts of the country with raised marine areas (Mertz 1924), and those where there was a continuing transgression until the Iron Age, i.e. the areas northeast and southwest respectively of Forchhammer's line from Nissum Fiord to the north tip of the island of Falster.

From the various studies of the Littorina Sea it transpires that the highest sea level in Vendsyssel (Dybvad) was reached in the High Atlantic. At Brovst in north Jutland (Andersen 1970) and at Vedbæk in northeast Sjælland it was reached in the Late Atlantic. In Himmerland (at Ertebølle), Djursland (at Dyrholm) and Amager it was reached in the Subboreal, and in southwest Sjælland (Præstø) (Mikkelsen 1949) in the Subatlantic.

This shows the tendency, already noted by Iversen (1943) for areas towards the periphery of the zone of land uplift to have their highest marine levels at later times.

In the downwarping area, investigations of submarine settlements show that the High Atlantic transgression in the Danish area cut shorelines which are now at –3 m. This fall of 3 m took place over 4000 years, up to the Iron Age, when the lowering of the land must have ceased because settlements of this epoch are still located as they are thought to have been when they were established (Petersen 1985 b).

It has not been possible to demonstrate the existence of the eustatic fluctuations, which must also have been in operation in the downwarping zone, through faunal investigations in the Danish area.

The Holocene Marine molluscan Fauna

The faunal association in the earliest Holocene marine deposits in Denmark is known from borings in northern Jutland, particularly the Limfiord, where deeply eroded valley systems formed during the continental period are also the places which were flooded by the Boreal and Early Atlantic transgressions (Petersen 1981, 1985 a).

It emerges from this that in the period 7860 – 7380 BP, in the depth interval 24.0 – 25.0 m below present sea level, virtually all the marine species that can be said to characterize the marine fauna of the Danish region were present (cf Petersen 1981, fig. 4). Littoral elements are found: *Ostrea edulis*, *Mytilus edulis*, *Tapes* (3 spp), *Tellina* (2 spp), *Gibbula* (2 spp), *Littorina* (3 spp) and *Retusa* (2 spp), as are deeper water forms: *Nucula* (3 spp), *Montacuta* (2 spp), *Cardium echinatum*, *Cardium exiguum*, *Cyprina islandica*, *Venus* (2 spp), *Abra* (3 spp), *Cultellus pellucidus*, *Spisula subtruncata*, *Hiatella arctica*, *Corbula gibba*, *Thracia papyracea*, *Lacuna* (3 spp), *Rissoa* (5 spp), *Natica intermedia*, *Nassa pygmaea*, and *Cylichna* (2 spp).

The fauna in these early transgression layers, even in the innermost parts of the fiord systems, are prolific in the whole country. It is thus remarkable to find the genera *Ostrea* and *Tapes* represented in both the southern Fyn region and the Little Belt area during the Atlantic. *Ostrea edulis* is known both as juveniles in intact gyttja samples from Møllegabet off Ærø, and as fully grown in the shell middens around Tybrind Vig (Petersen 1985 b).

This is a parallel situation to the Eemian, when these genera are also present. The latest, rather rare finds of *Ostrea edulis* and *Tapes aureus* within the Baltic date from as recently as the Iron Age, as shown by studies of Iron Age coastal settlements (Poulsen 1978; Petersen 1980).

The extinction of the *Tapes* species, apart from *T. pullastra*, in Denmark in relatively recent times has meant that they are regarded as type fossils for the Stone Age sea, which is also called the Tapes Sea, in northern parts of Denmark. *Tapes aureus* is regarded as belonging to the younger *Tapes* deposits (Nordmann 1910). It should be noted, however, that as mentioned above *Tapes aureus* is found in deposits of Iron Age date in southern Denmark, and in the Limfiord until about 2000 BP (Petersen 1976).

Regarding later immigrants, it is not correct that *Mya arenaria* characterizes deposits of older than late historic date, because the latest investigations have shown that this mussel only arrived in Europe in the post-Columbian era (Petersen 1976). The common term "Mya Sea" for the most recent subfossil marine deposits must therefore be given up.

The mussel *Donax vittatus* can on the other hand be mentioned as a late immigrant characterizing our earlier Subatlantic deposits. It is today common on the sandy western coasts, but is found in subfossil deposits in northwestern Jutland dated to 2110 BP (Petersen 1985 a) in the region near Agger, and is a type fossil for the latest marine deposits laid down in the Vester Hanherred area of northern Jutland by the Donax Sea (Petersen 1976) (fig. 8). Its late arrival at our coasts is supported by investigations on the Swedish west coast (Hägg 1913). It may be mentioned that *Donax vittatus* is known from Eemian deposits in southwestern Denmark, but is not found in the Baltic Eemian deposits (Nordmann 1928).

As mentioned above, the western Baltic in earlier times contained species that were characteristic of the Eemian in the same region; but it must be presumed that, in common with the rest of Denmark, species diversity is declining. The present Limfiord fauna thus consists of 85 shell-bearing molluscs, while we know of 138 from the subfossil deposits. This could be evidence that the maximum of the present *interglacial* has passed. Regarding individual late immigrants, special biotopic conditions and access routes may be relevant. The recent appearance of *Astarte borealis* in the Baltic fauna is an example of access routes. The species is regarded as a relict from the glacial period in this area, and as mentioned above the palaeo-Kattegat has existed virtually without a break for the last 100,000 years. As the palaeogeographic map of the late Weichselian shows, an arm of the arctic-boreal sea stretched right down to the southernmost part of the Kattegat at this time. This is the only possible way in which species like *Astarte borealis* could have got into the Baltic at the time of the early Littorina Sea.

The Regional Holocene Transgression History

This attempt to give a regional review of the Holocene transgression history is inspired by the many dates which have, during the past few years, made it possible to pinpoint shorelines in time. It also includes an evaluation of the depth indication and shoreline indication given by the molluscs used for the datings. A body of material has therefore been selected from the literature and from my own investigations which is thought most likely to refer to shoreline formation. This material does not therefore create curves of the sort produced by Charlie Christensen (1982), covering 3000 years at Vedbæk. The intention is solely to present the major changes in sea level.

By the major changes in sea level are meant the Early Atlantic transgression, the establishment of the maximum marine transgression, and the fixing of the point in time when the curves approach present day values.

It would of course be nice if the body of data was larger, but it does at least spread fairly evenly throughout Denmark. The data is therefore plotted from a little south of 55°N up to 58°N, in a three dimensional graph where the other two axes are time and sea level (fig. 9).

In plotting the data from individual sites their longitude must be born in mind as a fourth dimension. In all, 58 observations have been included in the figure.

As mentioned above, the development of the maximum transgression level in Denmark is metachronous, and it has only been established at a few sites so far. Cutting the shoreline displacement curve at, for example, the plane defined by present sea level should, I presume, show this situation. Variations in level caused by (for example) neotectonic movements should also be relevant beside the isostasy (fig. 10).

The latter condition is regarded as the reason for the very great age (8500 BP) of the Tværsted region of northern Vendsyssel, which is an extrapolation from the dated shells at the +6 m contour at 8250 BP (Krog 1984). If one examines the data from further south, Store Vildmose, Aggersund, Torsholm (Viborg), Korup Lake and Vedbæk, the values here are 1000 years younger, between 7200 and 6700 BP.

With longitude in mind, the observations can be fitted into the pattern (see fig. 12) that the isobases present of the uplifting of Denmark northeast of the

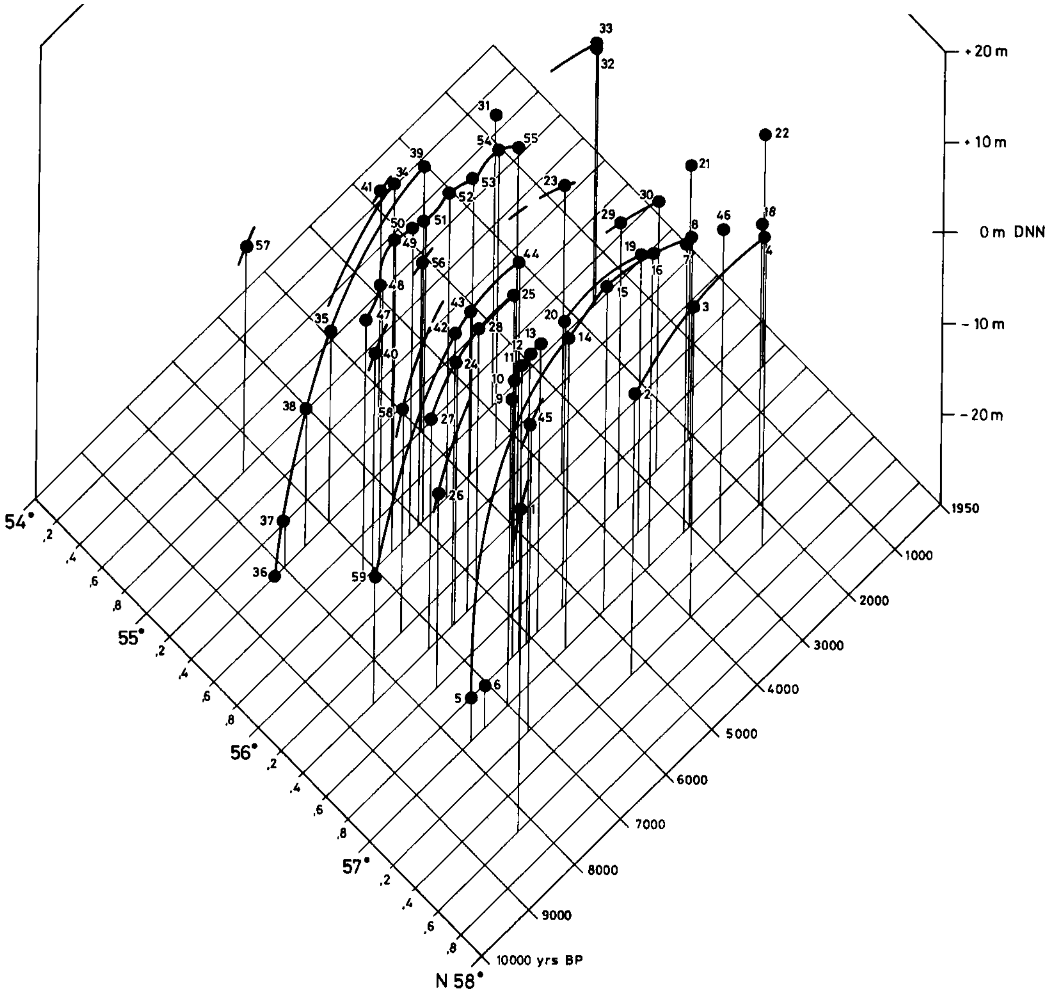

Fig. 9. The three dimensional graph plotting latitude, time and sea level, with the observations listed below (Table 1). Observations with the same longitude are connected.

Forchhammer line. They also offer support to the suggestion put forward by Iversen that the attainment of the marine maximum should take place later in areas peripheral to the uplift zone. Thus the present level of about 0 m was reached on Samsø at 6500 BP, and at Pinemølle on the Great Belt at 5000 BP.

The approach of the shoreline displacement curve to present levels is also shown (fig. 10), and although this is only a suggestion it does show a tendency to flatten out earlier in the south. Horsens Fiord is an exception to this, however, as the Iron Age shell middens there are the first settlements to lie on the present coast.

Against the above observations for the area north of the uplift line, the dated coastal settlements from the area to the south clearly fall into an area of downwarping, lying below the recent sea level (fig. 9). The model put forward above also involves holding time constant and then cutting through the shoreline displacement curves; this permits an understanding of the land-sea configuration at the chosen point in time.

It can only be my sincere hope that more data will become available for sea level changes for inclusion in the model. The remarkable rise in sea level in the Boreal and Atlantic periods shows clearly in the three dimensional computer plot viewing Denmark from the northeast at an angle of 30°, where the time transgressive movement over Denmark (as a linear function) appears as the third dimension (fig. 11).

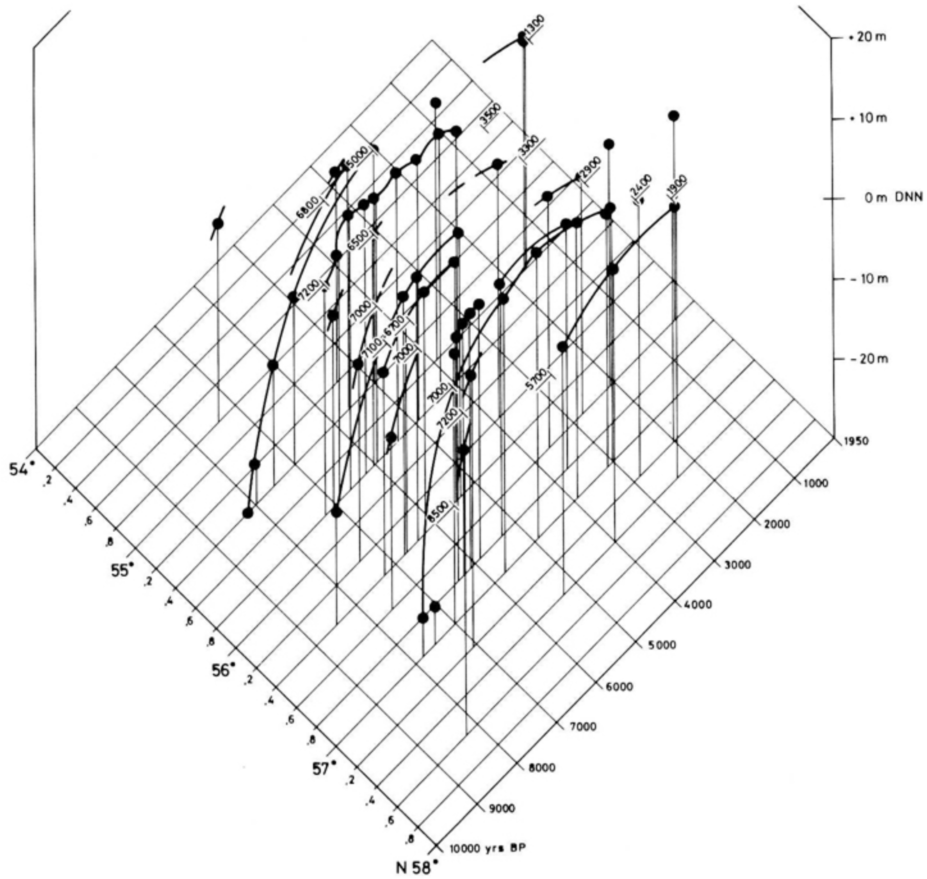

Fig. 10. A plane is inserted at the ±0 level, and the points where it cuts through the curves marked with the time before 1950 (BP).

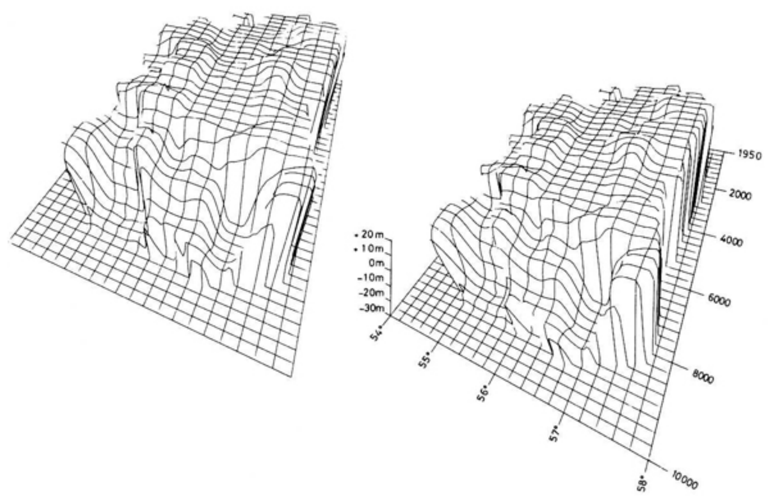

Fig. 11. Computer plot of the same number of observations as in fig. 9, using the same co-ordinates. Some evening out has occurred, as the squares are divided into 100 × 100 grids, each being given a value extrapolated from the four nearest observations. The sea level change in the early Holocene is clearly visible. This crosses the Danish area, which is plotted as a linear function from north to south.

No.	*Latitude*	*BP*	*Elevation*	*Locality*	*Material*	Lab. No.
1	57.6	8250	+6.0	Tværsted	*Cardium edule*	K-1472
2	57.4	5240	+1.3	Frederikshavn	*Ostrea edulis/Dosinia exolata*	K-1237
3	57.4	3980	+4.0	Frederikshavn	*Ostrea edulis/Dosinia exolata*	K-1236
4	57.4	2440	+4.0	Frederikshavn	*Cardium edule*	K-1246
5	57.0	7860	−25.0	Vust	*Cirripedia*	K-3281
6	57.0	7660	−25.0	Vust	*Mytilus edulis*	K-3280
7	57.0	3250	+0.8	Vust	*Tilia* sp.	K-2747
8	57.0	3130	+1.7	Vust	*Tapes aureus*	K-3221
9	57.0	6980	+3.5	Gjøttrup	*Ostrea edulis/Cardium edule*	K-2480
10	56.8	6650	+0.5	Skrandrup	*Cardium edule*	K-2383
11	56.8	6420	+1.0	Livø	*Cardium edule/Scrobicularia plana*	K-2477
12	56.8	6260	+1.5	Skrandrup	*Cardium edule*	K-2475
13	56.8	5910	+1.5	Livø	*Cardium edule*	K-2478
14	57.0	5790	+3.0	Ullerup	*Cardium edule*	K-2570
15	57.0	4990	+6.0	Aggersund	*Ostrea edulis*	K-2481
16	57.0	3990	+4.0	Bjerregd.	*Ostrea edulis*	K-2479
18	57.2	1910	+0.0	Kovad Bro	*Donax vittatus*	K-2384
19	56.8	3690	+0.5	Ertebølle	*Cardium edule*	K-3679
20	56.8	5280	+1.5	Ertebølle	*Cardium edule*	K-3680
21	56.6	2110	(+0.0)	Agger	*Cardium echinatum*	K-4254
22	56.6	410	−4.0	Agger	*Cardium edule/Macoma balthica*	K-4186
23	56.2	3860	+0.7	Korup Sø	*Cardium edule*	K-3681
24	56.4	6550	−1.5	Fiskbæk	*Mytilus edulis*	K-3547
25	56.4	5400	−0.5	Fiskbæk	*Cardium edule*	K-3548
26	56.6	7620	−8.5	Torsholm Sø	*Ostrea/Mytilus/Thracia/Corbula*	K-3431
27	56.4	7150	−5.0	Jordbro Å	*Ostrea edulis*	K-3432
28	56.4	6190	+1.0	Romlund	*Ostrea edulis*	K-3433
29	56.6	3650	+1.5	Torsholm Sø	*Ostrea edulis*	K-3283
30	56.6	2750	+0.5	Torsholm Sø N.	*Cardium edule/Venerupis aurea*	K-3157
31	55.6	3890	+3.6	Vær (Horsens)	(*Mytilus edulis*) Sb3.	K-3158
32	55.6	1520	+0.2	Vær (Horsens)	(*Mytilus edulis/Venerupis aurea*) S.B.	K-3159
33	55.6	1480	+0.5	Vær (Horsens)	(*Mytilus edulis/Venerupis aurea*) S.C.	K-3160
34	55.4	5610	+1.0	Trylleskov (Køge)	*Halichoerus grypus*	K-3075
35	55.4	7170	−9.5	Pinemølle	*Cardium edule/Macoma balthica*	K-2382
36	55.4	(8200)	−30.0	Pinemølle	interpolated	Petersen 1978
37	55.4	(8000)	−25.0	Pinemølle	interpolated	Petersen 1978
38	55.4	(7500)	−15.0	Pinemølle	interpolated	Petersen 1978
39	55.4	(5000)	−2.0	Pinemølle	interpolated	Petersen 1978
40	55.8	7030	−5.7	Trundholm	Mollusca	Jacobsen 1983
41	55.2	5320	−2.9	Tybrind Vig	Wood	Andersen 1983
42	56.4	6780	+1.8	Dyrholm	*Cardium edule*	K-4092
43	56.4	6510	ca. +2.5	Dyrholm	*Ostrea edulis*	K-4094
44	56.4	5350	ca. +3.0	Dyrholm	*Cardium edule*	K-4096
45	57.2	7100	+4.3	Store Vildmose	Peat	K-3313 and K-3312
46	57.2	2930	+4.5	Læsø	*Physeter catodon*	Hansen 1980
47	55.8	7250	+0.0	Vedbæk	interpolated	Christensen 1982
48	55.8	6950	+1.5	Vedbæk	interpolated	Christensen 1982
49	55.8	6450	+3.0	Vedbæk	interpolated	Christensen 1982
50	55.8	6200	+4.0	Vedbæk	interpolated	Christensen 1982
51	55.8	5950	+3.5	Vedbæk	interpolated	Christensen 1982
52	55.8	5450	+5.0	Vedbæk	interpolated	Christensen 1982
53	55.8	4950	+3.8	Vedbæk	interpolated	Christensen 1982
54	55.8	4450	+4.5	Vedbæk	interpolated	Christensen 1982
55	55.8	3950	+3.0	Vedbæk	interpolated	Christensen 1982
56	55.8	6030	−0.9	Stavns Fjord (Samsø)	Wood	K-3996
57	54.8	ca. 7450	ca. −5.0	Argus	Archaeological	Fischer (pers.comm.)
58	56.2	7370	−9.0	Korup Sø	*Cardium edule*	K-3989
59	56.4	ca. 8500	−16.0	Grenå	Pollen dating	Krog 1979

Table 1.

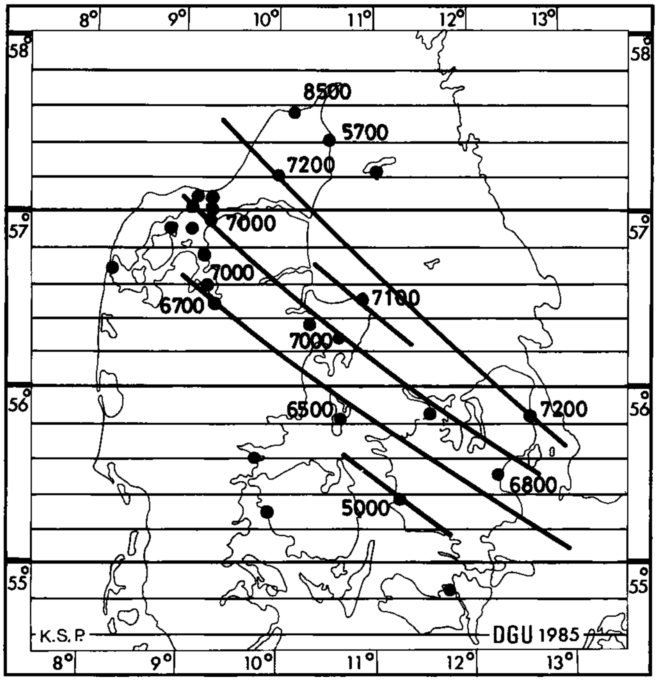

Fig. 12: Map showing the sites and times that the sea level displacement curves in fig. 9 intersect with the ±0 m level. Isolines are drawn between them. These isolines agree with the progression known from the isobases. Note a diverging value between Tværsted and Frederikshavn.

CONCLUSION

The foregoing presents the main features of an attempt to establish the chronology of shoreline development in Denmark. If the Holocene situation is compared with palaeogeographic development in the earlier part of the Late Pleistocene (put forward in the first part of this work), then it can be seen that, despite the changes caused by the Weichselian glaciations, a land-sea configuration has become established in our own time which is in many ways similar to that of the Eemian – also regarding the sea level.

Minor differences in southwestern Denmark regarding level may have been caused by the greater glaciation preceding the Eemian, when the whole of Denmark was covered with ice; the limits of the area of isostatic uplift in the Holocene, however, is in close agreement with the area of the Weichselian glaciation.

In presenting the late Quaternary as a whole, one aim has been to point out that parts of the Danish landscape lay outside the glaciated area right back to the Eemian, and that the Weichselian glaciations have either been partial, as for the Early Weichselian, or of short duration, as for the Late Middle Weichselian advance which covered the greatest part of Denmark. Thus the present Kattegat region has been a factor in land-sea configurations for the last 120,000 years, interrupted only by the glaciation from about 22,000 to 15,000 BP.

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Experiments with Danish Mesolithic Microblade Technology

by ERRETT CALLAHAN

INTRODUCTION

In the 1960s Don Crabtree pioneered a series of papers on experimental replication in lithic technology (i.e. 1966, 1967a, 1967b, 1968; also 1973). These papers have served as both inspiration and procedural models for countless lithic experiments and experiences ever since (Johnson 1978). While some aspects of lithic technology have gained greatly in sophistication since that time, there are other areas which have remained relatively dormant. One such area is the structured replicative experiment, the "how to" of contemporary flintknapping. In this paper, which is directly inspired by Crabtree's early writings and dedicated to his memory, I have returned to this neglected format.

To date, many replicative experiments have not been reported in enough detail to allow other researchers to duplicate the specified results. It is generally understood that experiments which cannot be replicated have little claim to science (Callahan 1981a: 141; 1981b). In other words, the term "experiment" has been used too loosely, often being confused with the terms "experience" or "exercise." As one remedy to this situation, I suggest, as demonstrated herein, that the experimental procedure, inclusive of holding positions employed in knapping, be described in enough detail so as to allow replication of the results by others. It is only in this way that a true laboratory science may evolve.

It is further suggested that the experiment conclude with an inference. An inference is simply a statement of probability as to how well the hypothesis stands up in the light of the experiments (Callahan 1981c). Binford and others tell us that such probability statements are the aim of science (1968: 20; cf Ascher 1961: 810, 811, and Reynolds 1979: 23). Yet all too often experiements in lithic replication only serve to illustrate possibilities, not to offer probabilities. Such studies, while of some value, fail to provide inferences to guide either explanation of the problem or future research in the area. The present paper is intended as an example in this regard also.

As the above principles are implemented by other flintknappers, we should not only give increased credibility to the term "experiment," as used in replicative studies – and thus make for better archeological science – but we can best perpetuate the Crabtree legacy as well.

THE ARCHEOLOGICAL CONTEXT

The problem selected for this investigation is the microblade technology of the Danish Mesolithic. I was introduced to this problem during a recent seven-month stay in Denmark made possible by a grant from the Danish-American Council and the Lejre Center of Lejre, Denmark. Peter Vang Petersen of the Prehistoric Institute of Copenhagen showed me a number of small microblade cores from the Vedbæk site in western Zealand, asking me to interpret the associated technology. The cores were of the "handled" or "keeled" variety, as opposed to the earlier "conical" variety (cf Figures 2 and 5a), and were thought to fit into the late Kongemose phase of the Middle Mesolithic. (The Late Kongemose dates from 5000 to 4600 BC, by the conventional dating method.) These smallest of all Danish microblade cores are thought to represent the terminal microblade industry in Scandinavia and, if so, would accordingly fit within a material culture known to include some of the largest and finest macroblades of any period (to 22cm).

There is currently a controversy between the Zealand and Jutland archeologists as to whether or not any microblades should be claimed for the Kongemose culture. The latter claim that the microblade cores from the Kongemose type site were intrusive from the preceeding Maglemose or possibly the Maglemose-Kongemose transitional period (Jørgensen 1956, Henriksen

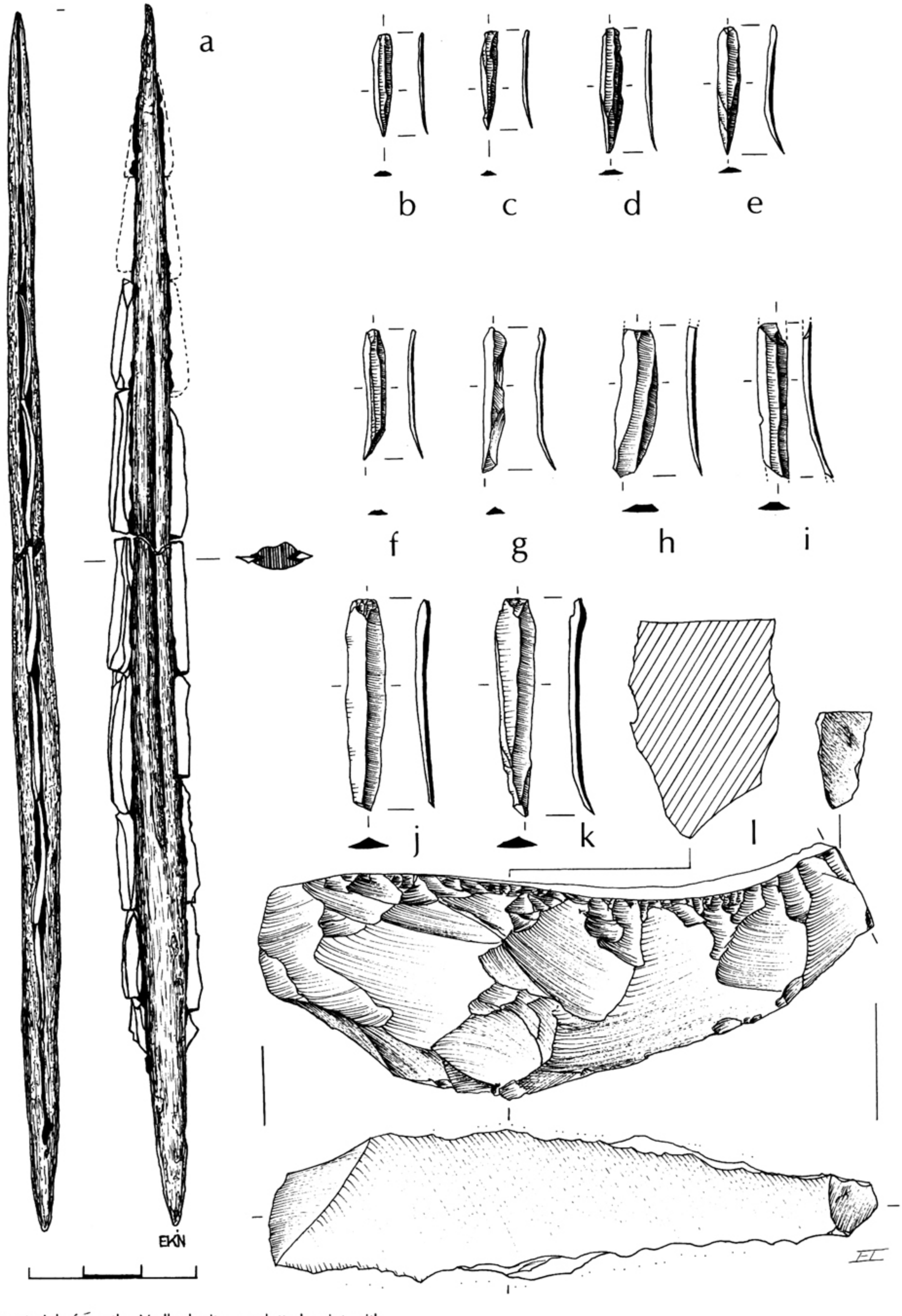


Fig. 1. Artifact materials from the Vedbæk site. a, slotted point with microblade inserts; b–k, microblades MGX491–518; 1, microblade core preform MGX356.

1976, Westerby 1927, and Bo Madsen, personal communication 1981). The Zealanders, however, while not denying the problems with the type site or the presence of handled cores in the preceeding period, claim over 130 distinctive microblade cores from the carefully excavated Vedbæk site and a total of nearly 400 similar cores from other locations in central Zealand and Scania (in adjacent Sweden) (E. Brinch Petersen et al. 1977, P. Vang Petersen 1979, 1984, and personal communication 1981). They further maintain that Jutland reflects more of a "Continental" influence, with microblade cores disappearing early, while the island of Zealand reflects more of a "Scandinavian" influence, with microblade cores disappearing significantly later (P. Vang Petersen, ibid). Earlier publications had characterized microblade cores as "keeled scrapers." (cf Brøndsted 1957: 112).

The Zealand cores are sub-divided into those made from flakes with a negative bulb and those made from flakes with a positive bulb. The former are placed in the Older Kongemose phase while the latter are placed in the Younger Kongemose (Vang Petersen 1984).

Be that as it may, while details of age may only be settled by analysis of excavated materials, it would seem that some details of technology might best be settled by replicative experiments. It seemed to me that if the technology of each core type could be closely defined and if it could be determined that each technology, or at least aspects thereof, was distinctive for each type, then this distinction might be used as an additional tool in relative dating and/or in deriving cultural inferences (Callahan 1975). With this in mind, I set about to make the first of what should be several series of experiments aimed, by a process of systematic elimination, at defining the production technology behind the relevant core types. The type which I selected to investigate was the Late Kongemose, positive-bulb-flake microblade core, the type initially shown to me by Peter Vang Petersen.

Observations

The Vedbæk microblade cores were found with a number of microblades (Figure 1 b–k) and with three slotted points, one of which is illustrated in Figure 1 a. (See E. Brinch Petersen et al. 1977: 159 for the others.) According to the excavators, there is no doubt that all of these artifacts share a similar temporal association (P. Vang Petersen, personal communication 1981). The slotted point is a long-bone with grooves along the lateral edges into which microblades are fastened. (This is similar to the razor-edged arrow-points which contemporary archers use in hunting and which is supposedly a modern invention.) The slotted point is thought to have been used for hunting land animals with the bow and arrow as well-preserved bows, arrowshafts, and similar points have been found from the earlier Maglemose period (Andersen 1978 and personal communication 1981; Clark 1983: 63, 89, 90, 95, 96, Plate VI). Unlike the retouched, microlith inserts used in the earlier periods, these microblade inserts were employed with no retouch at all.

The attributes of a small sampling of Vedbæk cores (all that were made available to me), are detailed in Table 1 (Figure 1 l; Figure 2). Here, I have divided the cores according to two stages of manufacture-preforms, in which no blades have been removed (unit MGX359 in Table 1 almost certainly being a reject because of its coarseness), and cores which are in the process of production (whether exhausted or not). A comparison between the preforms (Figure 1 l) and cores (Figure 2 a–d) indicates little variation in average width, a somewhat moderate degree of variation in average thickness, and a strong degree of variation in average length. In that the thickness, or depth, of the preforms is generally less than that of the cores, the possibility that these preforms were rejected, or set aside as "seconds," because they would have produced too short microblades, must be considered. The variation in length is easier to understand. The utilized cores are shorter because of prior blade removals. The difference in average length between preform and core would seem to indicate that an average of only about 1.4cm of material was used before discarding. However, Vang Petersen assures me that cores as short as 5cm – and as long as 10cm – are common at Vedbæk. If cores were used to about 5cm in length, then this would seem to indicate that up to about 5cm of length was used in microblade production.

The edge-angle on the platform of the cores varies between 68 to 108° and averages 95.3° (Table 1). This phenomenon of greater than 90° is characteristic of the Danish Mesolithic and is discussed at length in a separate paper (Callahan 1984).

The lateral edges of the cores and some of the pre-

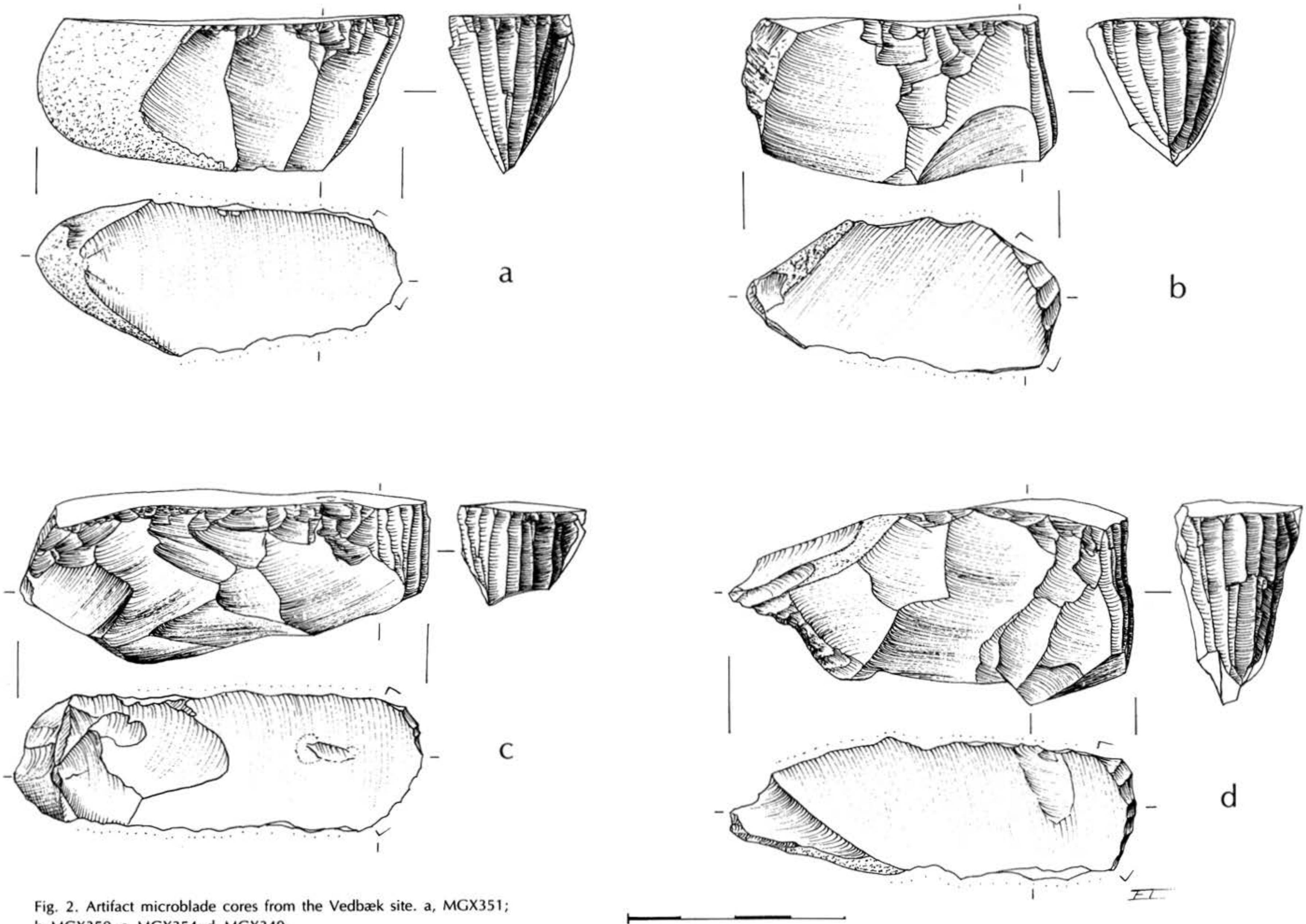


Fig. 2. Artifact microblade cores from the Vedbæk site. a, MGX351; b, MGX350; c, MGX354; d, MGX349.

forms are rather heavily abraded. The platform edge, on the other hand, is rather lightly ground.

I am assuming, based upon my experience, that preforming of the core prior to blade removal was done by direct percussion, with a tool such as a pebble hammerstone. I am also assuming that the microblades were removed by pressure. That is, direct or indirect percussion may be dismissed outright as either necessary for or typical of microblade removal of these particular cores. What is not known, and this lies at the heart of this investigation, is whether such microblades were removed from a hand-held core or from a core supported in a holding device; whether an antler or antler-like flaker is capable of such microblade removal, as the copper-tipped flaker is known to be; or whether the hand-held fabricator is capable of producing such microblades, as the body-pressed chest crutch is known to be (Crabtree 1968).

Hypotheses

In contemplation of the problems just indicated, hypotheses were sought which seemed to offer the most likely explanations of the unknowns. The hypotheses which were selected were based upon the attributes of the cores, a consideration of the fabricator materials known or thought likely to have been employed in the past, and the experience which other contemporary flintknappers (notably Don Crabtree, Rob Bonnichsen (1978: 247), Jeff Flenniken, J.B. Sollberger, Marvin McCormick, and Bo Madsen: all personal communication) and myself have had with microblade removal.

The following hypotheses were constructed to guide the experiments in this study:

1) Microblades were removed from cores which were secured in a holding device.

2) Microblades were removed from their respective cores by means of a fabricator of an antler-like material.

3) Microblades were removed by hand-held fabricators.

In the experiments, efforts were aimed at invalidating, rather than verifying, these hypotheses. Such a strategy may require a much more rigorous investigation than does mere verification (Reynolds 1979). It was furthermore hoped that by systematically testing possibilities, the way would unfold for offering statements of probability and allow the creation of one or more inferences to guide future research.

EXPERIMENTS

A total of eight cores in various stages of reduction were prepared for inclusion in this study. (Numerous other "practice" cores were prepared as well.) Each core represented a single experiment. The entire run of experiments comprised the first of a potential series of tests, as indicated earlier. To this end, I have attempted to provide enough procedural details so that similar results may be obtained by other experienced knappers and so that the remaining series of experiments may be undertaken by other knappers.

Experiment 1 – core blank (Figure 3 a)

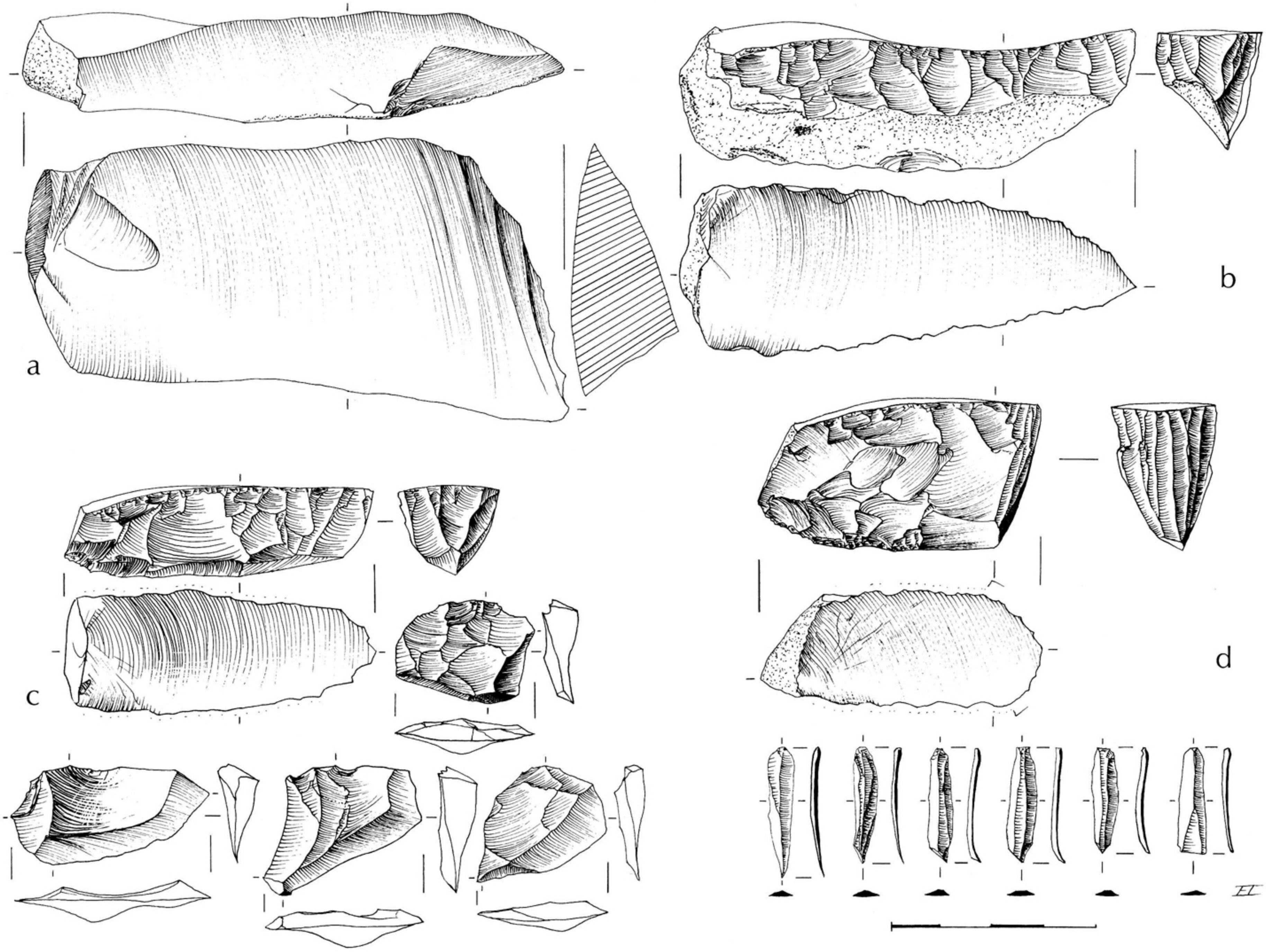
A blank was prepared by striking a flake from a larger flint core using direct percussion with a relatively heavy granite cobble. The mass, morphology, and ventral surface of the flake seem to have all the attributes noted on the original preforms, i.e. there are no attributes which would prevent the ready removal of preforming flakes and subsequent microblades. The flake, however, is a little thinner than the average core. (Assumption: the convex curvature at the distal end of this flake will have to be trimmed away before microblade removal may commence. Otherwise, the pressure tool might slip off the platform. A slightly concave or cupped distal curvature would have been more typical.) Whereas this experiment was repeated with each of the tests which follow, I felt it desirable to have an unworked core blank on hand for study and analysis.

Experiment 2 – core preform (Figure 3 b)

A core blank was preformed by direct percussion with a relatively small limestone pebble. The bulbar end of the flake was chosen as the proximal end of the core, as is typical of the artifact cores. The pointed distal end is also more typical than the squared end seen in Figure 11. (Assumption: the concave curvature of this flake unit should facilitate microblade removal). This experiment was also repeated on all test units.

Experiment 3 – core preform with all preforming flakes (Figure 3 c)

This unit was necessitated by the realization that there might be value in retaining the flakes derived from pre-


a
b
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forming of the core. The core was otherwise prepared the same as was unit 2. The resultant preform however, may be a little on the short side as it resembles cores which were apparently nearly exhausted, in this regard, more than it does the size of the typical preform (Figure 1 l). It is felt, nevertheless, that the preforming flakes (only a selected number of which are illustrated here) are typical of those experimental cores represented in the remainder of this study.

Experiment 4 – core flaked with copper-tipped tine and clamp (Figure 3 d)

For the blademaking experiments, I started with the technique with which I had the most experience and confidence. The object of this particular experiment was simply to test the feasibility of using a clamp and to re-familiarize myself with the process of microblade removal. These were both thought to be independent of the material used for the fabricator (copper). I reasoned that once I had grasped how to use the clamp and the copper fabricator, I could then convert to an antler fabricator with minimum confusion of critical variables. Thus 80 microblades were removed from a core secured in a small, hand-held clamp (Figure 5 f). The core was oriented in the clamp with about 2cm of the distal end of the core protruding beyond the end of the clamp. The core was repositioned in the clamp when less than about 1cm protruded in order to have sufficient room to work. The clamp was held across the lap in the left hand, while seated, with the platform area being between the spread legs and facing upwards. The legs were employed to assist in squeezing the two hands together (Figure 5 l/m).

Two holding positions for the pressure tool were tested. With the first, the fabricator (Figure 5 c) was pressed straight downward into the platform and parallel to the axis of the anticipated blade. (Figure 5 g, j). Once the maximum amount of downward pressure was obtained, a small amount of what could be described as downward-swooping, outward pressure was applied till the blade popped off. The downward pressure was generated to the maximum degree before any outward pressure was applied. The outward pressure, which was applied slowly and without a sudden "lunge," was made by moving the right wrist outwards, rather than inwards, as with most of my bifacial pressure work. Accordingly, the microblades flew – with a melodic "ping" – away from, rather than towards, the body. A hide-like sheet was used to cushion the fall of the blade.

With the second position, the near end of the fabricator was tipped outward from the core, with the blades being, as it were, "raked" off the platform by moving the wrist downwards rather than backwards (Figure 5 h, k). The second position, which was new to me at the time, allowed much more rapid blade removal than the first position and required little or no platform preparation. (This affected the platform attributes accordingly.)

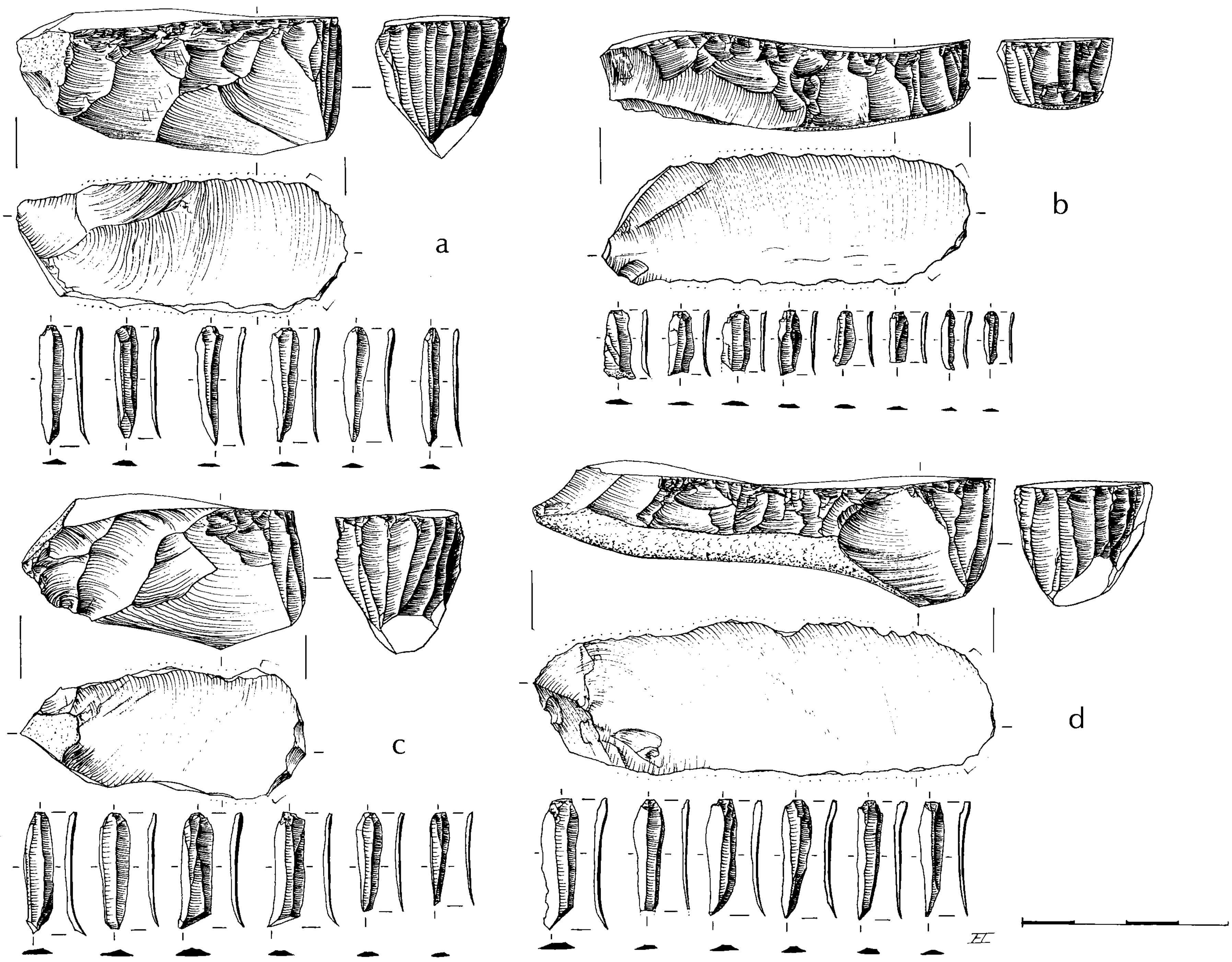
The core face had to be refurbished once during production due to crushed platforms, which prevented further blade removals. This was done with a small pebble while the core remained in the clamp. This action changed the platform angle from about 90° to about 70° and consequently allowed continued blade removals. (Assumption: the attributes of the blades themselves – except as to platform angle – did not seem to be affected by this change. Furthermore, the lowness of platform angle on the finished core should not be taken as representative of the use of a clamp.)

Experiment 5 – hand-held core flaked with copper-tipped tine (Figure 4a)

The object of this experiment was to test the feasibility of microblade removal without the use of a clamp. Again, using the copper-tipped tool with which I was familiar, 40 microblades were removed. Blade removal was stopped when it was felt that a representative sampling of blades was obtained. Upon termination, the core still had sufficient length for it to be gripped tightly enough to allow for even further blade removals (Table 2).

During fabrication, the core, with abraded lateral edges, was simply gripped in the padded left hand with about a centimeter of the platform protruding (Figure 5 i). With the assistance of leg squeeze, a backhanded motion was given the right wrist once maximum inward pressure was obtained, as with Experiment 4 (Figure 5 j). (Although an inward wrist pressure may have functioned – assuming that the core were re-oriented in

Fig. 3. Replica core blank, preforms, and core materials. a, Experiment 1: core blank; b, Experiment 2: preform; c, Experiment 3: preform with 4 representative preforming flakes; d, Experiment 4: core and 6 of 80 microblades flaked with copper-tipped tine and clamp.


a
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d

the palm so that the platform faced the knapper and the bulbar end of the core were facing away – such as the holding position many use for biface projectile point manufacture, I preferred to use outward pressure. Not only do I feel that more pressure may be so exerted, but there seemed to be a greater likelihood that the blades would be removed unbroken – not being forced into the padded palm – and I could better compare the same flaking motion for both hand-held and supported cores. Nevertheless, other holding positions than those I employed might be investigated).

Experiment 6 – hand-held core flaked with short antler tine (Figure 4 b)

In this experiment I sought to determine whether the success I had with the last experiment could be duplicated by using an antler tine (red deer, Figure 5 d). This was a critical experiment because copper is not known from pre-Neolithic Denmark.

The core and fabricator were gripped and manipulated as they were in the last experiment. Despite the use of a shallow core (of minimum depth), it was exceedingly difficult to remove any microblades. A longer antler tine was used for awhile, being held in the same manner as the shorter one, but the results were equally poor. In actual fact, 65 microblades were removed; but as detachment required all the strength I could muster, with the antler tip slipping off the platform repeatedly – as well as considerable time (Table 2), and as the blades being questionably within the acceptable range of variation, and did not approach the length of the average artifact blade (Figure 1 b–i), I was quite skeptical as to the significance of this experiment. My inability to remove sizeable microblades surprised me because of the success with which I had removed relatively long blades with antler in the past with much smaller cores (Figure 5 a). These cores, however, while being flaked with the same short antler tine I was now using, had been secured in a clamp (Figure 5 f). This realization led the way to the next experiment.

Fig. 4. Replica core materials. a, Experiment 5: hand-held core with 6 of 40 microblades flaked with copper-tipped tine; b, Experiment 6: hand-held core with 8 of 65 microblades flaked with short antler tine; c, Experiment 7: core and 6 of 60 microblades flaked lwith long antler tine and clamp; d, Experiment 8: hand-held core with 6 of 30 microblades flaked with long antler tine.

Experiment 7 – core flaked with long antler tine and clamp (Figure 4 c)

The object of this experiment was to see if microblades could be removed with an antler fabricator from a core supported in a clamp. Following a few aborted attempts to remove blades with a short antler tine, I observed that a primary advantage of the clamp was to increase leverage by having the far end of the clamp resting along the left forearm, thus preventing hand/core movement (Figure 5 l). Accordingly, I reasoned that if I were also to use a long antler tine (caribou, Figure 5 e) so that it rested along my right forearm, I might obtain a similar advantage for the fabricator. (This was most successful when the antler rested along the inside of the forearm, creating increased leverage as leg and stomach pressure locked the fabricator in place, figure 5 m) (Crabtree 1967b:72). In short order, 60 microblades were obtained. There was no difficulty in obtaining sufficient pressure to remove blades the full length of the core. In fact, blades were removed when the platform angle was greater than 90° (Figure 4 c). Work on the core terminated because of crushing of the platform edge, not because of the shortness of the core. (The clamp would allow the use of a much shorter core; cf Figure 5a). (Note: P. Vang Petersen, personal communication 1981, tells me that the antler tines found on Kongemose sites are relatively long, whereas in the subsequent Ertebølle period, which lacks microblades, the tines are rather short.)

Experiment 8 – hand-held core flaked with long antler tine (Figure 4 d)

The object of this experiment was to test once again, this time with a long antler tine, whether or not an antler tine is capable, in my hands, of removing microblades from a hand-held core. This was, in effect, a retest of Experiment 6. Had the experiments been terminated with Experiment 7, one might be tempted to conclude that these cores must have been secured in a clamp if flaked with an antler flaker. As I still had reservations about this conclusion, given my recent experience with the long fabricator, I felt that one more test was essential.

Holding the core as in Experiment 6 (Figure 5 i) and the long tine as in Experiment 7 (Figure 5 m), 30 microblades were easily removed from the core. Although the core tilted downward somewhat when pressure was applied to the platform, there was more than enough core length to grip the core so as to prevent excessive tilting. Work on this core was stopped when it was felt that a representative sampling of blades was obtained. Because of the odd configuration of the bottom of this particular core, if many more blades had been removed it might appear as if the core were less thick than it actually was during production. Although it was far from exhausted, since the core face in its present form typified the appearance of the core during most of the blade production, it was decided to terminate work at this point.

DISCUSSION

There were several common factors running throughout the experiments which need discussion. These include the attributes on the raw material and the treatment of the platform. The lithic material used in these experiments was a blackish Senonian chalk flint which came from either Holtug beach in the Stevns area of Zealand or from a glacially deposited nodule found in a field in Gammel Lejre near Roskilde, also in Zealand. Both flints are of an identical nature and lithic grade (i.e. 3.0 on a scale of 1.0 to 5.0; cf Callahan 1979: 16) and approximate the artifact material in all evident attributes.

Platform preparation followed each blade removal and involved the elimination of overhang on the core face on one or both sides of the forthcoming microblade area. The fabricator and/or a sandstone pebble was used for this task. The upper platform face itself was modified only rarely and then only because the pressure tool slipped from the platform. (Such preparation is lacking on the artifact cores observed.) When blades were able to be removed in series, such as from left to right when looking down on the platform (Figure 5 i), as was often done in these experiments, then only the overhang on the top and near side of the anticipated blade was usually removed.

Occasionally, when the fabricator slipped from the platform, the platform edge was slightly ground with an abrasive sandstone. This slight scarring and, more importantly, I think, the residual grit left on the platform by the abrader allowed for more secure gripping of the edge by the fabricator and facilitated blade removal. (Such light grinding is found on the artifact cores.) With the antler fabricator, less abrasion was required than with copper. I suggest that this is because of two factors: (1) the grit is pressed into the antler tip and allows for more traction than with copper, which either crushes or slips aside the grit; and (2) fabricators of antler, the tip of which need not be very sharp (Figure 5 d, e) because only a corner is used, may be set on the very edge itself, while with copper, the fabricator tip, which should be rather sharp (Figure 5 c), must be placed slightly back from the edge (by 1mm or so) to prevent crushing of the platform.

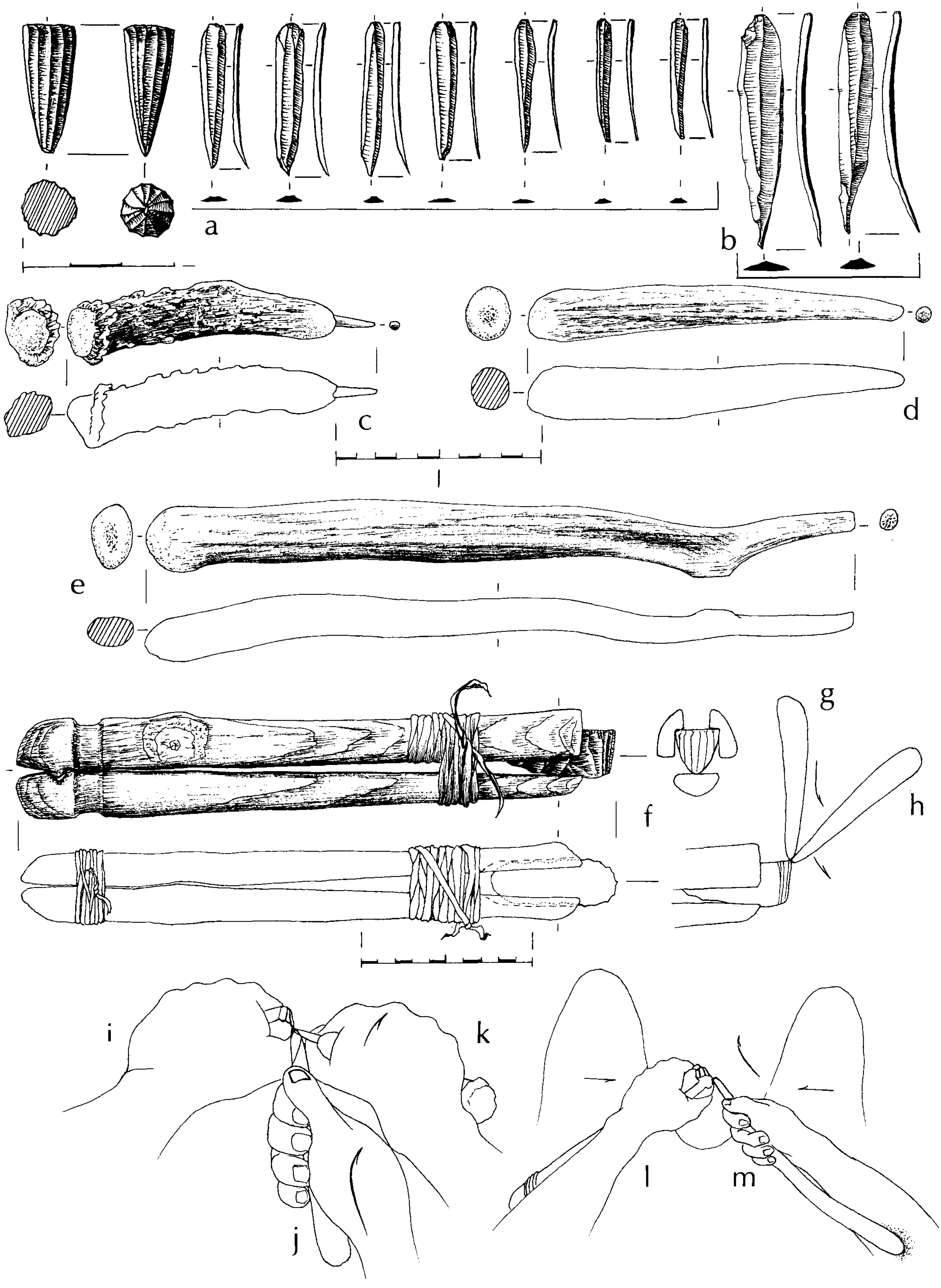
One consequence of the use of antler was a slightly more diffuse and flat bulb (Figures 4 b–d). The bulbs of the copper-flaked blades, on the other hand (Figures 3 d, 4 a), tended to be somewhat more salient.

In so far as was possible, the blade was oriented so as to follow two or more ridges rather than one. This replicated the majority of the artifact blades most accurately and would seem to allow for a more secure seating in a hypothetical bone shaft.

As indicated in Experiment 4, it was discovered that blade removal could be considerably speeded up by, in effect, "raking" the blades from the platform (Figure 5 h, k). This technique worked well with the copper flaker, but I could not make it function at all with antler. Therefore, pressure straight downward into the platform was the rule (Figure 5 g, j).

Several insights were obtained during the course of these investigations. These concern core attributes for both hand-held and clamped holding positions, the predicted size of the exhausted core for each position, platform angles, and work rates. The clamp which was used for these experiments (Figure 5 f) was inspired by a clamp which I witnessed J. B. Sollberger exploying for Folsom fluting at the Little Lake knap-in in 1980 (Hardaker 1980: 7). (I had previously used a clamp which gripped with two contact points instead of three.) For such a clamp, which is certainly not the only possible solution to the problem, it was necessary for the core to be quite parallel-sided for a secure seating in the

Fig. 5. Replica materials, fabricator tools, and holding positions. a, conical bullet core with 7 of 116 microblades produced with hand-held clamp and short antler tine; b, 2 microblades struck with hand-held technique and short antler tine; c, copper-tipped tine (roe deer); d, short antler tine (red deer); e, long antler tine (caribou); f, hand-held clamp (hickory); g–h, two possible angles of force application; i–m, hand-held and clamped holding positions with antler and copper tines.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ARTIFACT CORES

Unit	Length	Maximum width	Thickness at maximum width	Maximum thickness	Width at max. thickness	Platform edge angle	Abraded lateral edges?
Preform							
8aIII M.V.							
MGX17	8.90	3.57	2.06	2.58	3.25	–	yes
*MGX356	10.96	2.56	3.77	3.88	2.48	90°	yes
MGX352	7.82	2.40	2.90	2.92	2.22	–	yes
MGX359	6.35	2.64	1.87	2.11	2.18	(reject?)	no
average	8.51	2.79	2.65	2.87	2.53		
Core							
MGX353	7.20	2.59	3.93	4.04	2.58	100–108° (av.104.5°)	yes
*MGX351	6.80	2.78	3.06	3.11	2.38	68–73° (av.70.5°)	yes
MGX358	6.05	2.36	1.92	2.10	1.75	105° (prob.rej.)	yes
*MGX349	7.50	2.56	2.92	3.71	2.35	105–108° (av.106.5°)	yes
MGX355	9.41	3.16	1.72	3.12	2.23	96–108° (av.102°)	yes
MGX357	6.64	2.26	2.31	3.65	1.94	85–91° (av.88°)	yes
*MGX350	5.77	2.83	2.95	3.10	2.68	86–97° (av.91.5°)	yes
*MGX354	7.45	2.62	2.74	3.13	2.46	92–97° (av.94.5°)	yes
average	7.10	2.64	2.69	3.25	2.30	range 68–108° (95.3°)	–

(* = illustrated)

Table 1.

clamp. Otherwise the core would tend to rock back or forth during the stress of pressing. On the other hand, it was found not necessary to abrade the lateral edges of the core as sharpness there neither interfered with the function of the clamp nor did any apparent damage to it. The cores which were hand-held did not have to be quite so parallel-sided, as the hand could accommodate some degree of irregularity here with no repercussions. However, it was necessary to abrade the lateral edges of the cores when holding by hand, even when several layers of leather padding were used. This prevented undue discomfort to the hand aswell as cutting of the leather pads.

The artifact cores are sometimes not quite parallel-sided and exhibit lateral edges which are rather heavily abraded (Figures 1 l, 2 a–d).

The smallest core which I could grip by hand tightly enough to allow the removal of blades was about 5cm in length. (This was determined by numerous experiments not incorporated into this study.) (My hand is said to be on the large side. I have no idea as to the hand size of the Mesolithic Danes.) Clamped cores, on the other hand may be used until their length is less than 1cm (Figure 5 a).

The artifact cores registered a length in excess of 5.77cm (Table 1).

The qualitative attributes of the core faces, the area of microblade removal, seemed to match those of the

REPLICA CORES

Exp. No.	Unit	Length	Maximum width	Thickness at max. width	Maximum thickness	Width at maximum thickness	Edge angle	Abraded lateral edges?	No. of blades	Knapping time (min.)	Knapping rate
	Flake Blank										
1	81EC20L	9.07	4.90	1.84	2.00	4.75	–	no	–	–	–
	Preform										
2	81EC21L	8.65	3.20	2.82	2.82	3.20	73°	no	–	–	–
3	81EC19L	6.08	2.43	1.78	1.78	2.39	90°	no	–	(3.42)	–
	average	7.37	2.81	2.30	2.30	2.80	81.5°	–	–	–	–
	Core										
4	81EC12L	5.27	2.25	2.66	2.98	2.13	79°	no	80	31.57	1.51/ min.
5	81EC13L	6.26	2.65	2.55	2.64	2.59	84–90° (av.87)	yes	40	14.06	1.74/ min.
6	81EC18L	7.18	2.57	1.70	1.68	2.57	74–78° (av.76)	yes	65	1.35.00	.93/ min.
7	81EC23L	5.40	2.51	2.55	2.75	2.28	89–99° (av.94)	no	60	1.01.18	1.02/ min.
8	81EC27L	9.01	3.05	1.75	2.48	2.76	88–97° (av.92.5)	yes	30	27.33	1.09/ min.
	average	6.62	2.61	2.24	2.51	2.47	range 74–99° (av.86.5)	–	–	–	–

Table 2.

archeological examples, although no structured comparisons were made. (Compare Figures 2 and 4).

The platform of the core in Experiment 4 (Figure 3 d), as noted above, was rejuvinated once during microblade production (note its similarity to Figure 2 a). Blade removals subsequent to rejuvination increased the platform angle of this core from 70 to 79°. With continued flaking I suspect the platform angle would have approached 90°. It could therefore be hypothesized that during the course of reduction, the platform angles of such cores undergo a gradual increase. No data were recorded to document this, but the tendency was noted to be consistent. Accordingly, it would seem that the platform angle of the core following blade removal would not quite reflect the platform angle evident before the removal. (This is apparently due to a greater thickness in the bulbar area.) Thus platform angles of just over 90°, for instance, do not necessarily indicate that the platform was this steep prior to the last blade removals. In actual fact, however, platforms of somewhat over 90°, more than would be accounted for by the above, were indeed flaked in these experiments with both antler and copper flakers used with and without a clamp and without flaking of the platform face (Table 2). (Flaking on the platform face on either side of the platform is known, by me, to increase the *apparent* platform angle.) This area needs further study (cf Bonnichsen 1978: 24).

From a look at the work rates recorded in this study, the most rapid blade removals occurred in Experiments 4 and 5 and the slowest in Experiment 6 (Table 2). The higher rates correlated with the use of the copper flaker and the lack of platform preparation; the slowest rate correlated with the use of the short antler tine and the difficulties I was having in making it function. Experiments 7 and 8 provide, I feel, the most reliable indices of the rates at which I worked during this study, i.e. an average of about one blade per minute. This figure should only be used to show the possibilities, not the probabilities, in the past. (The figures also seem to suggest that one may use less care, concentration, and perhaps understanding of platform preparation variables with copper than with antler in order to obtain suitable results. Copper would therefore seem to have an apparent adaptive advantage over antler, a factor many contemporary flintknappers rely upon today, unfortunately for replication's sake.)

In view of the large size of some of the microblades observed in the artifact sampling (Figure 1 j, k), (although no comparably sized core was observed), an attempt was made to remove microblades of maximum length using antler in both hand-held and clamped positions. Two blades so derived are depicted in Figure 5 b. It should be noted that these blades represent only the upper range obtainable by this knapper on this type of core at this point in time and applies to an unknown degree to the past. (Note: this core had a 2cm radius on the blade face. According to Bo Madsen and Jacques Pelegrin (personal communication 1981), a lesser radius would allow for longer blades were the core deep enough.) This experiment does, however, illustrate that it is possible for the largest size of the observed microblades to be removed according to the above system. Therefore, since the average-sized artifact blades fall noticeably beneath this length, it could be assumed that the attributes of the blades were influenced by their functional destiny rather than by the limitations of human strength.

A comparison between the replica and artifact cores, as indicated in Table 1 and 2, shows a close degree of conformity in all measurement attributes except maximum thickness. The replicas averaged .74cm less in thickness than the artifacts. In view of the preceeding paragraph, I do not feel that this should be taken to indicate that the system was not capable of producing thicker cores, but rather that the core units chosen for inclusion were inadvertently a little on the thin side. (If the tests with thicker cores had not been successfully accomplished, then this discrepancy would have been to be questioned.)

It will also be noted that the average edge-angle of the platforms of the replica cores was less than that of the artifacts but also that less of a range was subjected to testing. (The range for all units indicates the highest and lowest angles recorded.) Edge-angles of well over 90° (97 and 99°) were successfully employed for microblade removal. I tended to stop when blade removal became difficult; I did not thoroughly investigate maximum edge-angle possibilities. I did note, however, that by a combination of delicate flaking and abrasion of the platform edge, the seating of the antler fabricator on a thin layer of grit on the very edge, and a slight downward tilt of the wrist (or tilt of the core within the clamp), I could work with an edge-angle appreciably over 90°. (For a discussion of pressure flaking on a Danish Maglemose core with edge-angles of up to 113°, like Brøndsted 1957: 70g, see Callahan 1984).

A factor which was inadvertently not tested in this study was the number of microblades which could be expected from each core or from each centimeter of core length. Such information would allow for important inferences and I apologize for its omission. I suggest that such be incorporated into similar future studies.

SPECIFIC CONCLUSIONS

Concerning the first hypothesis cited earlier, I was able to remove microblades of the correct attributes by both hand-held and clamped holding positions. However, considering the length of the exhausted cores, the degree of dulling of the lateral edges, the degree of parallel-sideness of the cores, the appearance of the core face, and the feasibility of removing microblades of the proper attributes by either method, the preponderence of evidence seems to be that the archeological cores were hand-held rather than clamped. (It is felt that the greater likelihood should be assigned the simpler holding position when each of two positions functions.) Because of the above realizations, the first hypothesis could said to have been invalidated.

Concerning the second hypothesis, I was able to demonstrate that microblades of the proper attributes could indeed be removed with an antler fabricator. Although this does not necessarily eliminate other kinds of fabricators (except copper, which was not available at that time), it does place a high degree of probability upon antler or an antler-like material having been used. (Other "antler-like" materials include bone, tooth, horn, ivory, and hard shell. Non-antler-like materials include wood, stone, and soft shell. From my own past experience, I feel it highly unlikely that the latter group would function for microblade removal on these cores, although this has not been systematically tested.) Therefore, I was not able to invalidate the second hypothesis.

Concerning the third hypothesis, the tests showed that simple hand-held fabricators allow more than enough force to be generated to create typical microblades. As with most of my hand-holding techniques, the body was employed to a greater of lesser degree in manipulating the hands (using the legs and/or stomach to squeeze the hands together: Figure 5 l/m). This, however, is quite different from the employment of body weight to manipulate a T-shaped chest crutch such as Crabtree endorsed (1968). However, although the chest crutch will allow the removal of both delicate microblades (personal experience) and large macroblades (over 20cm in obsidian (Flenniken, personal communication 1980) and over 10.5cm in Danish flint (personal experience), such tools and techniques are *not necessary* for the removal of typical microblades. Considering the principle of least complexity as indicated above, the greater probability should be assigned the simpler position. The third hypothesis, therefore, could not be invalidated.

In the beginning of this paper, assumptions were made that initial preforming of the artifact cores was done by direct hammerstone percussion and that the microblades were removed by pressure. The tests done in this study, while not comprehensive in this regard, do not invalidate these assumptions. The assumptions, therefore, could be said to have tentatively been demonstrated and not merely assumed. The other assumptions (Experiments 1 and 2) concerning degree of curvature of the flake blank/platform surface, while not systematically tested on the particular units under consideration, were demonstrated repeatedly on the cores which were subsequently rejected and on those selected for the remaining experiments.

It should be noted that extensive testing of both the second hypothesis and the above assumptions was not done. It might seem, therefore, that I was not attempting to invalidate my suppositions concerning these variables. It is felt that in this case, the 25 years of experience I have had with making stone tools has equipped me with enough information concerning the capabilities and limitations of the materials which were not systematically tested to substitute for direct, structured experiment. In cases where there is doubt, experience may be no substitute. There was no such doubt in this case. To run experiments with the obvious may be a waste of time.

It should also be mentioned that, in the months following the above tests, numerous similar cores and structured experiments were run through the system by the writer. The findings indicated herein were repeatedly confirmed. Furthermore, Danish and Dutch flintknappers who participated in a semi-structured flintknapping seminar at Lejre independently confirmed these findings.

INFERENCE

Considering the goodness of fit between the hypotheses and the experiments, and considering all intervening information, the following inference is posed:

There is a high degree of probability that, on the observed microblade cores, blade removal was made on cores which were hand-held and was effected by pressure with a hand-held fabricator of antler or an antler-like material.

GENERAL CONCLUSIONS

This study has not provided proof of how a particular type of tool was made; but it has provided a probability statement concerning manufacture. If probability statements are the aim of science, as Binford claims (op. cit.), then my task, for the moment, is done. It now remains for other researchers to take this inference as a starting hypotheses and to repeat the experiments, if desired, in an attempt to invalidate – or furher specify – the above conclusion.

Concerning the archeological remifications of this study, it should be made clear that these experiments did not serve to clean up the archeological problems. As stated earlier, before cultural inferences may be made, it is first necessary to define and compare the relevant technologies. This present study is but one of a series which should be undertaken in order to define the production characteristics of each of the types of microblade cores under consideration. In this study, I have only defined one of these types. It will now be up to other experimentors to define the other types, after which comparisons may be made and inferences offered.

As a further cautionary note, I should mention that this study was done in isolation, without a clear understanding of the microblade technologies which preceeded. In some cases, this knowledge may be irrelevant; but, after considering the somewhat larger and generally more obtuse-angled platforms on the Maglemose microblade cores which supposedly preceeded those tested in this study, I hesitate. Although I have not systematically tested it, I strongly suspect that the explanation of the technology underlying these high-edge-angled cores lies in the use of a clamp of some sort. If clamps were in common use in the preceeding period, then the strength of the inference resulting from this present study may be somewhat weakened. Thus, it may be that when the entire series of experiments has been completed, some earlier inferences may have to be revised. Such is the nature of science.

In these experiments, I have shown, by example, the value of attempting to invalidate rather than to verify an hypothesis. It would have been quite simple to show, for instance, that microblades could be removed from cores which were secured in a holding device, as stated in the first hypothesis. This would seem to have verified the hypothesis. But because of the doubts I had about this conclusion, a further exercise was felt necessary. The results of this additional experiment contradicted the previous conclusion. This illustrates that not only is invalidation a more rigorous exercise than verification, but it is more accurate as well. This process is akin to our legal system in which guilt, rather than innocence, must be proven.

It is hoped that enough procedural details have been provided herein that the experiments may indeed be replicated, as admonished by Hansen (1972: 11). This aspect has been notably lacking in previous reports of replicative work. It is especially hoped that the beginnings of a true laboratory science may get underway so that such experiments may be repeated on a systematic basis. This is the way in which true laboratory sciences operate, from the high school and university classroom to the basement laboratory or workshop. It would seem that such systemization of replicative procedures would be a fitting homage to Don Crabtree, both for its utility as an educational tool and for its impact on science.

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I would like to extend my appreciation to the late Don Crabtree, to Peter Vang Petersen, Bo Madsen, Delbbie Seitzer Olausson, Linda Abbey, Poul Otto Nielsen, C. J. Becker, the Lejre Center, and the Danish-American Council for moral, material, and/or financial support related to this study. I especially thank Eva Koch Nielsen and Peter Vang Petersen for permission to reproduce Ms. Nielsen's illustration of the slotted point in Figure 1 a.

The conical microblade bullet core illustrated in Figure 5 a was prepared as a gift for Don Crabtree. It was made as a small token of appreciation for his years of inspiration and moral support and in return for some replicas which he had given me some years before. The desire to give him a gift equal to his led the way to the skills and attitudes required for this present study. The gift was sent to him while on his deathbed, a fact of which I was not aware at the time. I do not know if he ever saw it.

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A Functional Study of Lithics from Vænget Nord, a Mesolithic Site at Vedbæk, N.E. Sjælland

by HELLE JUEL JENSEN and ERIK BRINCH PETERSEN

Since 1975 the so-called Vedbæk-project has been in operation with the aim of describing and explaining the changes observable in the behaviour of a Mesolithic (and early Neolithic) population around a Zealandic fjord during the Atlantic and early Subboreal periods, app. 5.500 to 2.500 bc (Brinch Petersen *et al.* 1976).

A first step forward was the investigation in 1975 of the Mesolithic cemetery at Henriksholm-Bøgebakken (Albrethsen and Brinch Petersen 1977). During the following years a number of sites were excavated in the bog as well as under the town (Vang Petersen 1982). Meanwhile, the recovered faunal material from the excavations were recorded and analysed, and a general picture of faunal diversity emerged (Aaris-Sørensen 1980a, 1980b, 1982a, 1982b, 1983; Enghoff 1983). Likewise, profitting from the many cuttings in the bog as well as from a great number of C14 dates, a local shore displacement curve has been worked out for the period in question (Christensen 1982a, 1982b). Furthermore, this curve has been tied in with the Mesolithic chronology as put forward recently (Vang Petersen 1984).

VÆNGET NORD

Another important step forward within the project has been the discovery and subsequent excavation of the Mesolithic site at Vænget Nord. The site was discovered by chance in 1976, tested in 1977 and then excavated in 1980, '82, and '83. As a result of the testing it became evident, that the site was situated on a small island just outside the southern bank of the original fjord. Actually, the exact location is only 150 meters to the west of "Vedbæk Boldbaner", excavated by the National Museum in the forties (Mathiassen 1946).

The material recovered from the testpits indicated, as did the first C14 dates, an occupation around 5.000 bc, thus making it one of the oldest known Mesolithic sites in the area (Vang Petersen 1984). Furthermore, not only was the site intact, a rare case in Vedbæk, but as the top of the island attained a maximum height of only 2,75 m a.s.l. the Littorina transgression around 4.800 bc made an end to the habitation, and the ongoing transgression sealed of the site completely (Christensen 1982a). Therefore, it became tempting to undertake a total excavation of that particular site, and today a little more than 500 m^2 have been excavated with various strategies. Despite the attempt there are never the less still areas reserved for a future investigation (fig. 1).

Over the central part of the island, some 226 m^2 were exposed during a horizontal *décapage*, with all the backdirt being watersieved and sorted out per quarter square metre. Most of the lithics studied in the present paper originate from this exposure (fig. 2).

Due to the horizontal exposure of the central part of the island, it has been possible to locate and excavate a number of anthropogenic features (fig. 1). These can tentatively be described as simple hearths, charcoal patches (*vidange*), cooking pits, dumps of fire-cracked stones, and some, until now, unspecified pits. Also a paved stone platform was noticed. Furthermore, in one pit was found a flint cache while another has been interpreted as a burial pit. Wooden posts were found on the fringe of the island, while more than 200 stakeholes were discovered on the top of the island during the last field season, and it is highly possible, that an even greater number was missed during the earlier seasons. However, neither the posts, nor the stakeholes can be said to form evident structures (Brinch Petersen in press).

Unfortunately, faunal remains were not preserved on the top of the island, and bones were only recovered in some quantity in the saturated part in front of the site. However, despite the limited number of bones, Vænget Nord shows the same mixture of marine and sylvan spe-

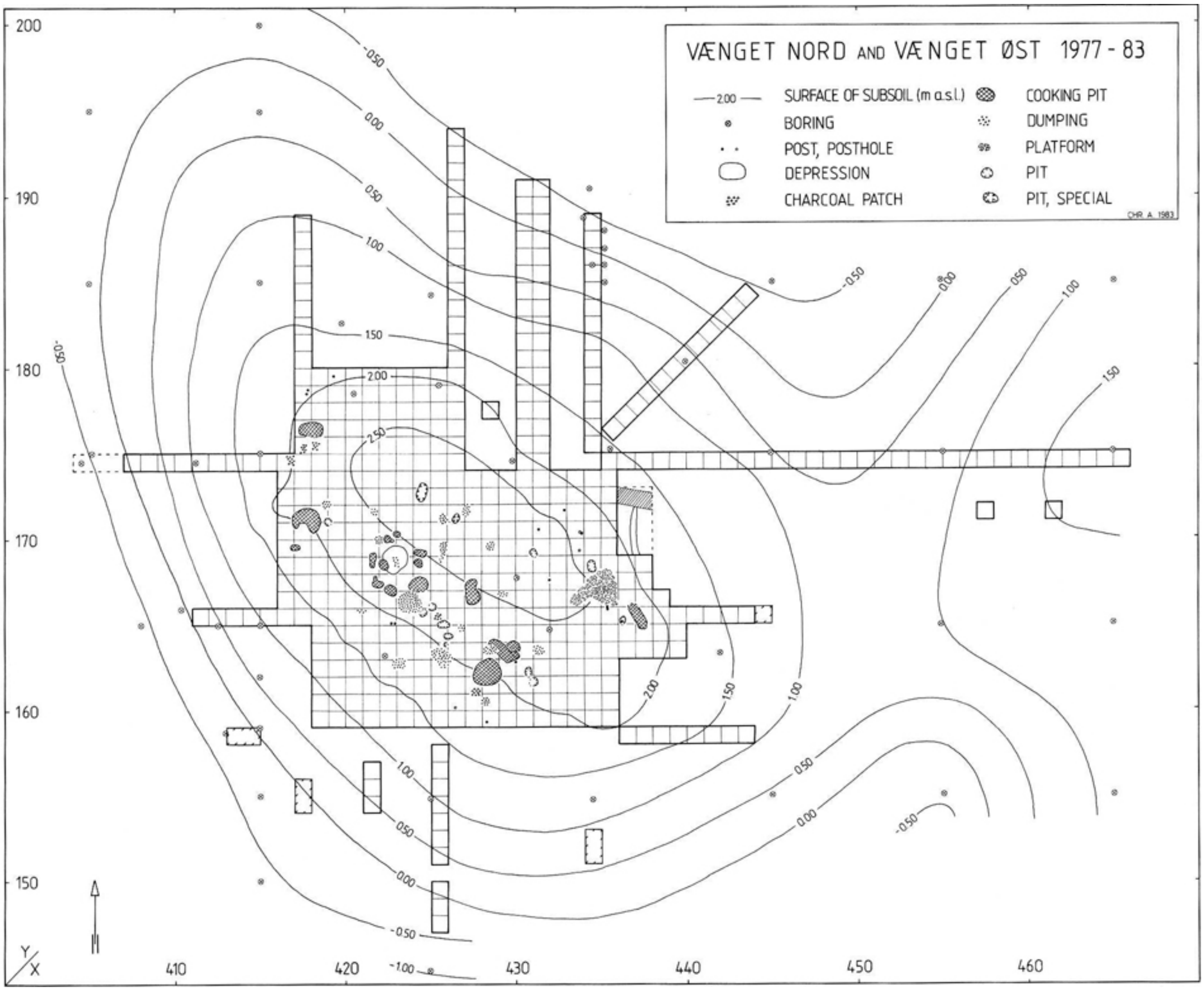

Fig. 1. Vænget Nord, excavation plan (Chr. Adamsen *del.*).

cies as is known from the other sites (Aaris-Sørensen 1982b). In order to indicate the range of possibilities when interpreting the results of the wear analysis, a list of the identified species from Vænget Nord is given below (Aaris-Sørensen *in litteris* and excavation report).

Pisces:	**Fish:**
Anguilla anguilla (L.)	Eel
Belone belone (L.)	Garfish
Esox lucius L.	Pike
Gadus morhua L.	Cod
Gadidae	
Pleuronectidae	
Raja clavata L.	Sting ray
Scomber scombrus L.	Mackerel
Squalus acanthias L.	Piked dogfish

Aves:	**Birds:**
Anatidae	
Mammalia:	**Mammals:**
Capreolus capreolus (L.)	Roe deer
Castor fiber L.	Beaver
Cervus elaphus L.	Red deer
Halichoerus grypus (Fabricius)	Grey seal
Homo sapiens L.	Man
Martes martes (L.)	Pine marten
Sus scrofa L.	Wild boar

Finally, it must be stated, that the two wooden objects found on the site, a dugout canoe and an elmbow, are both younger than the main occupation, which due to poor preservation conditions were devoid of such finds.

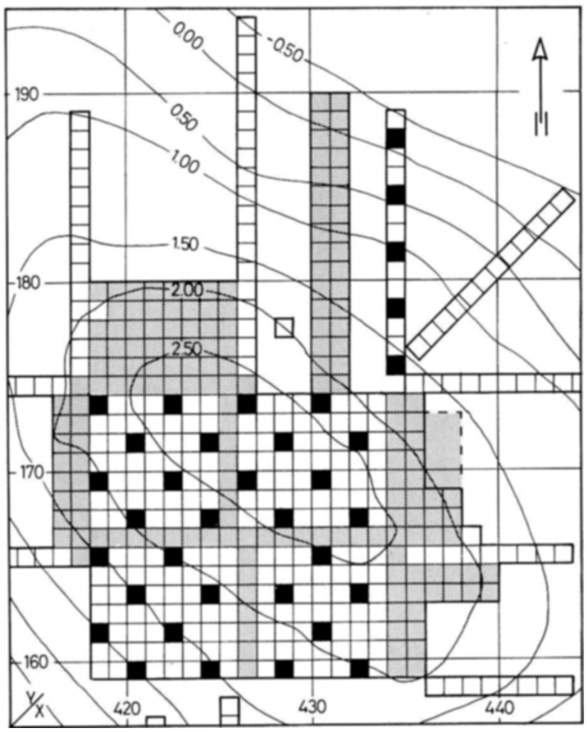

Fig. 2. Vænget Nord, location of sampled squares (Chr. Adamsen *del.*).

USE WEAR ANALYSIS

The present study summarises the results of a functional investigation of lithics from Vænget Nord. Material discussed in this paper was uncovered during the first two field seasons of excavation (1980 and 1982) while flints from the final field season are not considered here (fig. 2). At the time of this writing a second stage of wear analysis has been initiated. Likewise the general analyses of the site and the final excavation report are still in progress. Because of this the following report must be considered partly preliminary. However, it may be reasonably supposed that the material studied so far is representative of the excavated area, of the total number of stone tools recovered and of the variations exhibited in the lithic assemblage.

OBJECTIVES AND SAMPLING

The main objectives for the analysis were two-fold, namely

1) to get an idea about the function of the site by examining a cross-section of the lithic component, and
2) to investigate if only retouched tools and some of the blades had been used or if "hidden tools" could be detected even further down the "debitage hierachy" (*i.e.* flakes).

Since a serious lithic use wear study is time consuming, a functional analysis of the entire collection was precluded. Within the given time frame one could realistically expect to examine about 600 to 800 pieces of flint and the amount of square meters to be sampled was calculated on the basis of these numbers. Lay out of the selected square meters was determined by the wish to get as much as possible of the central area represented in this sample. Based on these considerations the analysis came to include pieces from $35m^2$, covering $5m^2$ in the northeastern trench and $30m^2$ distributed over the central excavation area (fig. 2).

For 17 of the sampled square meters the investigation included all worked, unpatinated and unburned flints larger than 3 cm. From the remaining $16m^2$ (all situated in the western half of the area) only blades, retouched tools and their by-products have been examined. Furthermore, since the number of retouched implements was fairly limited, it was decided to study *all* such tools found in the *décapage* areas.

METHOD OF ANALYSIS

The wear study follows the method and observations presented by L. Keeley (1980, Keeley and Newcomer 1977), P. Anderson-Gerfaud (1981) and E. Moss (1983). Basis for the functional assessments consists of several hundred experiments, executed before and during the investigation. The analyses were carried out by means of a reflected light microscope, type Olympus BHM, at magnifications between 100 and 400 diameters. Before inspection the flints were cleaned in a weak solution of NaOH and/or in luke-warm detergent water. All analysed pieces were drawn on data sheets with indications of the exact location of polishes. The natural state of the flint surfaces were registrered according to a gradient scale and various measures were recorded such as length, width, thickness and edge angle. A substantial number of micrographs were taken in order to document typical and unusual examples of the entire range of patterns of use and non-use wear traces.

RESULTS OF ANALYSIS (Table 1)

Retouched tools and their by-products

The number of retouched pieces at Vænget Nord is limited as is the range of morphologically distinctive types. The inventory is dominated by projectile points, core-axes and burins while scrapers are fairly rare. As retouched tools were few it was decided to include as many as possible in the analysis, not only from the selected square meters but from the entire central area. Not all core-axes and points were examined as their function was considered reasonably established so that time would be put into better use analysing other categories of flint. Axes and points from the sampled square meters were, however, analysed for possible wear traces.

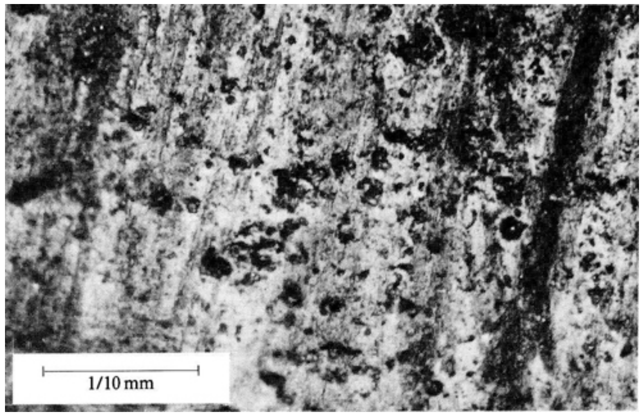

Fig. 3. Worn surface of core axe. Note the abraded surface and the deep linear striations.

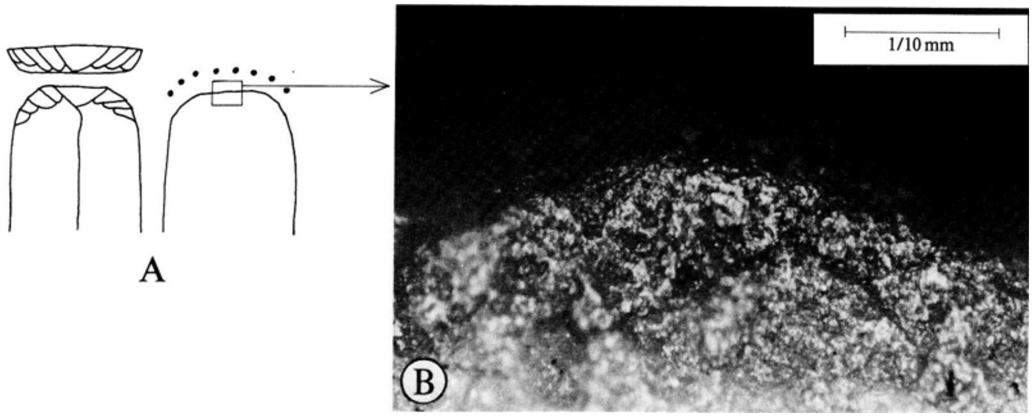

Fig. 4. A. Scematical presentation of scraper with broken edge. The dotted line indicates location of polish. – B. Light hide polish and rounding on edge of broken scraper.

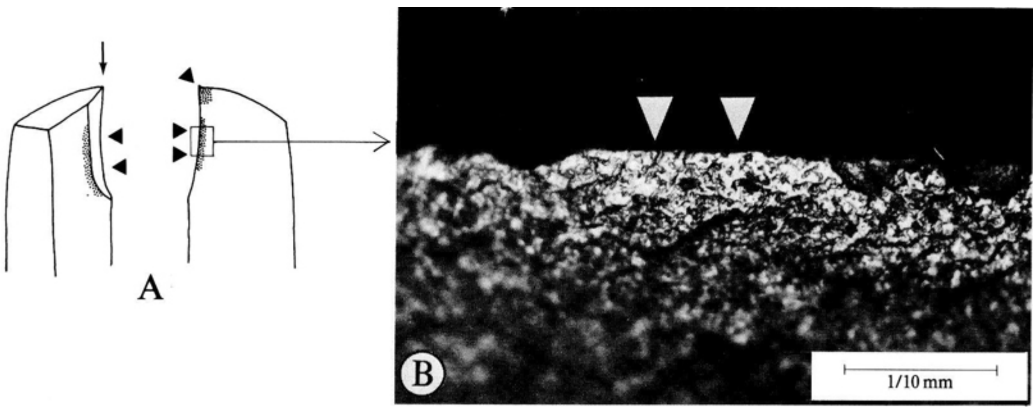

Fig. 5. A. Scematical presentation of polish location on burins. Arrows indicate direction of use. – B. Bone/antler polish on edge of burin facet (arrow).

Table 1.

MORPHOLOGICAL TYPES	NUMBER EXAMINED	NUMBER OF ANALYSABLE PIECES[a)]	NUMBER OF PIECES WITH USE WEAR
Core axes	4	4	3
Rejuvenation flakes	9	8	4
Scrapers	11	10	9
Burins	34	26	23
Burin spalls	17	14	1
Truncated pieces	12	8	7
Projectile points	23	23	10
Microburins	11	11	0
Diverse retouched pieces[b)]	59	37	19
Blades, unretouched	410	259	59
Flakes, unretouched	256	223	5
TOTAL	846	623	140

a) Some of the pieces originally considered for analysis were later excluded because of natural surface alterations which only showed up at the microscopic scale.
b) Categories not considered in the text.

The following section presents a *general* summary of patterns of edge utilisation displayed by the major retouched tool classes, while more detailed descriptions of individual variations in tool use must await the final site publication.

Core-axes and axe rejuvenation flakes: Four core-axes were analysed of which three yielded use traces. In only one instance was typical wood polish observed. Most of the edge wear occured in the shape of heavy abration and deep linear depressions, running perpendicular to the edge of the axes (fig. 3). Identical use patterns were found on four of the axe rejuvenation flakes, i.e. abration and heavy striations rather than polish formation. Most likely this *frictional* wear pattern is due to the violent nature of the axe blow.

One core-axe was unused (or resharpened and not reused). Aditionally four edge rejuvenation flakes examined displayed no traces of wear indicating that the flakes derived from the initial manufacture of the axes rather than from resharpening episodes.

Scrapers: The analysed scrapers had been used for hide processing (7 pieces), for wood working (one piece) and for the working of "hard material" (one piece). Apart from a single side scraper (used in the "hard material") most of the tools are endscrapers on short sections of blades. Six of these implements exhibit a somewhat puzzling pattern with respect to production as well as to use. All of the pieces are short, ranging from 1.7 to 3.9 cm in length. With the exception of one the working edge is retouched only along the outer corners while the section in between is constituted by a steep break running from the ventral to the dorsal aspect of the blank (fig. 4). These scrapers are all localised in the same area of the site and at least two of the implements fit together. The scraping edges show a lightly developed hide polish indicating very short use lifes. Taken together the observations *might* be explained as the results of unsuccessful attempts to make the implements work satisfactorily by breaking or snapping off the malfunctioning working edge and creating a fresh one simply by blunting away the pointed and probably damaging corners of the breaks.

So far only one heavily used scraper has been detected. The piece in question differs from the remaining scrapers by being produced on a big flake. Morphologically the implement must be classified as an endscraper, but the most important traces of wear as well as some deep striations were located on the ventral aspect of one of the unretouched lateral edges.

Burins: Typologically this group of tools consisted mainly of angled burins on breaks, most typically produced on heavy flakes or blades.

Twenty three burins exhibited use wear on one or several portions of the tool. The microwear traces attributable to function were interpreted as bone/antler polish, unspecified hard material and a single instance of hide polish. The predominant material worked was bone/antler (20 pieces). Most burin tips or bevels showed traces of wear, although polish was often weakly developed. Frequently only one aspect of the bevel was used, either the ventral or dorsal broad side of the blank. However, use traces were not limited to the burin bevel as 18 of the tools were used to work bone or antler with the *sides* of the burin facets. In these instances polish was well developed, striations and polish direction indicating a scraping or shaving movement perpendicular to the edge (fig. 5). This particular mode of employment is not surprising. F. Bordes, among others, have illustrated the effectiveness of experimental burin sides for the finishing of surfaces of bone and antler (1965), and in archaeological contexts A. Leroi-Gourhan and M. Brezillon (1966) and P. Vaughan (1985) have demonstrated the edges of burin facets to be important functional units.

In addition to the burins 17 burin spalls were examined. Among these one displayed the same pattern of use found so frequently on the burins, i.e. the use of the facet edge for shaving or shaping bone/antler. The remaining 16 pieces showed no traces of wear.

Truncated blades and flakes: Seven truncated blades and flakes displayed traces of wear. In no instances did the truncated ends constitute an independent working edge. Rather, the retouch seem to have served mainly for producing a resistant point at the intersections of the truncations and the adjoining unretouched edges. Work polishes were found on both ventral and dorsal aspects of the points as well as along the sharp lateral sides of the blanks. Five pieces had been used for the cutting and scraping of hide and one for the cutting of siliceous plant material. The seventh utilised blade had worked hide as well as plant.

Projectile points: During the course of this study, a total of 23 rhomboid and oblique transverse points were analysed. None of these pieces showed actual work polishes indicating the nature of the target, but microscopic linear impact traces occurred on 10 of the points – parallel to the longitudinal axe of the pieces. The linear polishes were mainly located close to macroscopical fractures at the edge of the points. Most likely the microchips from the flint tips are responsible for the traces observed.

Table 2.

SITES	TOTAL	USED PIECES	%
Vænget Nord (VN)	259	59	23
Ageröd V (AG V)	76	43	57
Ringkloster (RKL)	63	46	73
Ertebølle (EB)	98	60	61

Frequencies of utilized blades

Absence of wear traces on the remaining 13 points do *not* necessarily indicate that these points were not used. Available experimental evidence demonstrate that only a proportion of fired arrow tips will yield diagnostic impact traces, depending for one thing on whether or not the projectile hit a hard substance such as bone or sinew (Barton and Bergman 1982, Moss and Newcomer 1983, Moss 1983, Fischer *et al.* 1984).

Unretouched pieces

Today it is widely acknowledged that retouched tools reflect only a small fraction of the activities going on at a site. Although retouched edges can be effective devices for the scraping, graving or chopping of harder or tougher materials as demonstrated in the previous section, a natural, sharp flint edge is the most logical choice for a number of other purposes. Thus ethnoarchaeological investigations of modern lithic industries have yielded numerous examples of the importance of unretouched tools (White and Thomas 1972, Gould 1977, Hayden 1977) and in recent years similar information begin to emerge from the archaeological record (Odell 1980, Moss 1983, Juel Jensen 1983 *inter alii*). Based on these considerations a total of 666 unretouched blades and flakes at Vænget Nord were selected for use wear examination, according to the sampling strategies outlined at the beginning of this paper.

Unretouched blades

Of the 259 analysable blades 59 (23%) displayed traces of wear. Because of differences in sampling procedures this figure is not strictly comparable to results from other south Scandinavian Mesolithic sites analysed by one of the authors (Table 2). As opposed to other samples, the Vænget Nord material includes all kinds of blades, i.e. microblades, broken pieces, small fragments. If regular, complete and almost complete blades are isolated, then the ratio between used an unused blades changes somewhat, although the frequency of

Table 3.

	Wood	Wood/ plant	Plant	Hide	Meat	Bone/ antler	Fish	Total No.
VN	13	4	21	39	23	–	–	56 (63)*
AG V	15	15	40	28	• –	3	–	40 (43)*
RKL	30	–	17	17	15	17	–	47
EB	9	6	57	11	10	4	4	53 (63)*

* Polishes, which have not been identified, are not incorporated into the table. Thus 7 pieces at VN, 3 at AG V, and 10 pieces at EB are excluded.

Distribution of worked materials (%).

used blades is still below 40%. Furthermore, the Vænget Nord blades were sampled from a proper living area, that is, an area where flint knapping actually took place, resulting in the deposition of all sorts of debris. The other samples (Ageröd V, Ringkloster (Andersen 1975), Ertebølle) all come from shell midden or dump areas, that is, discrete and specialised areas within a site where material remains can be expected to exhibit greater proportions of tools in relation to debris. On these grounds the Vænget Nord material displayes a much lower and probably more realistic percentage of utilised blades in relation to the total population of blades at a site.

Edge angle and selection for use: Figure 6 represents edge angle values of the unretouched blades in terms of individual lateral edges (cortical edges being excluded). The figure sums up the relation between the number of utilised/non-utilised edges *and* the edge angle, measured in 10° intervals (Juel Jensen 1983, p. 152). A preference for lateral edges with edge angles between 30° and 55° appears quite clearly from the graph. Edges with values below and above this range are used more rarely. In gross this selective pattern is in accordance with patterns observed for other samples of blades (compare fig. 6 A with 6 B–D). Furthermore these angles correspond to the preferred range of cutting edges reported for unretouched flake tools from modern New Guinea and Australia (Gould, Koster and Sontz 1971, White and Thomas 1972, White 1977), thereby supporting the assumption that edge angles were selected according to simple utilitarian needs, i.e. they offered a sharp, but at the same time a sufficiently strong edge that would withstand the stresses of use.

Materials worked: The Vænget Nord blades were employed in the working of soft to medium hard materials like plant, hide, wood and meat in various proportions. The general orientation of polishes and the direction of striations indicate that the blades had been used in cutting, sawing, whittling and scraping movements. Table 3 presents the major patterns with respect to contact materials, and for the sake of comparison the table includes results from other Mesolithic blade samples.

This paper will concentrate on a discussion of the two numerically most important functions attributed to flint blades at Vænget Nord, namely the working of hide and of plant materials.

Hide working blades: The group of hide working blades constitute 22 pieces, or more than one third of the utilised blades. In terms of functional analysis "hide" is not a single worked material, as hide can be worked and processed in many different stages. So far, polishes caused by fresh, moist and dry hide can be distinguished from one another (Keeley 1980, Moss 1983) and at Vænget Nord all three variations were idenfied.

Five blades were used for the cutting of fresh hide, striations and direction of polishes indicating a longitudinal movement of the tools. Obviously in the case of fresh hide-cutting it cannot be estimated whether the polish developed directly from the skinning and dressing of game, or if some of the knives can be perceived as manufacturing tools, employed in the processing of furs.

The 17 blades used in the working of moist and dry hide turned out to be wielded in a variety of ways, alone or in combination. Most of the implements had been cutting hide, but on 15 pieces additional patterns of use were detected along sections of the edges. In at least 10 instances part of the unretouched edge had been used in transverse motions – probably for scraping activities as the edge rounding, polish built-up and striations were generally more pronounced on one aspect of the

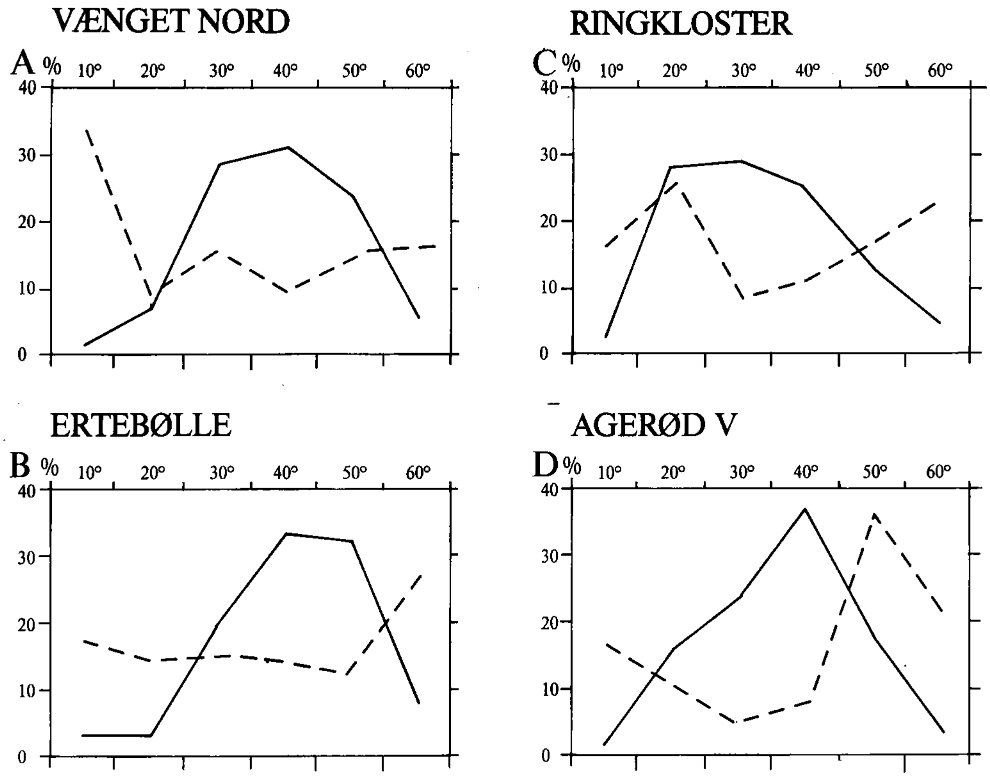

Fig. 6. Relative distribution of edge angles on blades. Full line: utilised edges. Broken line: unused edges.

edge (fig. 7). Furthermore it was noticed that several distal and proximal breaks had been used for the scraping of hide. Now, it is difficult to assess whether the hide scraping activities observed on the three different types of edges (unretouched edges, breaks, retouched scraper fronts) actually constitute *different* stages in the processing of hide, too subtle to be detected by wear analysis. Or, if the three kinds of edges were used interchangeably for the same tasks, i.e. the softening and currying part of the hide preparation.

Plant working blades: The plant working blades studied display a bright and shiny polish that is normally developed by the working of highly siliceous plant materials (Whitthoft 1967, Anderson 1980 *inter alii*). One of us (HJJ) has suggested elsewhere that most of the plant working knives found at Mesolithic and some of the early Neolithic sites are probably *manufacturing* tools rather than subsistence related implements used for the gathering of vegetable resources (Madsen and Juel Jensen 1982, Juel Jensen in prep). This proposition is in part substantiated by the structure of the polishes in relation to the working edges. In many instances the direction of the polish, as well as that of the striations are oriented perpendicular to the edge. The striations and the most heavily developed wear are found on the ventral surface of the tools which must therefore have constituted the leading side. In most cases the polish is restricted to a short section along the edge line – between 0.5 and 2 cm. It is reasonable to assume that these measures constitute the width of the material worked, and that the edges were used for the splitting and shaving of single plant stems, possibly for the use in the making of baskets or the like. This particular pattern, previously documented at the Kongemose site of Ageröd V, Scania (Larsson 1983), at the final Mesolithic site of Ertebølle, Jutland (Madsen *et al.* 1900, Andersen and Johansen 1983) and the early Neolithic site of Mosegården, Jutland (Madsen and Juel Jensen 1982), has been observed on seven of the 12 plant working blades at Vænget Nord (fig. 8).

Unretouched flakes

The functional analysis of lithic material from Vænget Nord included not only retouched tools and blades but also a substantial number of flakes. A total of 256 flakes were analysed, from the 5m^2 in the trench as well as

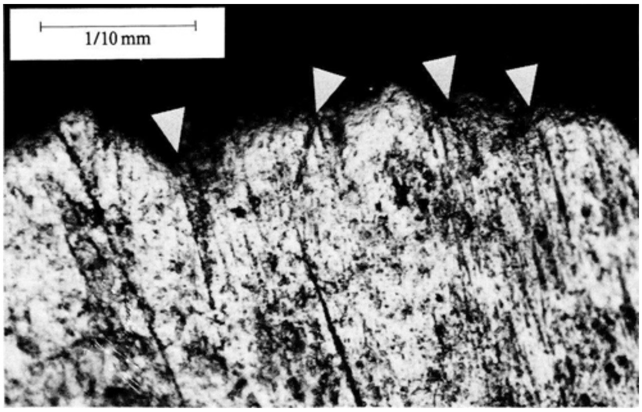

Fig. 7. Unretouched edge used for scraping dry hide. Linear striations (arrows) indicate direction of use.

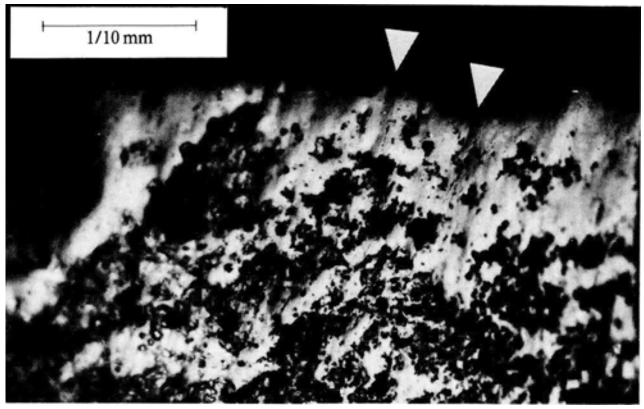

Fig. 8. Unretouched edge used for plant working (ventral aspect). Note the bright and reflective surface and the striations, that indicate the direction of use (arrow).

from the two eastern main sections of the excavation ($14m^2$). At this point the analysis was stopped; of all the flakes examined so far only five displayed traces of wear. At this site at least, it seems that flakes were neither produced nor perceived as potential tools; rather they were simply the debris – or by-products – of the lithic reduction sequence, in particular from the production of core-axes.

By measuring the lateral edge angles it becomes evident that the main body of flakes display edge angle values that are marginal in relation to the range of "optimal edge angles" demonstrated for the blade sample, that is, flake edges are either too thin or too steep to be effective devices for use (compare fig. 9 with fig. 6).

CONCLUDING REMARKS ON FUNCTION

Important activites at the site of Vænget Nord are bone/ antler working (represented by the burins), and the working of hide in different stages. Also, the number of meat- and butchering knives are fairly large (Table 3) considering the subtleness of meat polish. These particular functions can be classified as parts of the same activity "complex", i.e. the butchering of animals and the processing of raw materials from these. The many projectile points are part of this complex, too.

Evidently the dominating role played by hide has made little impact on the retouched tool categories, since scrapers, as mentioned earlier, are fairly rare. The relative absence of classical, retouched scrapers is typi-

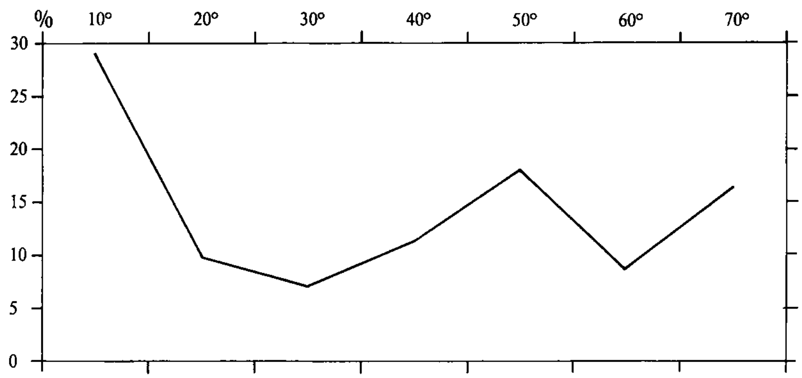

Fig. 9. Relative distribution of edge angle values on flakes (357 non-cortical edges).

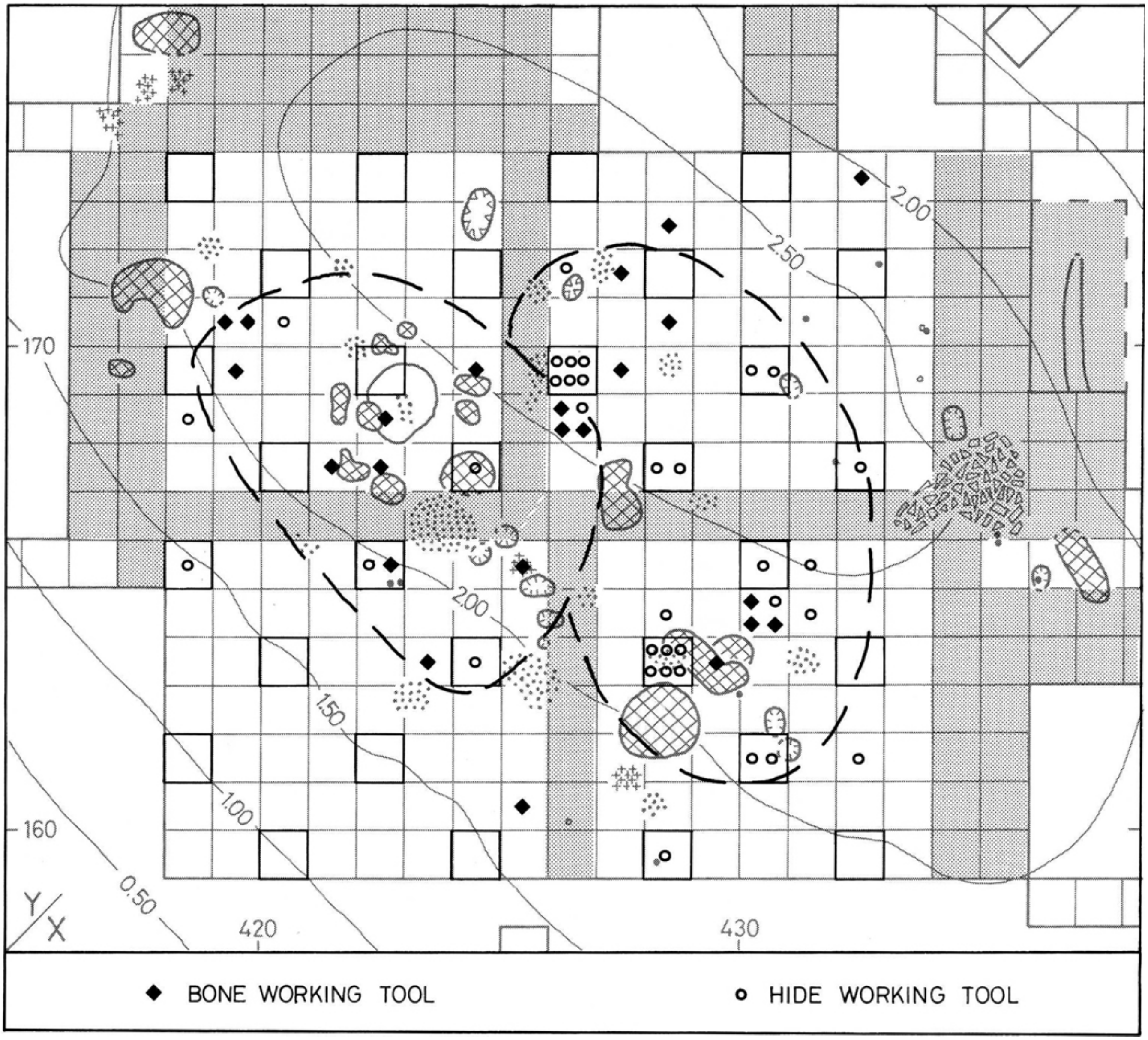

Fig. 10. Distribution of bone/antler working tools as opposed to hide working tools in the central part of the excavation (Chr. Adamsen *del.*).

cal not only for Vænget Nord, but for all East Danish sites from the Kongemosian and the early Ertebølle Culture (Vang Petersen 1984). Several factors might be responsible for this situation: (a) hide working procedures (*i.e.* the currying face) changed from the Maglemosian to the Kongemose period; (b) the softening part of the hide preparation was carried out by tools of organic materials; or (c) as suggested above, unmodified edges and natural breaks on blades took over the function of retouched scraper fronts.

Leaving out core-axes, only a few retouched tools displayed traces of wood polish, and the proportion of wood working blades is fairly modest. One of us (HJJ) would like to suggest that the proportional frequency of wood working activities may constitute one means of assessing relative duration of occupancy of a site. Unlike antler or hide, wood is a fairly "neutral" material in terms of seasonality. Wood working is carried out at all times of the year and wooden artefacts constantly need repairing. Furthermore, experiments as well as ethnoarchaeological observations have shown that the working of wood is very flint consuming (Allchin 1957, Crabtree and Davis 1968, Hayden 1978). Consequently the importance of wood working *relative* to other activities carried out at a site will tend to be over-emphasized when estimated solely on the basis of the numbers of tools employed in the tasks. This tendency towards an over-representation is further amplified by the technical fact that wood polish is one of the clearer and more easily recognisable polishes. On the basis of these considerations the low percentage of wood working tools discovered at Vænget Nord may be taken to indicate that occupations were brief and specialised in nature.

ACTIVITY AREAS AND FUTURE RESEARCH

The sampling procedures chosen for this particular study are not very useful for identifying activity areas, and consequently this kind of information is limited. However, on the basis of present results *some* internal organisation can be surmised, although further documentation is needed. Thus, the analysis seem to indicate that the site is divided into two major zones (fig. 10):

(A) Bone/antler working tools are mainly associated with the many features at the southwestern slope of the holm.

(B) Hide working implements are localised in an area with few features at the top of the holm.

Given that this zonation is real and not just an artefact of sampling procedures, it presents some interesting information about the site. For one thing, the presence of a central area – associated with hearths – where minor crafts are carried out, and a peripheral zone where space demanding and dirty work, like the processing of hides, takes place corresponds nicely to the structures observed in ethno-archaeological contexts (Yellen 1977). A second important implication is that "survival" of these kinds of patterns within a site suggests that the cultural material does not constitute meaningless palimpsests of residues from a series of totally unrelated occupational episodes (Brinch Petersen in press).

Current work is concentrating on further investigation of these distributional aspects of the tool functions at Vænget Nord.

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Tybrind Vig

A Preliminary Report on a Submerged Ertebølle Settlement on the West Coast of Fyn

by SØREN H. ANDERSEN

The late Mesolithic Ertebølle Culture in Denmark c. 4,600–3,200 b.c. (conv. C-14) is one of the most thoroughly investigated mesolithic cultures in Northern Europe. Our knowledge of Ertebølle economy and settlement types is, however, still limited by the fact, that almost all the excavated settlements are 1) located along the coast and 2) situated in the north-northeastern part of Denmark.

Since the end of the last glaciation, c. 13,000 b.c., the relationship between the land and the sea in Denmark has undergone great changes. The modern extent of Denmark is a result of a series of eustatic and isostatic movements during the late- and postglacial 13,000–500 b.c. (see K. Strand Petersen, this volume). As a result, today the prehistoric coastlines are exposed and lying far inland in northern Denmark, while the opposite situation is the case in Central and South/South-West Denmark; here late glacial and Mesolithic coastal sites are now submerged, and are either completely eroded away or very difficult to discover. In these areas of Denmark excavation of such sites is only possible by means of underwater archaeological techniques (Mertz 1924. C. Christensen 1982).

That these eu- and isostatic changes, and thereby the old coastlines, have a special interest for archaeologists is connected with our present knowledge of the settlement pattern of Mesolithic man: the coastal sites of the Kongemose (6,000–4,600 b.c.) and the Ertebølle cultures (4,600–3,200 b.c.) always lie adjacent to the beaches, the shallow water off the sites frequently producing immense numbers of wasters and artifacts – either because the adjacent waters have been used as a sort of 'dump area' or because the material has been washed out by wave action or high tides.

So far we just have very few traces of late glacial and Boreal coastal sites in the south Scandinavian area (L. Larsson 1983: 283–301). If we turn our attention to the Kongemose and Ertebølle periods the situation is quite different, which is understandable because the late Mesolithic coastlines are just 1–10 m below modern sealevel.

From the Ertebølle period we have several regional studies clearly indicating that the number of submerged sites are in hundreds or thousands in the south-southeastern parts of Denmark (Fischer & Sørensen 1983, Skaarup, 1983).

This environmental factor explains the special distribution of the Ertebølle-sites, and why the well known coastal sites are all found in the north-northeastern part of Denmark. These circumstances must always be taken into consideration in studies concerning the extension and the settlement-pattern of this culture.

That the southern part of Denmark has had a coastal settlement also, is shown by incidental finds, which have appeared from dredges of harbours etc. (Mestorf 1904, Norling-Christensen & Brøste 1945).

In many respects this situation is very unsatisfactory; we are not only lacking the most basic information of the Ertebølle Culture in this area, but the lack of excavated sites in such a large part of Denmark makes it very difficult to identify regional differentiation and influences/contacts between late Mesolithic cultures in Denmark and contemporary Neolithic cultures further to the south on the Continent (Andersen 1973).

History of investigation

It has therefore long been desirable to examine Ertebølle settlements in this part of Denmark. In view of this, the discovery in 1978 of a hitherto unknown submerged Ertebølle settlement in Tybrind Vig (Danish vig = cove or small bay), in western Fyn, aroused particular interest. The settlement, discovered by amateur divers, lies today on the seafloor some 250 m from the present day beach – an indication of the position of the prehistoric coastline (fig. 1).

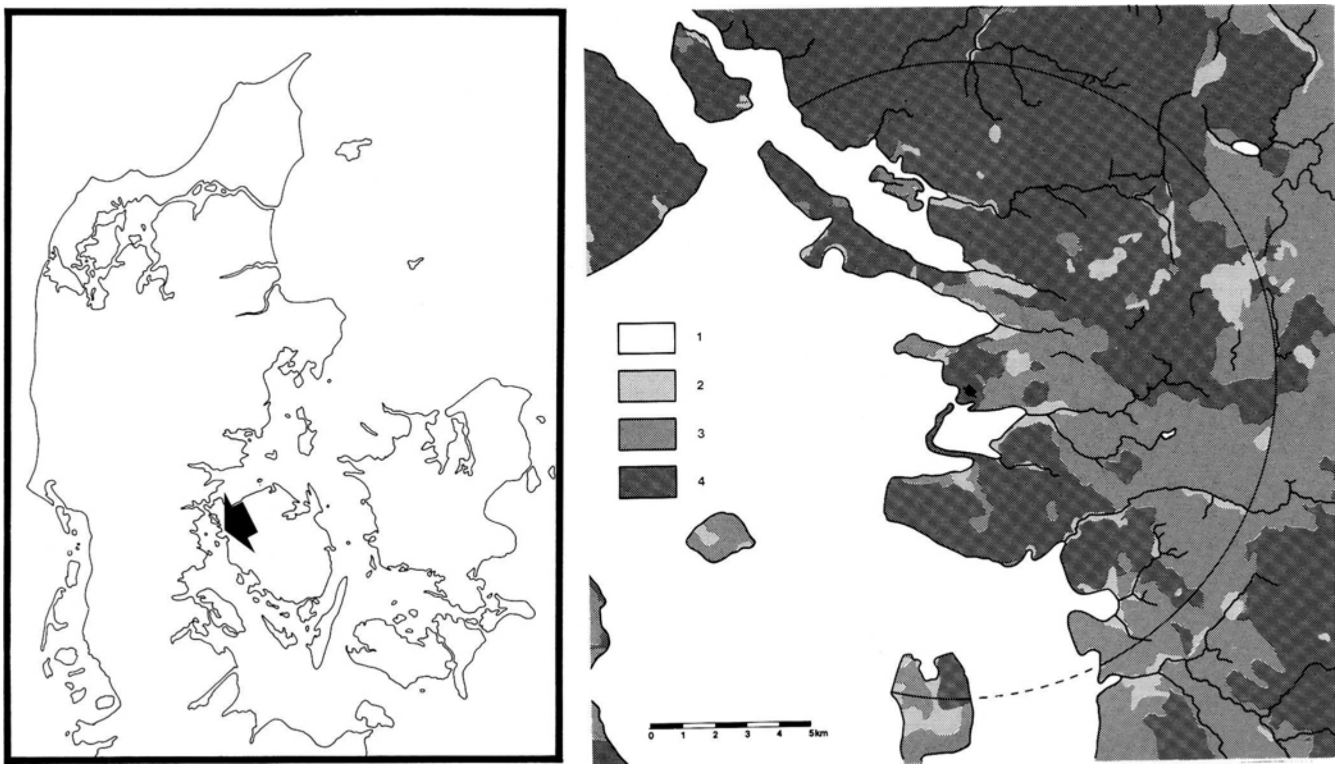


Fig. 1. The position of Tybrind Vig and the distribution of various resource types and coastline c. 3,200 bc (conv. C-14 years). (1) Sea and freshwater lakes. (2) Waterlogged areas. (3) Sandy soil. (4) Other soils. (Elsebeth Morville *del.*)

A trial excavation revealed that the seabed consisted of a layer of 1–2 m deep, undisturbed gyttja with artifacts, animal bones, antler, wood, leaves, fruits, seeds, and branches of trees and tree trunks. The gyttja layer – a prehistoric marine sediment – had been deposited just outside of the habitatin area (in the calm basin during a gradual rise in sealevel).

The position of the site indicates that the Tybrind area has sunk 2–3 m since the late Mesolithic, meaning that all items that, for whatever reason, ended up in the gyttja of the bay, have always lain in wet surroundings. Conditions of preservation for organic materials are therefore the most ideal yet encountered, as will be seen from the following.

As it became apparent that the site was unique, excavation was undertaken and subsequently developed into the first and largest systematic excavation of a submerged settlement ever carried out in Denmark. Therefore, we litterally had to start from "the bottom": to develope the nescessary technique and equipment and to solve a lot of problems, mainly technical ones, and to learn by our own mistakes. In addition, there was the big overriding question: Was it at all possible to accomplish an underwater excavation in Danish muddy and stormy waters? The answer is yes, but it took a lot of time, money, mistakes and experiences, and it has only been possible because the gyttja layer is soft, but nevertheless firm, while the waters of the cove were relatively calm (1).

Excavation

The excavation was carried out by frogmen at a depth of 2–3 m (fig. 2–3). Very quickly we found out that work had to be organized almost as on dry land, though with a few exceptions. A measuring-system was laid out and nailed in a fixed position on the sea floor. In other words, individual square meters were excavated and all finds were plotted three dimensionally with absolute depth measured relative to average sea level. The actual excavation was performed either by meticulous scraping with trowels or by careful "waving" or "whisking" of the hand. Very fragile finds were always exposed and excavated by means of a water spray, and recorded *in*

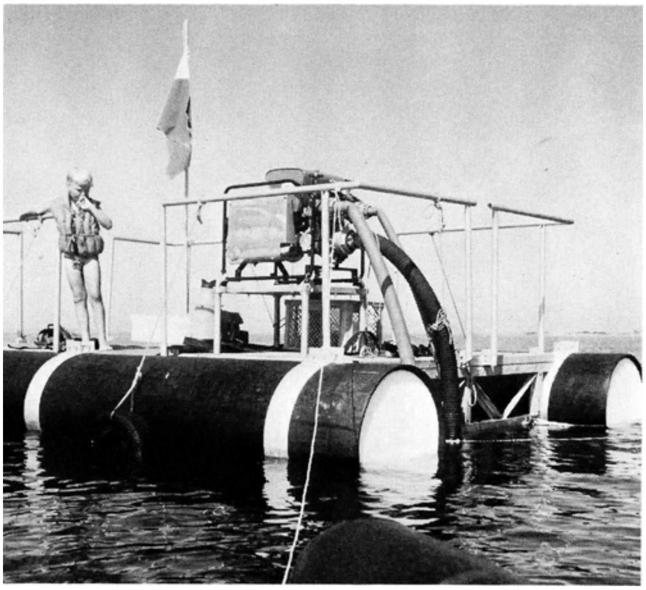


Fig. 2. Pontoon positioned over the site which lies c. 3 m below the surface of the water. The steel platform which measures 5 × 4 m carries a compressor for the pumps used to clear the digging area on the sea floor. (Photo S.H. Andersen)

situ before lifting for conservation. During work the squares were cleaned by means of pumps connected to a compressor mounted on a pontoon positioned over the site by means of large anchors in the four corners, fig. 2. Because of the composition of the deposits, vertical sections of the 1.5 m of organic layers could be cut and maintained – not only during a whole summer's campaign, but also from year to year. Horizontal plans and sections were measured and drawn, and C-14, pollen, seed, and wood samples were taken (fig. 5).

Today, after 7 years of work – c. 100 m^2 have been excavated which corresponds roughly to 20% of the site (fig. 4).

Tybrind Vig in the Mesolithic

About 6,000 years ago the inner part of Tybrind Vig was presumably very different from today and formed a large, bowl-shaped cove, cut off and well-protected from the Little Belt by a semi-circular reef or chain of small islands (fig. 1). The surrounding area was covered by dense oak forest, with sporadic lime, elm, and fir. Hazel, elder, and birch thickets lined the shore of the bay. In the Mesolithic the bay was a calm, shallow area surrounded by reeds (2). Only to the northwest there was a connection with the Little Belt, through a narrow opening which can be seen on the sea bed today as a deep, steepsided channel, originally cut by tidal erosion (fig. 1).

From the hilly areas to the east several freshwater streams had their outflow in the cove, whose water must have been brakish. Just at the opening, it was salty enough for molluscs as indicated by many shells of marine molluscs in the deposits of the cove.

Other Mesolithic sites have been found along the shores of Tybrind Vig. They all belong to the Ertebølle Culture (Albrectsen 1960: 147–151).

The site (arrow on fig. 1) was situated on the southwestern end of a peninsula, just at the opening which connected the cove with the open sea. This was the most suitable position for hunting, both in the surrounding forest and out on open sea, as well as for

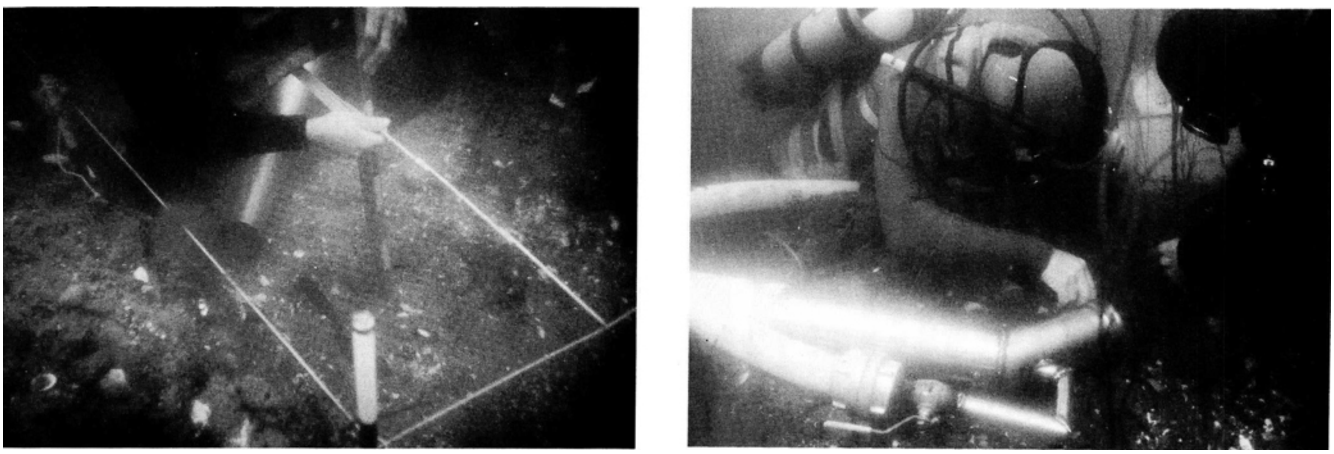


Fig. 3. Excavation by frogmen on the sea floor. (Photo H. Dal)

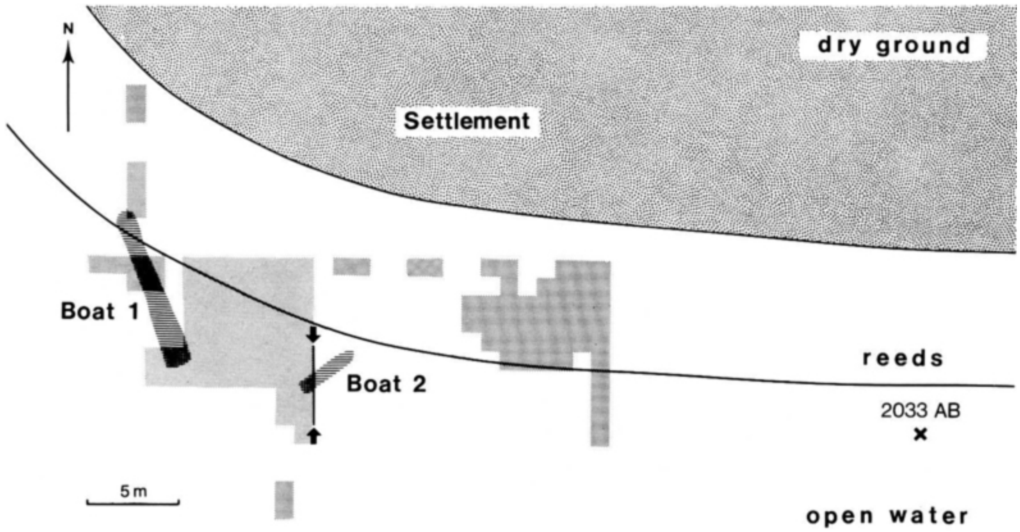


Fig. 4. Plan of the excavated area (shaded) and the position of the two boats in the reed area just outside the prehistoric seashore. (J. Kirkeby *del.*)

gathering and fowling. Next to the settlement was the channel, bay, and sea with all their possibilities for fishing.

Unfortunately, most of the habitation area has been eroded away when the site was flooded by the sea; only a part of the northwestern settlement area remains, as well as the beach, and the deposits from the shallow water off the coastline. 'In situ' finds occur in the marine layers in a zone some 50 m long (E-W) and 10 m wide (N-S) along the shore of the former bay (fig. 4). These finds consist of a mixture of discarded waste and tools, which were primarily fishing equipment lost in the bay during use. Along the shore there were traces of thick posts and a cobbled area going from the site out through the reeds, probably functioning as a dock for the beaching of boats (fig. 4). Also rows of pointed hazel sticks were found placed vertically, probably the remains of fish traps, and in at least one place, several leister prongs were found standing vertically or at an angle, presumably lost during fishing outside the reed area. In addition, several fish hooks were recovered. Everything here suggests the presence of an Ertebølle 'fishing location' which lay just off the settlement (Andersen 1980). Thus, this area was not just a "rubbish deposit" – a midden – of the sort known from many other huntergatherer settlements, but a combination of inshore fishing "activity area" and scattered settlement refuse.

Stratigraphy

The marine sediments deposited in the shallow waters adjacent to the site reflect a gradual rise in the prehistoric sea level during the period of occupation. However, it is not possible to say whether this was a continuous process or not. The bottom part of the section is made up of intermixed layers of sandy gyttja with marine molluscs, large boulders, branches, and tree trunks, while the top horizon consists of a thick homogeneous layer of fine, brown gyttja without sand, and with fewer mulluscs (fig. 5).

The explanation of this difference in sediments and what it means in terms of environmental change is so far unknown.

An analysis of the sections demonstrates that they probably reflect two or three well defined horizons of big stones, tree trunks and archaeological material. These levels, which are easily distinguishable – both as a horizontal and a vertical stratigraphical series (fig. 5) – most probably reflect a series of stages (beaches) – each attached to a period of occupation – during the gradual rise in sea level.

Dating and cultural context

The finds reveal that the site belongs to the Ertebølle Culture, and the C-14 analysis delimits the occupation from 4,600 to 3,200 b.c., i.e. the whole Ertebølle period.

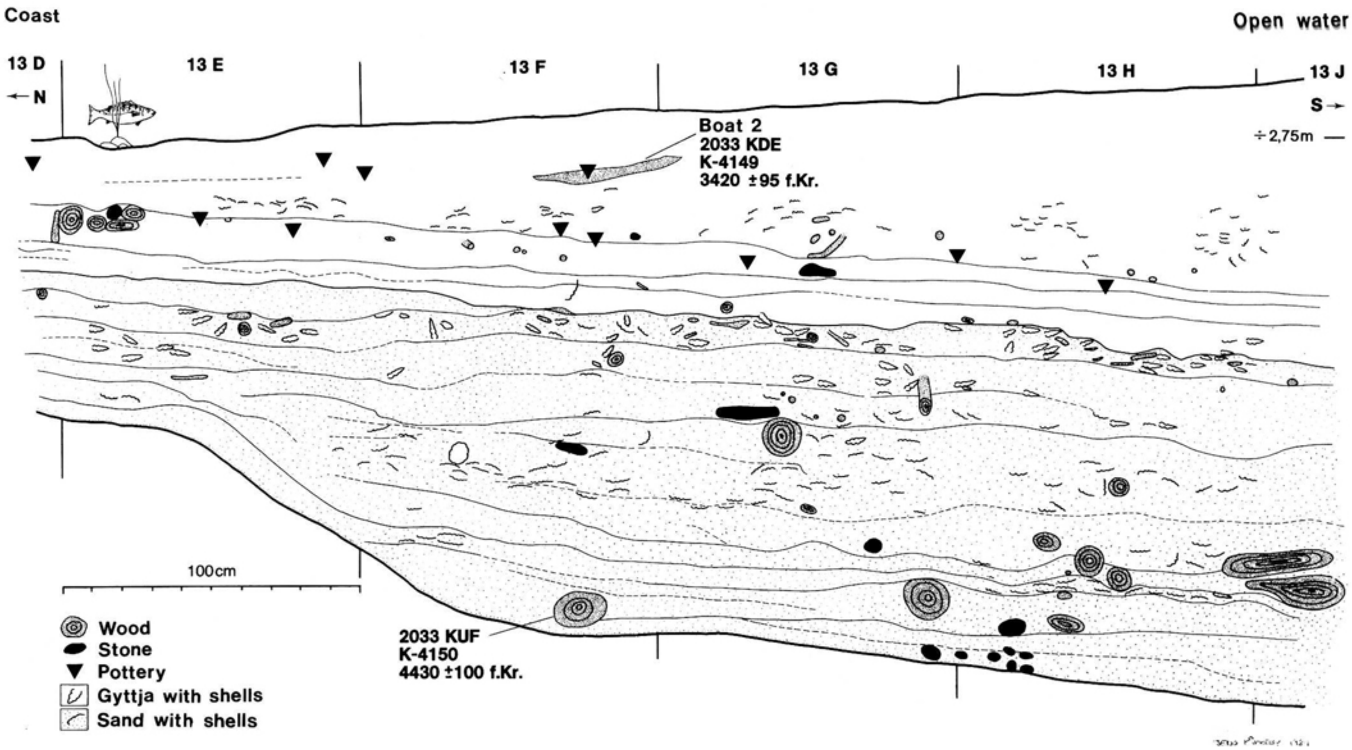


Fig. 5. N-S section through the marine deposits at right angles to the shoreline. The finds of Ertebølle pottery are plotted on the section (triangles), and the position of Boat 2 is indicated. The position of the section is indicated by arrows in fig. 4.

The deepest part of the cultural horizon contains artifacts belonging to the early or "aceramic" Ertebølle Culture, 4,600–3,700 b.c., (Dyrholmen I), while other finds, from the upper part of the gyttja layer, indicate that the site was also visited after the knowledge of pottery-making reached the area in (or around) 3,700 b.c., and right through the "ceramic" or younger, Ertebølle (Dyrholmen II) until the transition from the Mesolithic to the Neolithic c. 3,200 b.c. (Andersen 1980).

Anthropological evidence

Turning to the occupants themselves the scattered bones of at least 2–3 individuals were found, and among these, were several cranial fragments, one – probably male – with two (healed) lesions. This feature is known from other Ertebølle males skeletal remains, i.e. Korsør Nor (Norling-Christensen & Brøste 1945), and is probably an indication of stress and growing competition for land and territory in the Ertebølle period. In accordance with observations at the Ertebølle cemetery at Bøgebakken these scattered bones are best explained as the remains of an Ertebølle cemetery situated on the site, and have been eroded during the rise in sea level (Albrethsen & Brinch Petersen 1976, 1977).

This was confirmed by the finding of an inhumation grave of a young female (15–17 years) with a newborn child (1–3 month) on the remaining part of the settlement area proper (fig. 6). They have been buried in a shallow pit – the female laying in extended position with the child across her chest; unfortunately without any gravegoods. Analysis of the skeletons did not give any indication of the cause of death.

A C-14 sample dates the adult to about 4,490 b.c. (K-3558) and she is therefore one of the oldest mesolithic skeletons from Denmark (Andersen 1984b). Contemporary (and identical) graves of young females with children are also wellknown from Bøgebakken (Albrethsen & Brinch Petersen 1976: 9–10).

Analysis of the stabile isotope ^{13}C from the bones of the young female indicates that her food mainly was composed of a marine diet, i.e. fish, shellfish, seals etc. (Tauber 1981).

Our knowledge of *personal ornamentation* of the occupants of the site was extended by the finds of perforated

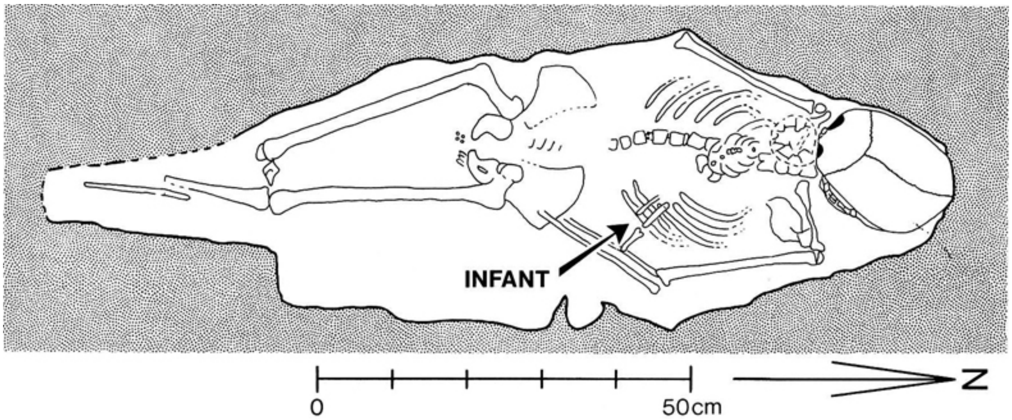


Fig. 6. Plan of the grave with the young female and the infant. (J. Kraglund *del.*)

teeth of wild boar and red deer (fig. 8) (Andersen 1984c, fig. 19).

Economy

The subsistence was based on hunting, fishing and gathering. This is well-documented by the many artifacts connected with hunting and fishing and by large numbers of animal bones, mainly of mammals and fish, while birds are few (3). In addition there are many mollusc shells, hazel nuts, and acorns. The only domesticated animal is the dog. Red deer and wild pig were the most common animals, roe deer were frequently hunted, while elk and aurochs are represented by only a few bones. Fur-bearing animals were also killed: pine marten, wildcat, fox, otter, badger, and polecat. It is interesting, that the proportion of fur-bearing animals is very high, as it is also the case in some of the other Ertebølle sites i.e. Ringkloster (pine marten) (Andersen 1975). In almost all cases the bones of fur-bearing animals lay in clusters, each representing a single animal, and hereby clearly indicating, that these animals were not eaten. Clear cutmarks on the mandibles and upper parts of the skulls were probably caused by the flint knives used for skinning; symmetrically placed depressed fractures on the rear of the skulls being either caused by the traps with which the animals were caught or stemming from the implements used to hold the animal in a fixed position during the skinning, (fig. 9).

It is remarkable that the majority of the bones from the fur-bearing animals, especially the pine marten, are only found in the top layer (gyttja). At present, however, it is impossible to tell whether this is a reflection of a general shift in the economic activities of the site, or just an "episode".

Seal, porpoise and whale were hunted at sea, and along the coast, some swans and ducks were captured. Despite the excellent conditions of preservation, it is interesting to note, that only a few bones of duck and swan are found.

That fishing has been of great importance is confirmed by the many technological items used for fishing, the large numbers of bones of small cod (30–50 cm), spurdog, and eel, the ^{13}C analysis of human bones, and food crust from the inside of the pots (Tauber 1981, Trolle-Lassen 1984, Andersen 1984b).

Gathering is documented by hazel nuts, acorns, and shells of oysters, mussels, clams and periwinkle.

As to the seasonality, a definite statement must await the final analysis by the quaternary zoologists. How-

fig. 7. Photo of the female skeleton partially exposed. (Photo H. Dal)

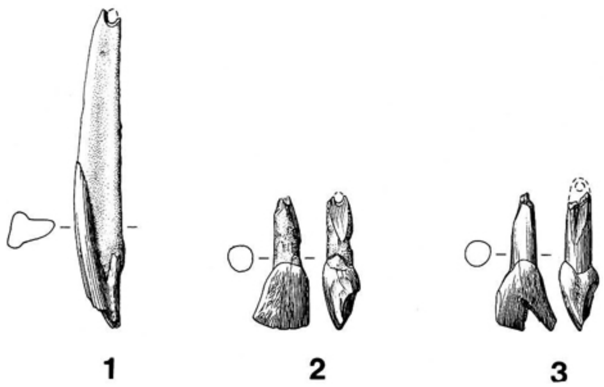


Fig. 8. Pendants of perforated teeth of wild boar (1) and red deer (2–3). 2:3. (Orla Svendsen *del.*)

ever, it is possible to state that both summer, autumn, and winter indicators are found, but it would be premature to argue for a permanent, whole year occupation.

The finds

A number of implements of flint, bone, antler and pottery of the types common for the Ertebølle Culture were found. The artifacts occur in the same types and relative proportions as known from other coastal sites covering the same time span. Due to the long duration of the habitation and the well documented stratigraphy and C-14 sequence we can observe several changes in the total artifact inventory – some of which are just gradual and minor relative changes, while others, i.e. the introduction of ceramics, are more abrupt and therefore more interesting from an cultural-historical point of view.

The flint inventory is characterised by many tools on good blades; *scrapers*, *borers*, *burins*, *truncated pieces*, and *saws* (fig. 10). Together with these types are *transverse arrowheads* and *axes* – both *flake* – and *core axes* (fig. 11). The flake axes dominate in the top layer, while the two forms are evenly represented in the bottom horizon. In addition, we have *axes made on greenstone* (Diabas). One of the differences in the flint inventary between the deepest layers at Tybrind Vig and contemporary sites in eastern and northern Jutland, is the absence of the so-called "scale worked flakes" (Andersen 1979). The lack of this type at Tybrind Vig seems to be significant and may reflect regional differentiation in the early Ertebølle.

The most interesting new artifact appearing during the habitation period is the pottery, which is found from 3,700 b.c. (fig. 5). The Ertebølle Culture is the first to introduce pottery making in South Scandinavia (Andersen 1973), and with the appearence of the earliest ceramic we find two distinctive types – *pointed-based pots* of different sizes (i.a. fig. 12) and *oval bowls* ("lamps"). The introduction of pottery is clearly reflected in the sequence of layers (fig. 5) – in which we only find ceramics in the upper part of the gyttja layer – a stratigraphical and chronological position supported by observations on other sites (Andersen 1973, 1975).

Both pointed-based pots and oval bowls were found in excellent condition – very often with layers of charred crust of foodwaste. Analyses of foodwaste from two of the pots demonstrate that the content was a mixture of grass and fish, but the main portion of the content was of an unknown substance coming from a terrestrial biotope. (Andersen & Malmros 1985).

Tools of antler and bone of the usual Ertebølle types are also common. Red deer *antler axes* were of two individually distinct types: deeper in the layer were those with the shafthole near the burr of the antler (fig. 13), while higher up, were those of the T-shaped variety with the shafthole through the base of a tine. Two of the early type of axes (dated to 4,600–4,000 b.c.) are ornamented with elaborate geometric patterns and there-

Fig. 9. Skull of a pine marten which has been skinned. The arrows point at the cut marks left by the flint knives used. (Photo P. Delholm)

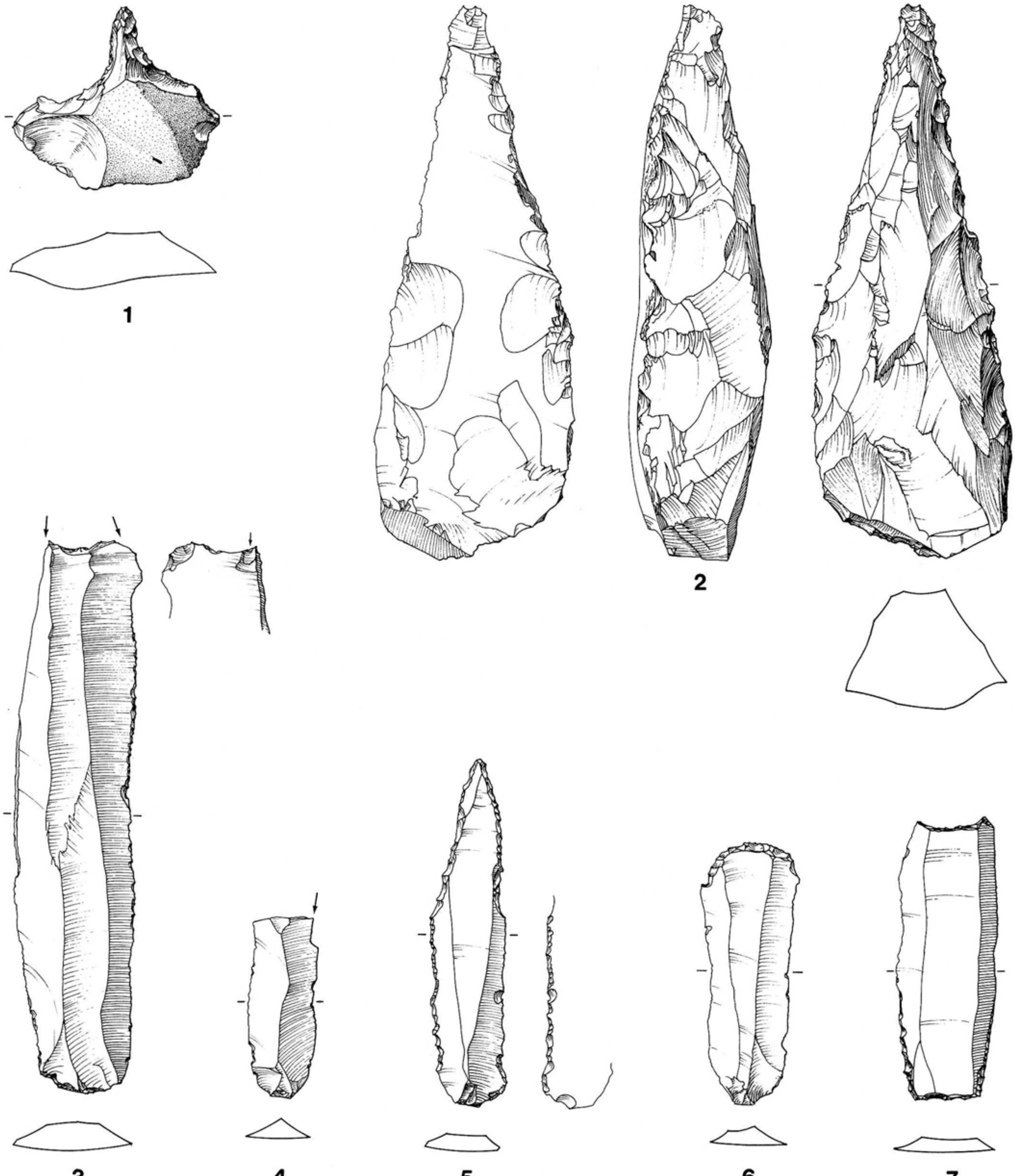


Fig. 10. Flint implements. (1) Borer on a flake. (2) Thick borer. (3) Angle burin on concave truncation. (4) Angle burin on a break. (5) Borer on a blade. (6) End scraper on a blade. (7). Blade with concave truncation. 2:3. (J. Kirkeby *del.*)

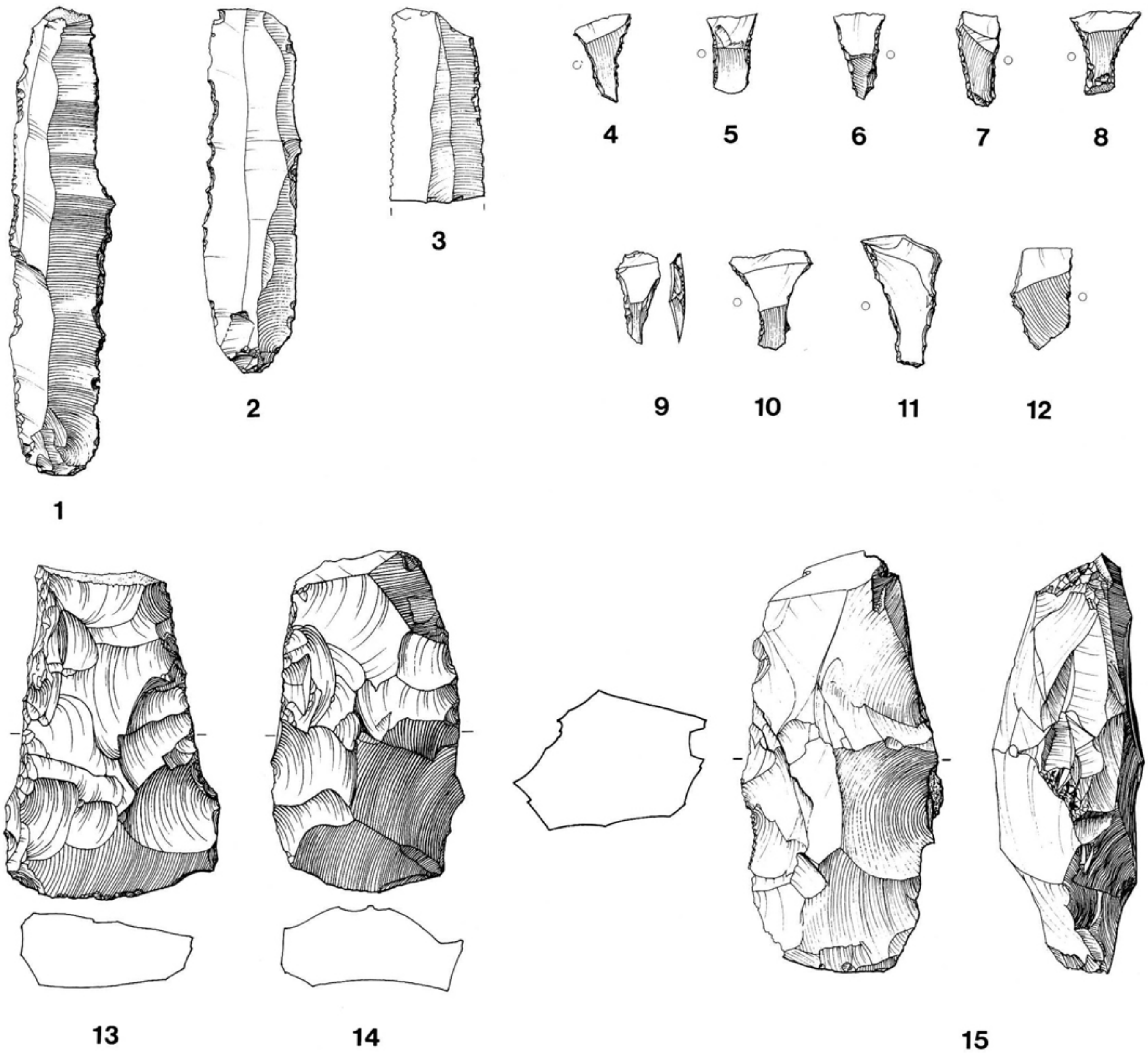


Fig. 11. Flint implements. (1–2) Denticulated blades. (3) Saw on a blade. (4–12) Transverse arrowheads. (13–14) Symmetrical flake axes. (15) Core axe 2:3. (J. Kirkeby *del.*)

with giving a good dating of the techniques and motives of antler Ertebølle art (fig. 13). Both types were found hafted on well-preserved hazel shafts. Mention must also be made of many simple round-sectioned bone points and small bone *fishhooks* (fig. 14), of which one is completely unique as it still carries a 5 mm section of the line, which is bound around the head of the hook by means of a clove hitch (fig. 14). Preliminary analysis indicates, that it is made of a plant product, perhaps bast. The knot is tied on the front of the hook. In the beginning this was thought to be accidental, but fishing with modern replicas clearly demonstrate that this placing is necessary to get the hook to stick in the fish.

Also, in this case, we find an interesting stratigraphic difference in the frequency of fishing gear. These implements (leister prongs, fishhooks etc.) are – with a few exceptions – only found in the top layers – an observation which fits nicely with the huge number of hazelsticks (parts of fishtraps and -fences) in this layer.

Again we are left with an inconclusive situation with regards to an interpretation of this observation: Does it indicate a general change towards an increased relience on fishing during the occupation period, or is this a reflection of the better preservation conditions in the top layers, or a mixture of both possibilities?

Normally the flint would dominate at such a site, but for a change, here it was the wood. The muddy layers along the former shoreline contain such large quantities of waste chips, worked wood, and wooden implements that Tybrind Vig is now one of the sites with the largest amount of preserved wood from the Mesolithic (5). The site both displays new implement types and casts essential new light on the high level of wooden technology.

The most frequent type is *leister prongs* probably lost during fishing outside the reed area (fig. 15). At Tybrind we have two variants of this type: One long and slender and another short and stubby (fig. 15). Identical forms are known from the Møllegabet site (Skaarup 1983: 148). The well-preserved *bows* are all of the same type, about 160 cm long, made from thin, split and knot-free elm trunks (fig. 16 a–b). The grip is nicely shaped and the "legs" are wide and semicircular in the crossection near the handle, while the ends are round in section. Halfway between the grip and the end of the legs is a clearly articulated "shoulder" (fig. 16 a). Tybrind, for the first time in the Mesolithic, clearly demonstrates how common the bow really was – and how frequently it broke and was discarded.

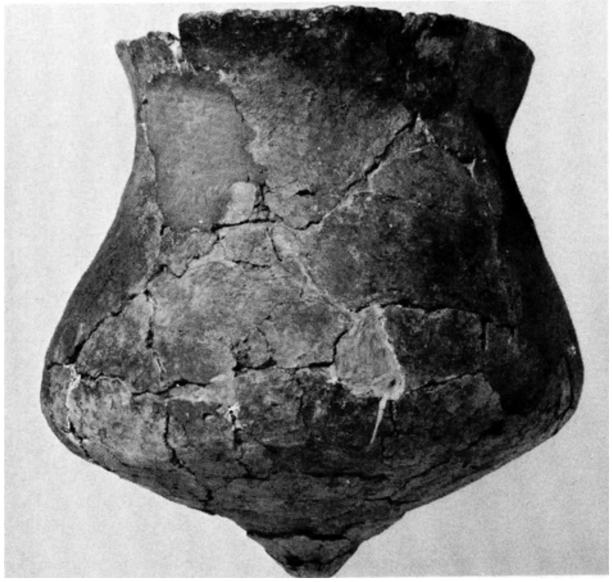


Fig. 12. Ertebølle vessel. Charred food remains encrusted on the inside of the pot were used for a C-14 analysis giving a date of 3,690 bc (K-3098). 1:5.

A *wooden arrow* (hazel) with a pearshaped point used for hunting furred animals and/or birds was also found (fig. 16c). Another arrow with a club-shaped point (hazel) is probably the front part of a composite arrow.

Two hazel sticks, round in cross-section, in whose ends were cut rectangular holes, were probably used as *thwarts* in boats (fig. 19).

Among the wooden objects there were also a *hammer*, a *fishweir* made of thin split alderbranches, a large number of long *straight stakes*, with nicely pointed tips, and several *shafts* of ash all of which were unfortunately broken. Examination of their function must therefore be left to a future date. Two of the shafts have pointed

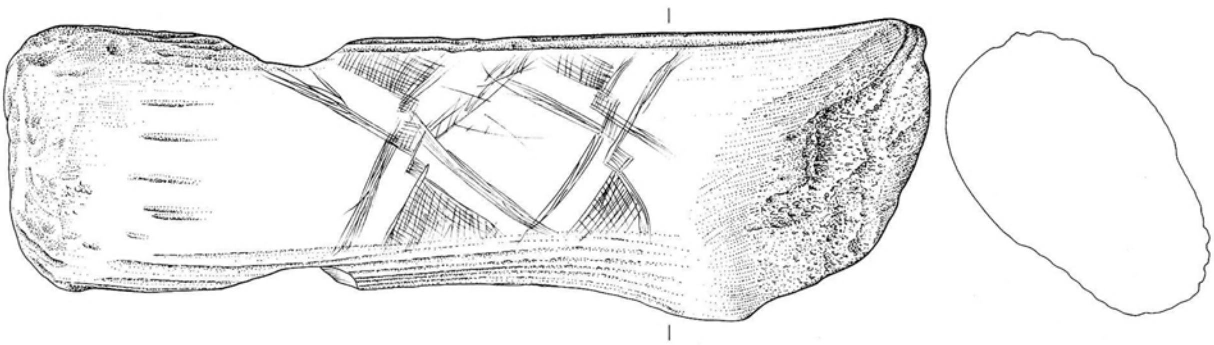


Fig. 13. Ornamented antler axe of early Ertebølle type with the shafthole near the burr of the antler. One of the very few ornamented antler axes found in a well dated settlement context. 2:3. (Orla Svendsen *del.*)

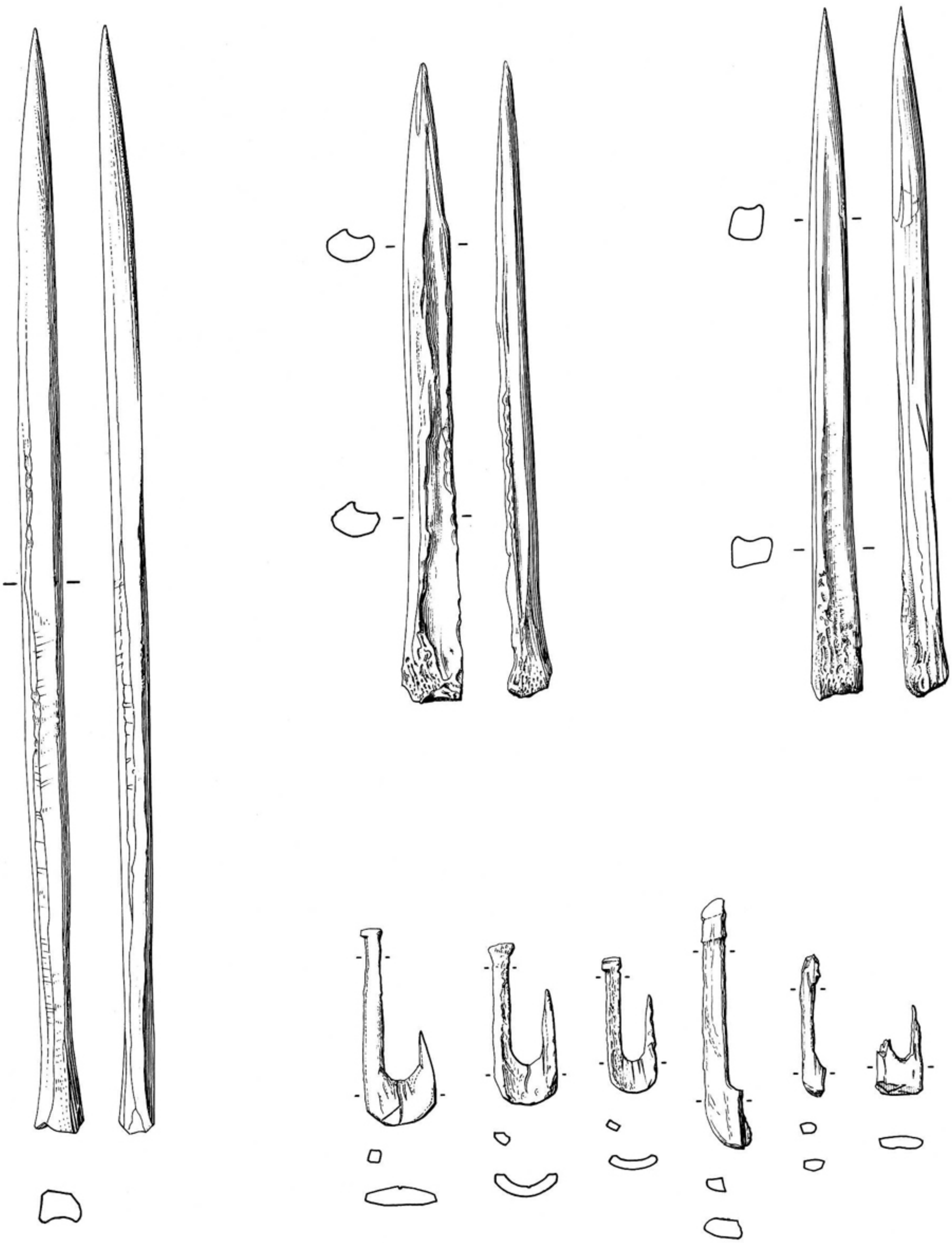


Fig. 14. Simple bone points (top) and bone fish hooks (bottom). 1:1 (J. Kirkeby *del.*)

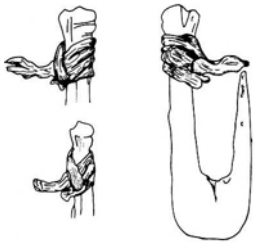
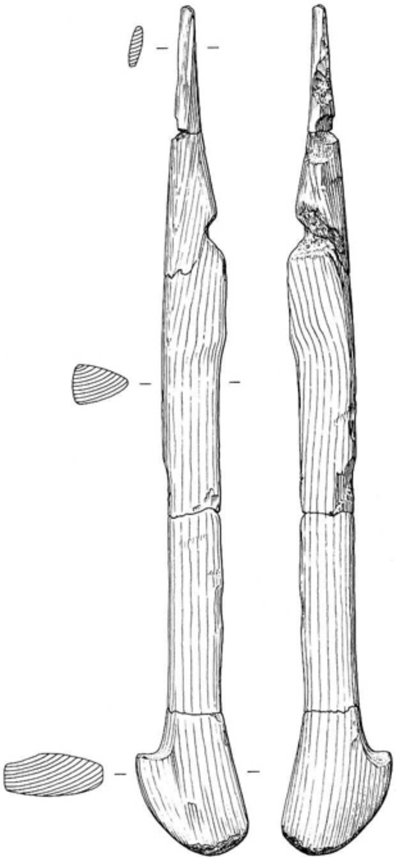


Fig. 14a. Attached to one of the fish hooks is a 5 mm section of its twine bound by means of a clove hitch. 1:1.



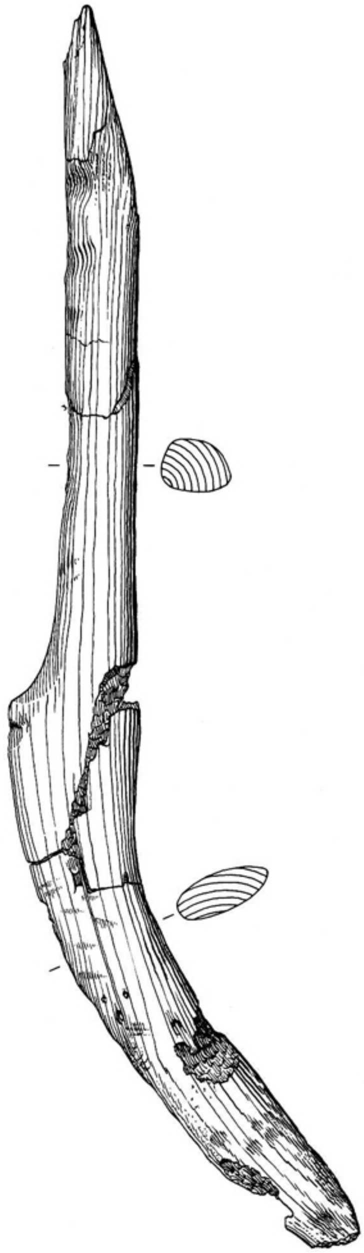
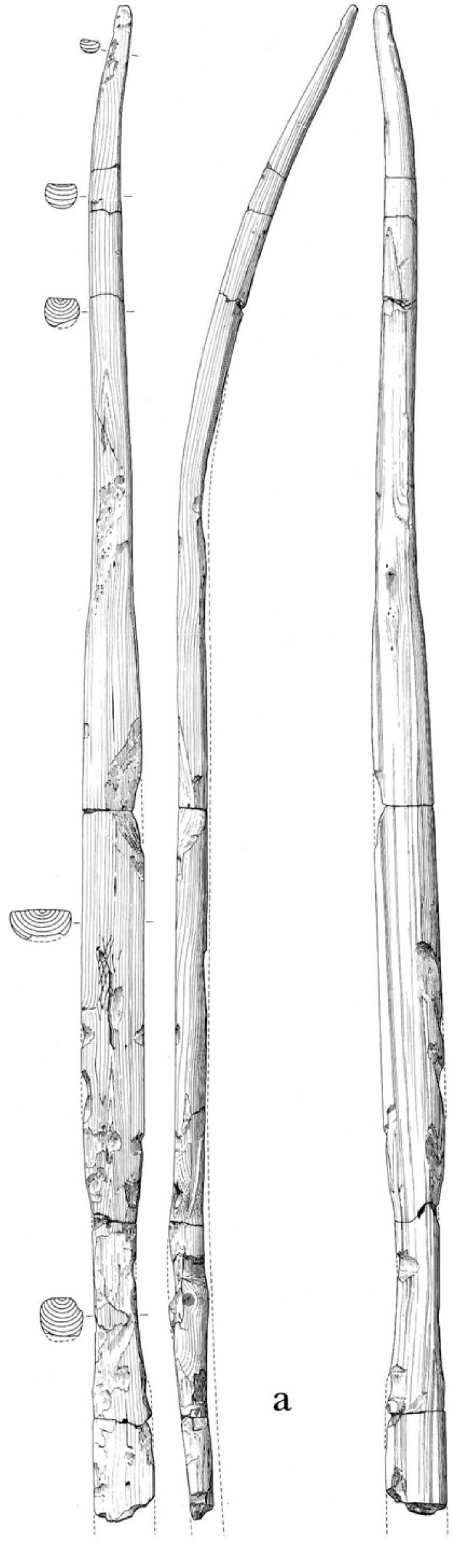
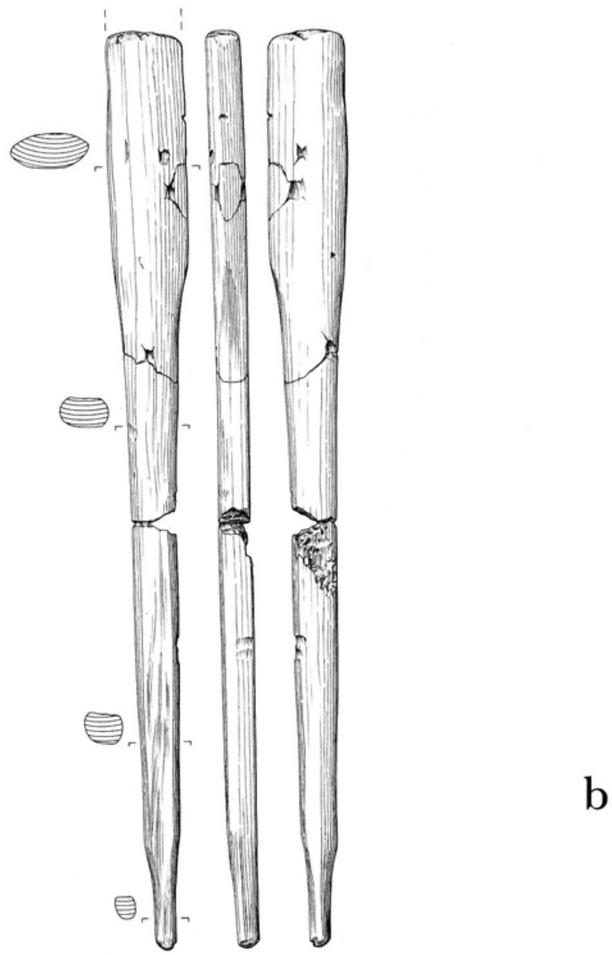


Fig. 15. Two types of leister prongs of hazelwood (*Corylus* av.). Some of the leister prongs were found standing vertically or at an angle in the mud. Presumably lost during fishing just outside the reed area off the site. 1:2. (Elsebeth Morville *del.*)

ends with a concave-convex section – a type also known from another underwater site south of Fyn (J. Skaarup 1983: 147).

The position of the site, and the many traces of fishing activities makes it obvious that the inhabitants must have sailed on the shallow waters of the cove; it was therefore not surprising that two *dug-out canoes* of the same type turned up. One of these is nearly complete (fig. 17–18) while the other is a large fragment of a stern. The "big" boat (Tybrind 1), the first whole canoe to be found in a Danish mesolithic settlement context, lay with the front end to the north-northwest and the rear





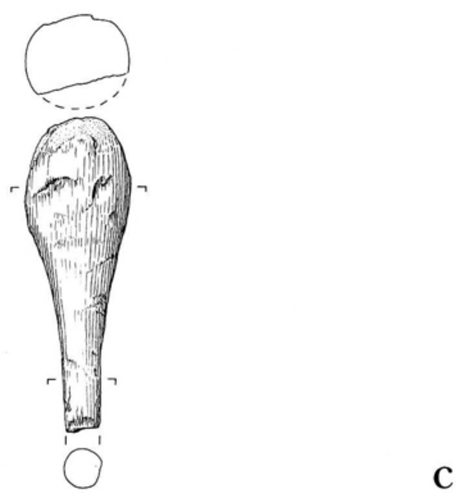


Fig. 16. (a–b) One of the bow fragments made of split, knot-free elm trunks (*Ulmus* sp.) 1:4. (F. Bau *del.*) – (c) Fragment of an arrow of hazelwood (*Corylus* av.) with a pear-shaped head. 2:3 (Elsebeth Morville *del.*)

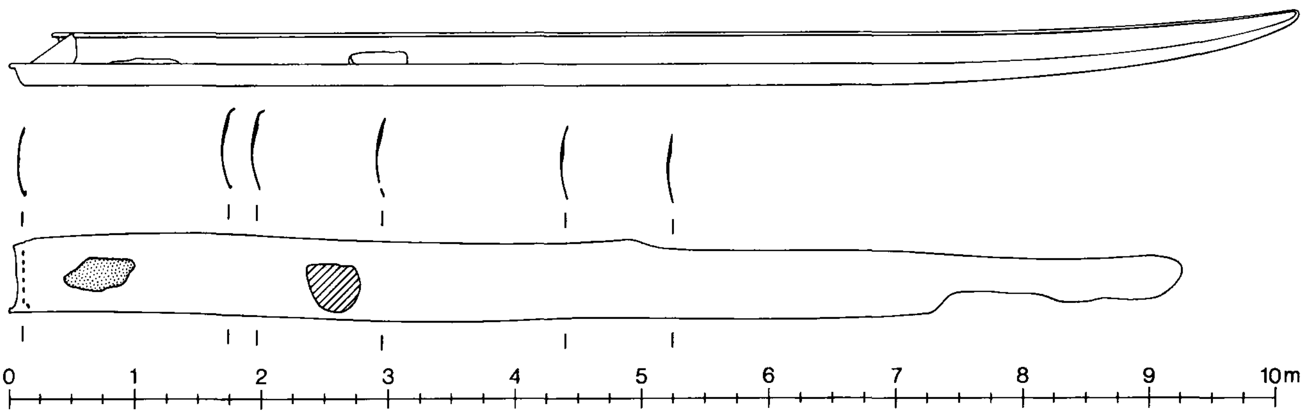


Fig. 17. Boat 1. Plan (bottom) and reconstruction (top) (Orla Svendsen *del.*).

tilting down into the gyttja, so that while the bow lay close to the surface of the sea bed, the stern was covered by about 1 m of gyttja (fig. 5). This boat is C-14 dated to 3,310 +/− 95 b.c. (K-3557).

Later a large fragment of the stern of a bigger but similar type of canoe was found (Tybrind Boat 2). This dugout also appeared in the top layer of the gyttja – a stratigraphic position supported by a C-14 dating of the boat to 3,420 +/− 95 b.c. (K-4149). The stern of this boat reveals the same typological features as Tybrind Boat 1. Both canoes are made of straight trunks of lime (*Tilia sp.*), and work was carried out with an axe or adze; chopping marks can still be seen over the entire surface.

The Tybrind Boat 1 is 9.5 m long, ca. 0.65 m wide, and with a thickness of 0.02–0.03 m (Andersen 1983). A big stone, weighing 30 kg, was found in this boat, probably put there as ballast. Despite the weight of the covering sediments, the boats are uniformly trough-shaped, with a height of at least 30 cm; the sides themselves are nicely rounded and smoothed. The stern was cut off squarely and had 7 regular holes cut out of the bottom and sides, presumably for the attachment of a board, which was not found.

An oval fireplace of sand and small stones was found half a meter inside the stern on the bottom of Boat 1 and traces of a similar fireplace were found in Boat 2. This feature is characteristic of many Danish stone age boats and is probably connected with (eel)fishing – the calm, shallow, muddy-bottomed bay must have been ideal for the use of "eel flares" in summer and autumn, an activity in which the many leister prongs would presumably also have played a part.

Such boats must have been essential items for the inhabitants – both for fishing but also for communication along the coastline and indispensable during the (seasonal) movements from site to site. Preliminary calculations indicate that such boats would have been able to carry 6–8 persons and their equipment.

Canoes of this type must have been paddled, and *paddles* were also present, some 10 examples of three different types have been recovered, several of them complete (figs. 20) (6). They are all carved in one piece from ash trunks and are of a similar type, with a short, heart-shaped blade on a shaft about 100 cm long. Blade size varies although the shape is always constant. Two of the bigger paddles are decorated on the blade (i.a. fig. 20, left). The design was cut into the surface of the wood and filled with a brown colouring matter, thereby recalling the technique used in bone and antler (Andersen 1981, 1984).

The two decorated paddles are some of the first examples of mesolithic decorated wood in Europe and such finds clearly indicate the potential of underwater sites.

The fact that we have two ornamented paddles indicates that this kind of decoration may in fact have been common. Probably many wooden items have been filled with designs. With regard to the motifs some are similar to what we know from other finds of art in bone, antler, and amber, but the dominating motifs are completely new and display a hitherto unknown kind of mesolithic art. The explanation for this is probably that we are dealing with a different material. In my opinion we should deal with different art-types (motives and

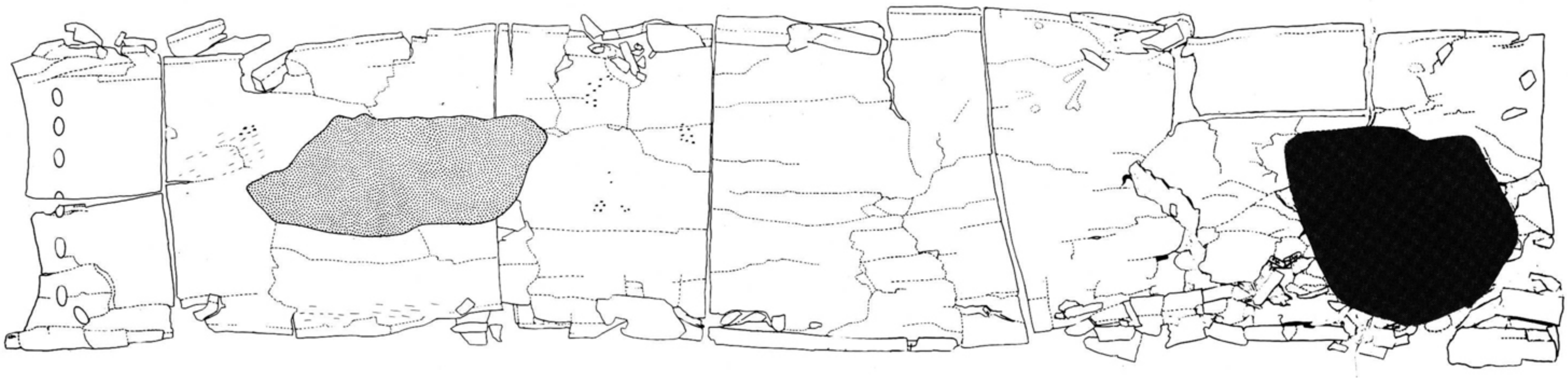


Fig. 18. The stern of Boat 1 with the fireplace and the ballast stone (dark). In the stern there are 7 holes carved out of the bottom and the sides, presumably for the attachment of a board (not found). (P. Smed Philipsen *del.*)

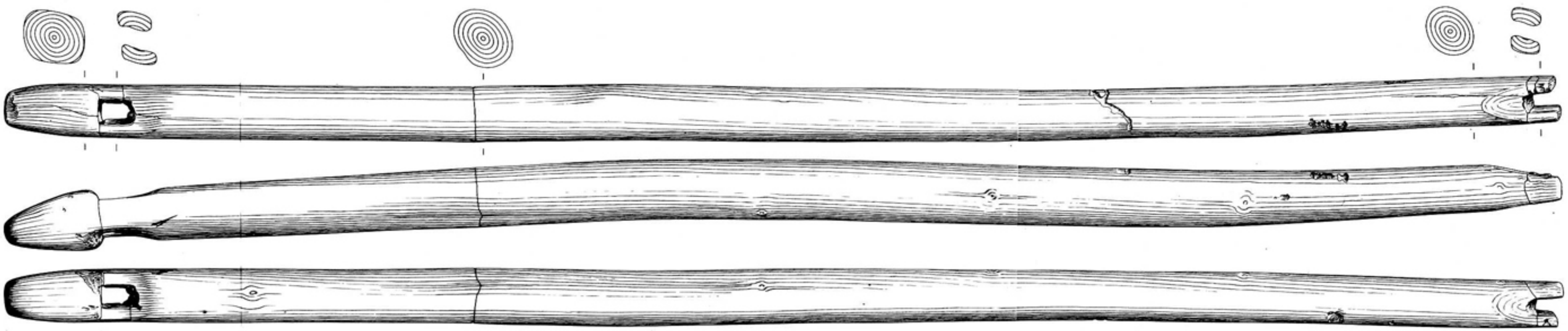


Fig. 19. An implement of hazelwood with rectangular holes in the ends, probably a thwart of a boat. 1:4 (Orla Svendsen *del.*)

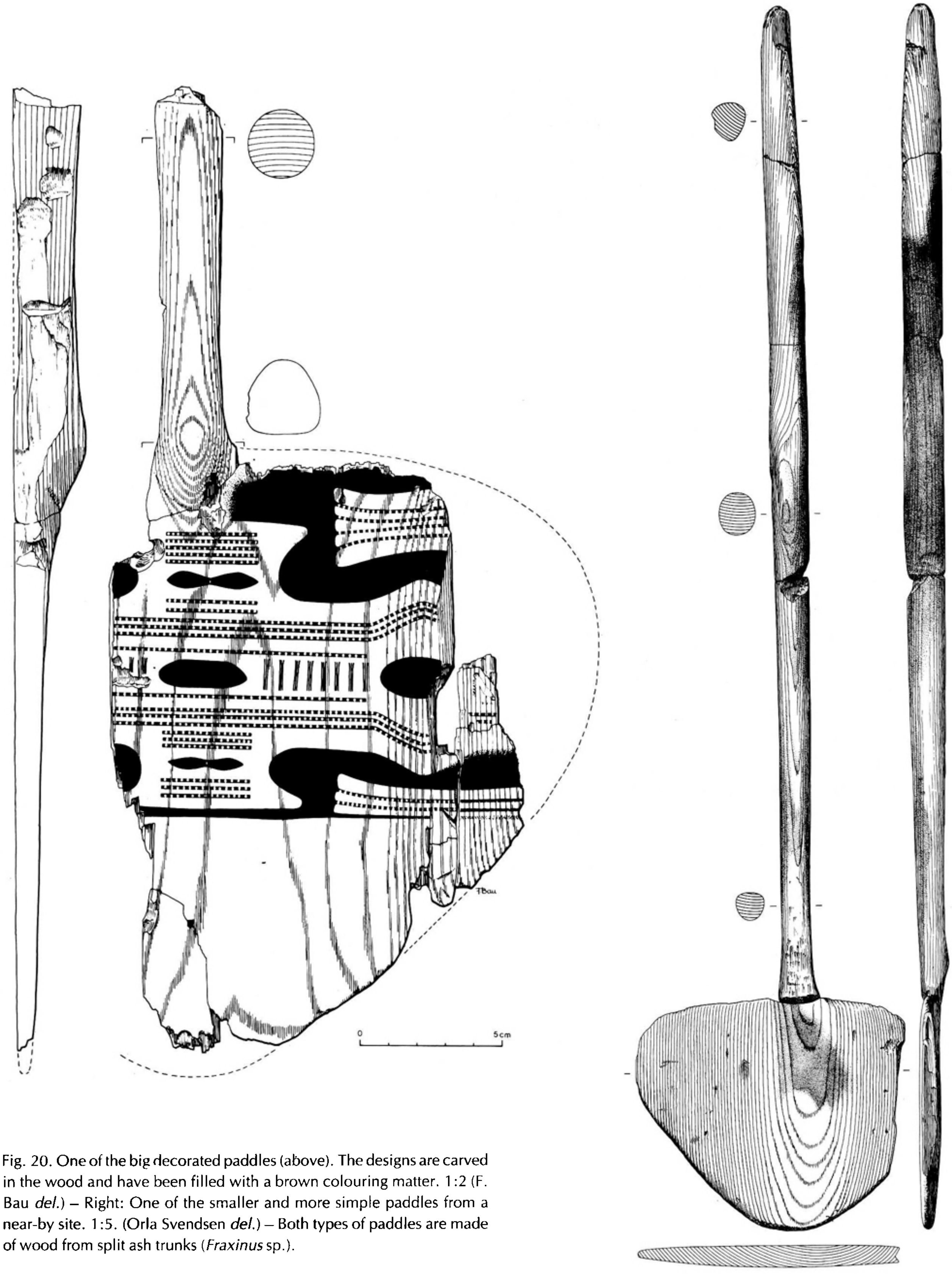


Fig. 20. One of the big decorated paddles (above). The designs are carved in the wood and have been filled with a brown colouring matter. 1:2 (F. Bau *del.*) – Right: One of the smaller and more simple paddles from a near-by site. 1:5. (Orla Svendsen *del.*) – Both types of paddles are made of wood from split ash trunks (*Fraxinus* sp.).

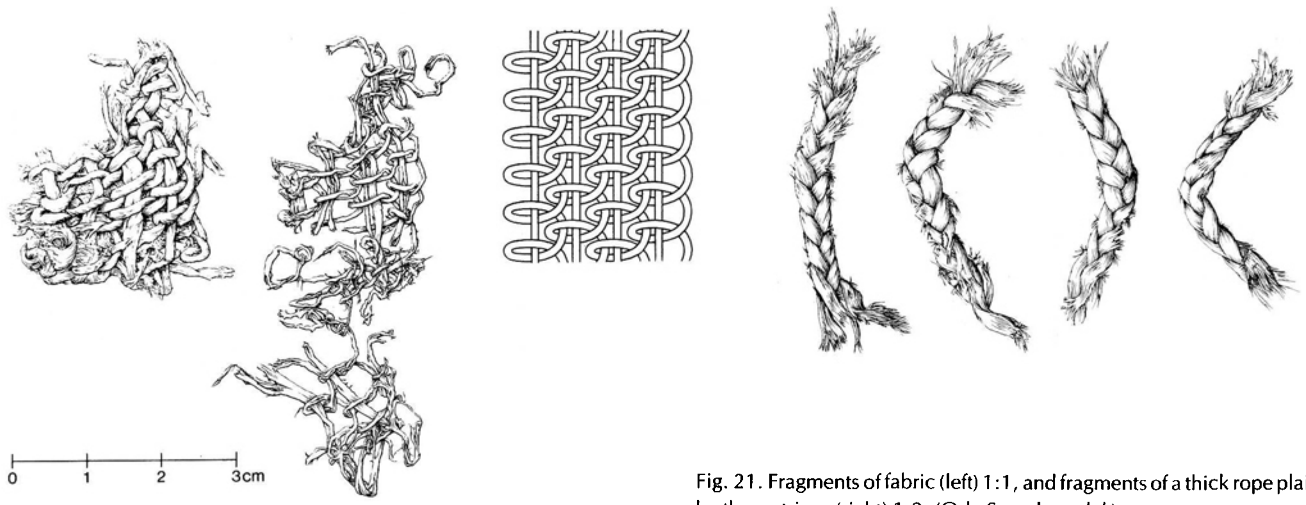


Fig. 21. Fragments of fabric (left) 1:1, and fragments of a thick rope plaited by three strings (right) 1:2. (Orla Svendsen *del.*)

compositions) in respect to the different materials.

An example of the extremely good preservation conditions for organic materials at this site is given by finds of *textiles*, and *ropes* (fig. 21). That we are dealing with a type of textiles and not basketry is demonstrated by the fact that the individual threads are spun (socalled Z-type) (Bender-Jørgensen, 1980: 4). Several small fragments (3–4 cm), each of the same type of textile, were found – all made in a technique called "needle-binding", wellknown from the Danish Bronze Age, some 2,000 years later (7). The material still awaits scientific analysis but observations suggest a type of plant fibre.

These textiles are the first from the Danish (and European) Mesolithic and give interesting insight into aspects of the material culture hitherto unknown.

It is nescessary to underline that by using the term "textiles" we are not saying anything about the origin and original use of these finds. Both clothing, belts and the like are possible origins.

Conclusion

The investigation at the submarine site at Tybrind Vig is the first systematic excavation of an Ertebølle settlement from this part of Denmark. The many well-preserved finds are significant especially because they fill gaps in our knowledge of the wood manufacturing technique.

Of great interest is the evidence of the "fishing ground" off the settlement – not just because of the good fortune involved in finding remains of *almost the complete range of equipment in one context*, (paddles, dugouts, leisters, fish weir and hooks), but more because it is possible to demonstrate that finds in the gyttja off the settlement are *not only settlement debris, but represent both rubbish and activity areas*. Tybrind Vig has therefore added a new dimension to our understanding of precisely what is found in lake and sea deposits off-shore at hunter-gatherer settlements.

The investigation has demonstrated that it is technically possible to perform underwater excavations at mesolithic sites in Danish waters. It has also shown the great potential of this type of site. If we are going to expand our knowledge of prehistoric Man, such sites may be the most profitable of all. The Tybrind site has not only expanded our knowledge of technology and material culture but the two finds of ornamented paddles have also given new insight into an art hitherto unknown. Finally, we have learned the techniques nescessary for such investigations, experiences which could be useful for other future underwater excavations in Danish or other North European waters.

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NOTES

The English text was corrected by T.G. Bibby and Brian Byrd.

1. Excavation was carried out under the direction of the Institute of Prehistoric Archeology, University of Aarhus. The daily work was performed by a group of local enthusiastic amateurs headed by Hans Dal, Fredericia, and archaeologists from the university: Jørgen

Dencker, Per Smed Philipsen, Torben Malm and Tine Trolle-Lassen.

The work has been supported by *Kreditforeningen Danmark's Fond*, The Danish Research Council for the Humanities, *Rigsantikvaren*, The ministry of Environment, and several other private donators.

2. Preliminary pollen analytical work has been carried out by Jens Ørnbøll, University of Aarhus, Moesgård.
3. The quaternary zoological investigation is carried out by Tine Trolle-Lassen, M.A., University of Aarhus, Moesgård. See also: Trolle-Lassen 1984.
4. The preliminary analyses indicated that the twine was made of sinew, but this result is today considered questionable. In the light of the preservation conditions at the site it is more reasonable to argue for some type of plant material, i.e. lime bast.
5. The wood has been determined by dr. Peter Wagner, *Botanisk Centralbibliotek*, Copenhagen, miss Jane Squirrel, and miss Veryan Heal, National Maritime Museum, Greenwich/London.
6. These implements have previously been labelled "Spades" by H. Schwabedissen (1968) and J. Troels-Smith (1960). Based on experimental archaeological tests, analysis of traces of wear, and the two new finds with ornaments, this functional explanation is refuted, cf. Andersen, 1984 a.
7. Analyses of the fabric and the technique have been performed by Lise Bender Jørgensen, University of Copenhagen.

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A Comparison of two Neolithic Flint Industries

by D. LIVERSAGE and P.K. SINGH

The purpose of this paper is to compare the flint industries of two Neolithic sites that were found as part of a study of prehistoric settlement in an erosion cliff in NW Denmark. The sites chosen are named "Penbjerg" and the "Barrel Site". They are 700 m apart and each contained a sealed and uncontaminated assemblage of flint, pottery, and worked amber. Penbjerg (1) belongs to the Funnel Beaker Culture and may be dated to the period Middle Neolithic I – a bit before 3000 B.C. according to the calibrated radiocarbon chronology. The Barrel Site (2) belongs to a local variant of the Bell Beaker Culture. The dating to 1770 bc (±85) in radiocarbon years of charcoal from the site suggests a true date late in the third millenium B.C. (K-3537).

PENBJERG

The raw material used at Penbjerg had already been to a large extent broken and when struck it often shattered instead of flaking nicely into pieces with conchoidal fracture. It was apparent that the flint was derived mostly from the ice-age deposits (till, boulder clay) which cover the area and in which flint of this kind is found. Other possible sources would have been the pebble beaches and the chalk outcrops, both of which were used at the Barrel Site, but the raw flint from the beaches is better rounded than that used at Penbjerg, and the flint from the outcrops has a clean white crust. The poor raw material influenced the character of the work at Penbjerg, in that an unusually large proportion of the implements are made on irregular pieces instead of on true flakes.

The assemblage

Table I shows the flints classified into various types and classes. It is divided into four parts. Part A is a rough overall classification of the total material. Part B shows the clear implement types scrapers, knives, borers, and burins and gives percentages both in relation to the total clear implement types and in relation to the total material. Part C shows the implement types whose classification presents difficulties. Here also percentages are given in relation to the total of clear implement types and of the total material. Part D shows waste products, or at least pieces without retouch, and the percentages are calculated as before. In our opinion this is the best way to set up a table of Neolithic flints from Denmark.

Attention should be called to the following points about the assemblage:

1. It faintly reflects the character of a blade industry, in that a number of regular blades are present and about one third of the cores can be described as poor blade cores. The blade element was, however, of a low standard, and blades were not much used for secondarily retouched implements (fig. 1, 19).

2. By far the commonest definite tool was the scraper (fig. 1, 1–6). During the initial sorting the scrapers gave the impression not of a homogenous group, but of being of two types. They were therefore subjected to a more detailed analysis using metrical procedures (see below), and it was confirmed that two (or possibly three) different kinds of scraper were being made.

3. The next commonest tool type was the flake or blade knife (fig. 1, 7–9) comprising one fifth of the finished tools. Only one was on a blade. Unfortunately flake knives often look very much like scrapers, and it is not by any means sure that different archaeologists could produce identical classifications of the same material. The class was first clearly defined by Davidsen (1979). It consists of flakes (or at Penbjerg also other fractured pieces) with a sharp edge along one side and a blunted back opposite to or more often at right angles to this edge. Davidsen pointed out that a blunted edge tends to be steeper than a scraper edge.

4. A third major tool type was the borer (or awl), comprising about one tenth of the finished clear implements. Metrical analysis (see below) suggested that there also were two distinct types of borer at Penbjerg – heavy ones on a core or thick flake (fig. 1, 10–11) and lighter ones (fig. 1, 12).

5. Burins are present, though rare. The two at Penbjerg were both angle burins on truncated flakes (fig. 1, 14–15).

6. In the less clear part of the tool-kit pieces with notch were the commonest category (fig. 1, 16). It is thought that the notch or notches have been deliberately made, but in some cases they may only have resulted from hard use. The pieces varied a good deal in shape and size. They shade over into other pieces which appear to have been irregularly retouched, but where again hard use could be the cause. Notched pieces were about as common as flake knives, other retouched pieces somewhat rarer. This part of the tool-kit included also some supposed core tools. There were a small number of long rectangular cores with a high, but narrow flaked edge at one end (fig. 1, 18). As waste cores they seemed decidedly odd, and they may have been definitely formed implements such as could be termed "narrow planes" or "core burins". Another group consisted of cores with wide flaking all down a long, fairly straight edge (fig. 1, 17). It seemed that these too might be "planes". We do not know whether they occur regularly in assemblages of the Middle Neolithic Funnel Beaker Culture or not.

7. As at all normal settlement sites the bulk of the material (86.8%) consisted of waste flakes and blades, here mostly flakes. Because of abrasion it was not possible to estimate what proportion showed signs of use. Utilisation of some of the primary flakes and blades was normal in prehistoric times – and indeed unretouched blades are not uncommon as an item of grave goods, showing that they were looked on as a definite implement. The presence of the blades (e.g. fig. 1, 19) shows that a certain residue of blade technique survived from earlier periods, when blade technique was better and blades more abundant. A particular kind of waste was the keeled flakes struck when rectangular axes were being chipped to shape before being polished (fig. 1, 13). As such flakes were rare at Penbjerg axe manufacture can only have taken place to a very limited extent.

8. The cores also show a residue of blade technique. A group can be picked out characterised by having one or more plane striking platforms from which flakes or blades were struck in parallel batches. About one third of the cores were of this kind. They shade over into other kinds of core without clearly intended striking platforms and with flakes struck in a greater variety of directions. Many such cores tended to be somewhat flat with flakes struck from the perimeter in towards the middle. Others however were so irregular or rudimentary that it is hard to say anything more about them.

9. One last point is to call attention to a puzzle. The last flakes struck from most of the cores before they were thrown away were too small to have been any use as blanks for the tool types found. No doubt at an earlier stage the cores had given blanks suitable for scrapers, knives, notched pieces, etc.; but the inhabitants continued to strike flakes after the cores no longer had any potential for producing suitable blanks. There seem to be two possible explanations, either the cores themselves were tools and this last flaking was a form of retouch (which seems unlikely), or else the inhabitants as a silly habit just kept on striking.

Metrical analysis of scrapers and borers from Penbjerg

The subjective impression that the scrapers from Penbjerg were not a homogeneous group inspired a closer examination to explain that impression. 59 suitable scrapers were measured, and weighed. Weight is the simplest way to measure total size. The lengths and breadths are shown in the scatter diagram (fig. 3), which also shows which scrapers were made on flakes and which on irregularly broken pieces. It will be seen that as well as the main group there is a compact little group very homogeneous in its dimensions, consisting of scrapers with lengths 3–4.6 cm and width 1.9–3.0 cm. This group consists almost exclusively of scrapers made on regular flakes. The main group consists of scrapers ranging from 4.2 to 7.6 cm in length and 2.1 to 6.9 cm in width. The majority are on rough pieces of flint, but examples on flakes also occur. Four exceptionally large scrapers could be regarded as a third group, but in our opinion their size is due to the peculiarities of the raw material and they were not really a separate tool type. Some scrapers were more than twice as long as they were wide. This does not reflect a blade component, as the implements in question were only made on irregularly fractured pieces, but it does show the great variation in the shape of these scrapers.

The same scrapers are shown in fig. 5, above, arranged according to weight. Here also a separate group of small scrapers shows up. These weigh under 20 g and are the same individuals as are indicated as a separate group in the scatter diagram. It seems therefore clear that the inhabitants were aiming at making two dif-

		number		% of clear implements	% of total pieces
A	total number of pieces	2083			100%
	of these tools or utilised	133			6%
	cores	118			6%
B	scrapers	59	65	68%	3.1%
	broken scrapers	6			
	(scraper roughouts)	(3)			
	flake or blade knives	18		20%	0.9%
	borers	10		10%	0.5%
	burins	2		2%	0.1%
	total of clear implement types	95		100%	
C	notched pieces	20		21%	1.0%
	pieces with miscellaneous retouch	7		7%	0.3%
	"planes", broad	20		21%	1.0%
	"planes", narrow	5		5%	0.2%
D	scraper roughouts	3		3%	0.1%
	keeled flakes from preparation of axes	3		3%	0.1%
	flakes struck from polished axes	3		3%	0.1%
	unretouched regular blades	67		69%	3.2%
	waste flakes	1742		1815%	83.7%
	cores: with residual blade technique	36			
	flattish	28	118	122%	5.7%
	not further classified	54			
	total	2083			100.0%

Table I.

ferent implement types within the category we call scrapers. One is represented by fig. 1, 1–3, the other by fig. 1, 4–5. It may be supposed that they had separate functions, that there were different words for them, etc.

One had a similar subjective impression that the borers fell into two groups. Owing to the small number, the result is not so clear as with the scrapers, but the weight distribution does suggest two different classes of implement. One group consisted of rather slight implements, mostly on flakes (fig. 1, 12) and the other of much heavier borers on shattered pieces or core fragments (fig. 1, 10–11). The diagram of weights, fig. 6, shows two different groups, one weighing around 10 g, the other around 50 g.

THE BARREL SITE

The usual raw material at the Barrel Site was drift pebbles with well-rounded surface. A few pieces showed very fresh chalky cortex, indicating that they were brought direct from the original deposits of chalk. These outcrop on the coast at Hanstholm, 40 km further north, and inland were exploited by mining in some periods, though there is so far no evidence of mining in Bell Beaker times.

The assemblage

The material is classified in Table II using the same methods that were used in Table I. The following points should be made:

1. Although there was a single regular blade and a small number of cores that seemed in principle to be blade cores, the quality was generally so poor that we may say that virtually nothing remained of blade technique.

2. On the other hand a technique of surface-covering pressure flaking had made its appearance. This technique was used to finish off fine barbed-and-tanged or hollow-based arrowheads and larger flat-flaked implements such as daggers and sickles. There were alto-

A	total number of pieces	1367	100%	
	of these tools or utilised	57	4%	
	cores	57	4%	
		number	% of clear implements	% of total material
B	barbed and tanged arrowheads	2	5%	0.1%
	hollow-based arrowhead, broken	1	2%	0.1%
	(uncompleted arrowheads, one made into borer)	(4)		
	fragment of sickle	1	2%	0.1%
	(other flat-flaked roughouts)	(5)		
	scrapers	23 } 33	79%	2.4%
	broken scrapers	10		
	(uncompleted scrapers)	(5)		
	borers, one on arrowhead roughout	3	7%	0.2%
	flake knives	2	5%	0.1%
	total of clear implement types	42	100%	
C	notched pieces	11	26%	0.8%
	pieces with miscellaneous retouch	11	26%	0.8%
D	uncompleted arrowheads	3	7%	0.2%
	other flat-flaked roughouts	5	12%	0.4%
	uncompleted scrapers	5	12%	0.4%
	a blade	1	2%	0.1%
	waste flakes	1232	2933%	90.1%
	cores: with residual blade technique	8		
	flattish	32 } 57	136%	4.2%
	not further classified	17		
	total	1367		100.0%

Table II.

gether 13 pieces with surface-covering retouch, comprising about 1% of the total material (fig. 2, 1–6).

3. Scrapers were by far the dominant tool, making up nearly four fifths of the clear and obvious tool types. They were mostly made on roundish flakes with cortex on the back (fig. 2, 7–10). In contrast with Penbjerg they appeared to be a single homogeneous group, and this was confirmed by metric analysis (see below).

4. There were only two flake knives (fig. 2, 13), but they were quite typical.

5. Borers appeared like scrapers to be a homogeneous group (fig. 2, 11–12). They were light, fairly delicate implements, one of them adapted from a roughout for an arrowhead. In fig. 6 they are compared metrically with those from Penbjerg (see below).

6. There are a number of pieces with retouch or heavy use of less clear kinds. Eleven can be classed as notched (fig. 2, 15–16) and 10 as miscellaneously retouched (fig. 2, 14 and 17).

7. As usual the bulk of the material consisted of waste flakes. A proportion of them (estimated at nearly 4%) appeared to have been used. There was only one unretouched blade. There was no indication that axes were made or re-sharpened at the Barrel Site.

8. Cores made up 4% of the total material. As already said, there were very few blade cores, and they were of such poor quality that one could dispute whether they ought to be so described at all. The commonest cores were flattish with a tendency for flaking to have been done in towards the middle from different parts of the perimenter. As at Penbjerg the cores had been flaked up long after they could give the sorts of flakes needed for scrapers and knives. Possibly some of the small flakes were wanted for light borers and arrowhead blanks, but if so the number struck was far in excess of requirements.

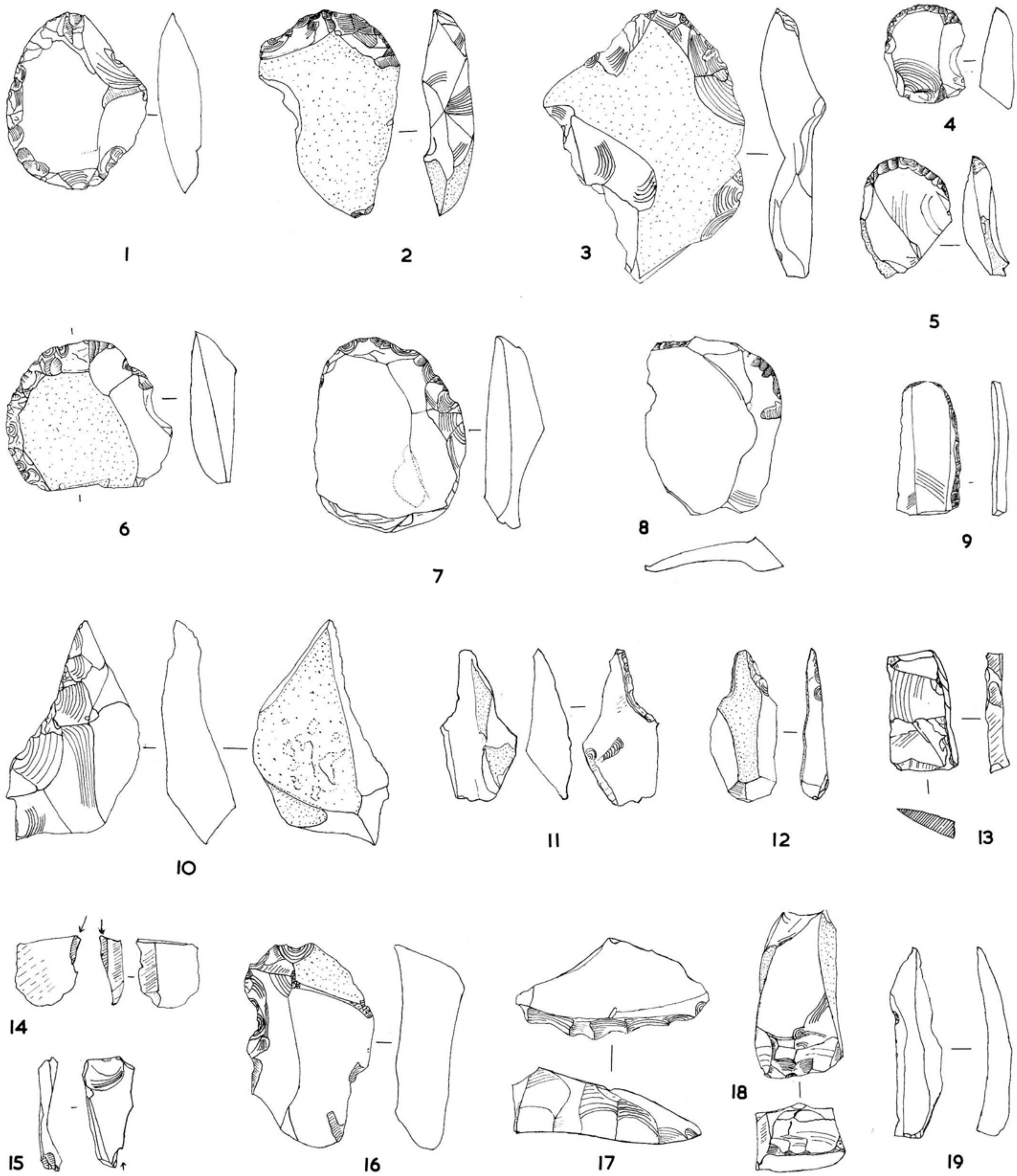

Fig. 1. Selection of flints from Penbjerg, scale 1:2. Drawn by P.K. Singh.

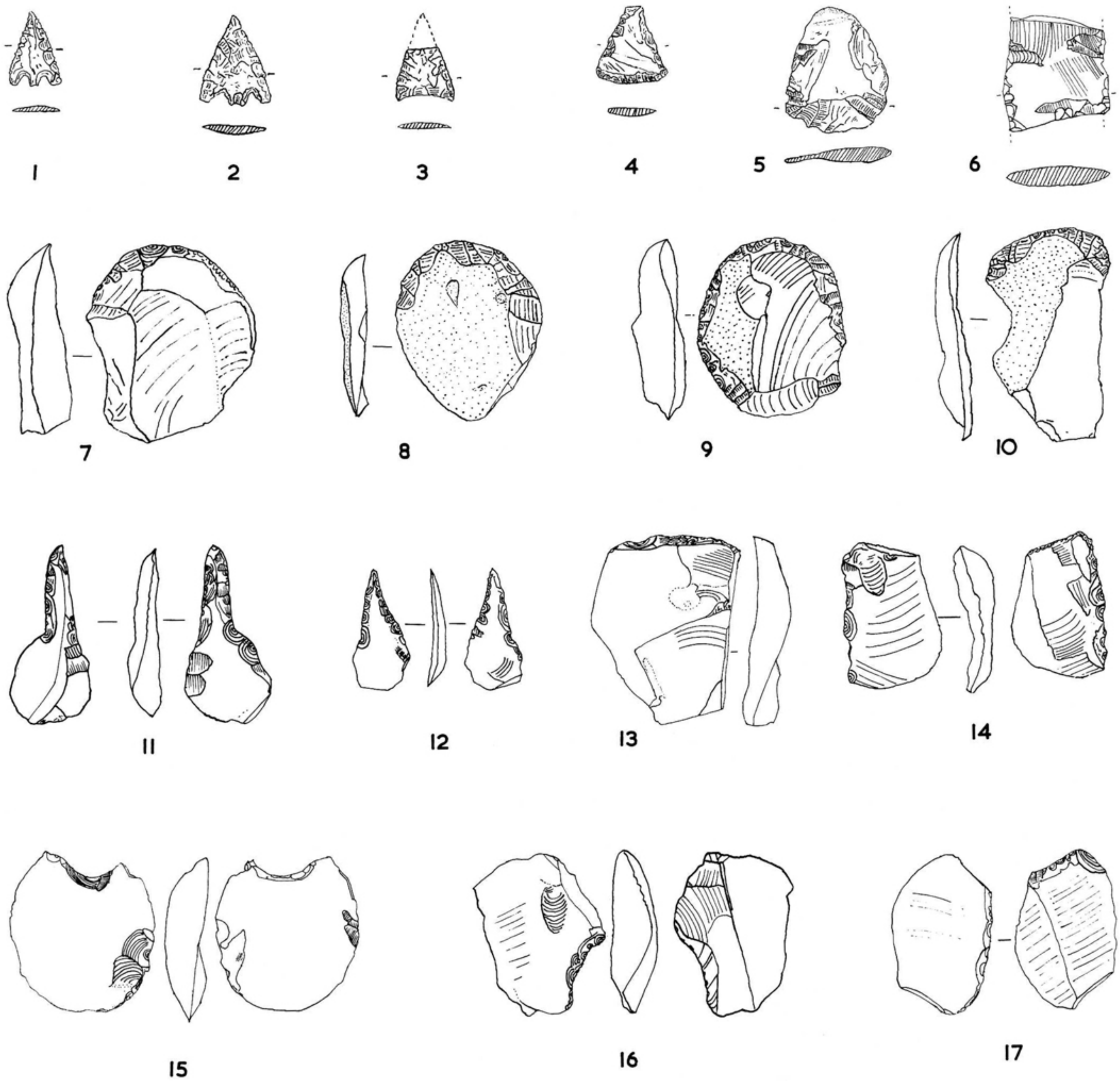

Fig. 2. Selection of flints from the Barrel Site, scale 1:2. Drawn by P.K. Singh.

Metrical analysis of the scrapers and borers from the Barrel Site

The lengths and breadths of the scrapers are plotted in fig. 4 in exactly the same way as was done for Penbjerg. It can be seen that the scrapers from the Barrel Site are a more homogeneous group. The size range is less, there are none twice as long as they are broad, and nearly all are on regular flakes. From the clustering of the dots it can be seen that there is only one type present. The same is shown by the diagram of weights, fig. 5. As for the borers, fig. 6 shows that they all are very light, but as so few are present no real weight distribution has emerged.

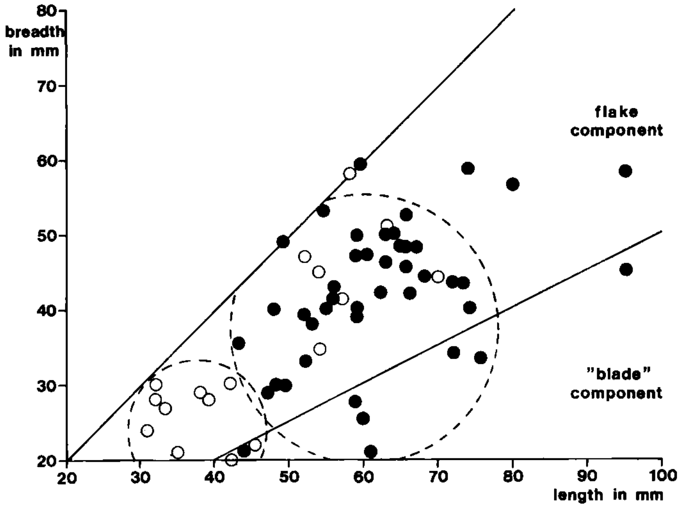

Fig. 3. Length and breadth of 59 scrapers from Penbjerg. Open circles on flakes, filled circles on shattered fragments.

COMPARISON OF PENBJERG AND THE BARREL SITE

When both assemblages had been fully analysed it was found that there were clearer and more consistent differences than had been expected when the work was begun. The differences can be summarised as follows.

The blade technique had degenerated. It was already poor at the older site, where blades were sometimes struck but hardly ever used for retouched implements. At the later site it was virtually extinct. On the other hand a new technique of flat, surface-covering pressure flaking had been evolved and was used to finish such tools as arrowheads, daggers, and sickles.

Tools other than scrapers became fewer, so that at the Barrel Site scrapers dominated the assemblage with 79%, as against 68% at Penbjerg. The percentage of knives had fallen correspondingly from 20% to 5% and of borers from 10% to 7%. The burins apparently had completely disappeared. At the same time requirements for scrapers and borers apparently became simpler. At the earlier site it was aimed at producting two distinct kinds of scraper, the normal kind and a small kind, and also at producing large as well as small borers. At the later site the scrapers and borers each formed a homogeneous group of one type only. It seems that the requirement for a detailed tool kit was lowered.

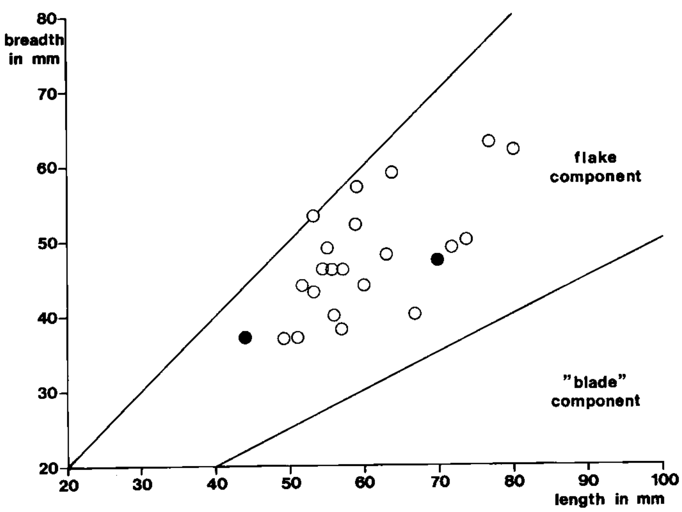

Fig. 4. Length and breadth of 23 scrapers from the Barrel Site. Open circles on flakes, filled circles on shattered fragments.

COMPARISON WITH OTHER SITES

Can any overall tendency be detected in the development of Neolithic flintwork in Denmark?

In fig. 7 is shown a diagram of the proportions of clear tool types at a number of sites. The data is all taken from recent publications (3). The sites represent the Funnel Beaker Culture in the pre-megalithic, the megalithic, and the final phase, or are from the Bell Beaker Culture. The implements are divided into four major groups. These are:

1. The Mesolithic-derived burins, flake axes, and transverse arrowheads.

2. Knives and borers – tools without such a definite Mesolithic association.

3. Scrapers.

4. Implements with flat surface-covering retouch.

The diagram illustrated how the proportions of these four groups changed through time. It shows that the Mesolithic-derived types were important in the pre-megalithic phase of the Funnel Beaker Culture, but later became insignificant. The knives and borers, on the other hand, maintained their position in both the pre-megalithic and megalithic phases, but declined apparently in the final Funnel Beaker Culture and definitely in Bell Beaker times. As these tools lost importance the scrapers became correspondingly more and more to dominate the statistics. The only thing that prevented them from becoming at the end almost the only tool was the appearance of a new series of implements characterised by flat retouch.

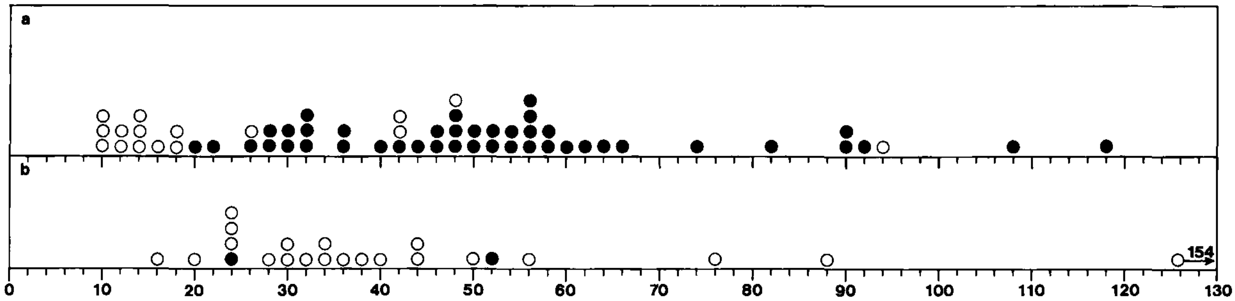

Fig. 5. Diagram comparing weights of scrapers from Penbjerg (above) and the Barrel Site (below). Open symbols show implements made on flakes, filled symbols show implements made on shattered fragments.

Thus quite a definite overall tendency can be seen in the development of the Neolithic flint industries in Denmark.

It would be interesting to discover also whether the internal development or simplification that is seen when the scrapers and borers from Penbjerg and the Barrel Site are compared was found at other sites too.

Unfortunately, owing to the limited time available for this joint study the material from the other sites in fig. 7 could not be studied directly, but a certain amount of further data could be gleaned from the publications. The statistics of scraper size given in the publications used (3) show that scrapers within the size range of the small group at Penbjerg were present at all Funnel Beaker sites. Only at Lindebjerg was analysis of the same kind applied as in the present paper, and the conclusion drawn was that the scrapers fell "naturally into three groups – large roundish, small roundish, and longish". Closer examination shows unfortunately that the "small roundish" group is not the same as the group of small scrapers at Penbjerg, but includes individuals up to 5.8 cm long and 4.4 cm wide (Liversage, 1981, Table II). Happily a second look at this diagram reveals a distinct separate concentration in the lower left-hand corner made up by 11 scrapers from 3.0 to 4.4 cm long and from 2.1 to 3.3 cm wide. These conform exactly to the small group at Penbjerg. They make up 13% of the scrapers at Lindebjerg and 17% at Penbjerg.

So far as concerns the presence of small scrapers the situation appears to have been similar at the other Funnel Beaker sites in the diagram. For the following references see note (3). Skaarup, p. 117, Table 17 gives minimum flake scraper dimensions of 2.3 and 2.2 cm, at Stengade II and 3.1 and 2.4 cm at Stengade I. Ebbesen and Mahler, Table VI gives 3.1 and 3.0 cm at Virum. Ebbesen et al., fig. 12 gives 3.5 and 2.6 cm at Lyø. Statistics of size are not given for the final Funnel Beaker Culture, but Davidsen's illustrations show that small scrapers were present (e.g. Pl. 3,0; Pl. 41,9; Pl. 73,1; Pl. 101,g). We should therefore be able to conclude that small scrapers, smaller than any found at the Barrel site, were a normal part of any Danish Funnel Beaker assemblage. The contrast with Myrhøj is interesting, where Jens Aarup Jensen gives minimum lengths of 3.5 and breadths of 3.0 cm, i.e. distinctly larger.

That small scrapers were present, however, does not mean the same as that they formed a separate group. To show this more detailed statistics would be necessary, such are only available at Lindebjerg. As an experiment the scrapers from Virum were taken out of the museum's study collection and weighed. There was found to be a slightly separate grouping of scrapers weighing under 20 g. It would be premature to generalise from this, but it does look as though the dual nature of the scraper category as shown by the collection from Penbjerg was a normal feature of at any rate the earlier part of the Funnel Beaker Culture.

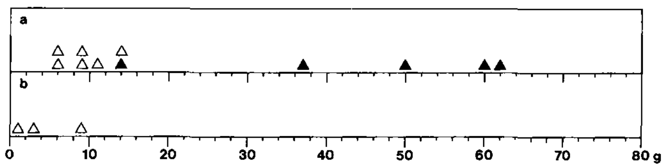

Fig. 6. Diagram comparing weights of borers from Penbjerg (above) and Barrel Site (below). Open symbols show implements made on flakes, filled symbols show implements made on cores or fragments.

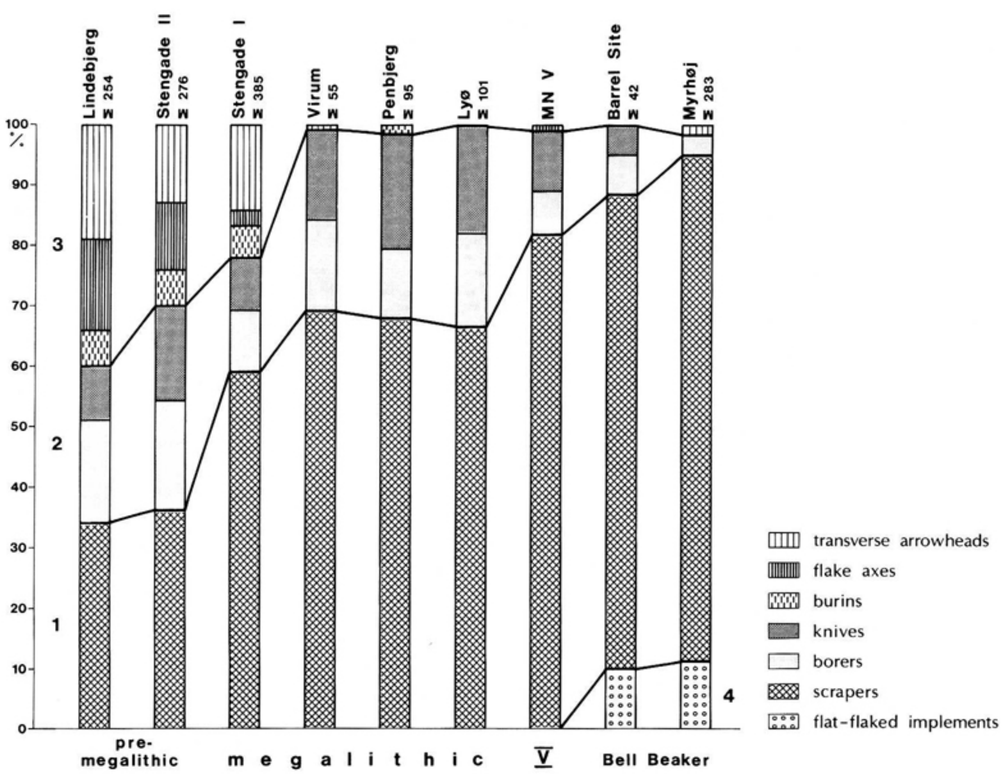

Fig. 7. Diagram showing progressive changes in the flint industry as exemplified by a number of Danish sites.

It is much the same with the borers. Those at Penbjerg fell into a large and a small group, while at the Barrel Site only small borers were present. At Lindebjerg it was written of them that "These appear to fall into a thick type with fairly strong point, which can be made either from a nuclear piece or from a thick flake... and a thin type made from a slighter flake or blade". The presence of both large and small borers is furthermore shown by illustrations and/or size statistics given for the above Funnel Beaker asemblages; but at Myrhøj, from the Bell Beaker Culture, the four illustrated borers have the same rather slight and delicate character as at the Barrel Site. However, there is so far so little Bell Beaker material to compare with that future finds may upset these results.

The general conclusion that can be drawn from the above is that the development of the flint industry in the Danish Neolithic is what may be called retrogressive. Forms became fewer and simpler, and the scraper group became more and more dominant among the implements. The only positive development was the introduction in the Late Neolithic of a technique of shallow surface, covering flaking.

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NOTES

1. Sb. 27 of Lodbjerg parish, Hassing herred. NMK. A 51028.
2. Sb. 37 of Lodbjerg parish, Hassing herred, NMK. jr. nr. 1250.
3. Lindebjerg after D. Liversage, "Neolithic monuments at Lindebjerg, northwest Zealand", *Acta Archaeologica* 51, 1980, 85–152. Copenhagen 1981. Stengade I and II after J. Skaarup, *Stengade, ein langeländischer Wohnplatz mit Hausresten aus der frühneolitischer Zeit.* Rudkøbing 1975. Virum after K. Ebbesen and D. Mahler, "Virum, et tidligneolitisk bopladsfund". *Aarbøger for nordisk Oldkyndighed og Historie* 1979, 11–61. Copenhagen 1981 (with German summary). Lyø after K. Ebbesen et al. "En neolitisk boplads på Lyø". *Aarbøger for nordisk Oldkyndighed og Historie* 1978, 45–72. Copenhagen 1980 (with German summary). The period Middle-Neolithic V after the combined statistics of K. Davidsen, *The Final TRB Culture in Denmark.* Copenhagen 1978. Myrhøj after J. Årup, "Bopladsen Myrhøj". *Kuml* 1972, 61–122. Århus 1973 (with English summary).

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The Single Grave (Corded Ware) Economy at Kalvø

by PETER ROWLEY-CONWY

INTRODUCTION

The Single Grave settlement of Kalvø (for preliminary reports see S.H. Andersen 1982, 1983) lies on a small rise at the edge of Norsminde Fiord, eastern Jutland. At the time of occupation the small rise was an island measuring some 200 × 100 m, about 500 m from the shore. The site belongs to the Ground Grave period of the Single Grave culture, and has been radiocarbon dated to about 1900 bc (C14-years) (S.H. Andersen op. cit.).

The purpose of this article is to describe the economy of the Single Grave settlement. The Single Grave culture is the local facies of the Corded Ware, and settlements of this culture are rare throughout northwestern Europe. Economic reports are even rarer: no faunal reports have been published from Denmark, and very little is known of the Corded Ware economy from anywhere in northwestern Europe. Although there is only a small sample of animal bones and plant remains from Kalvø, these are therefore of great interest in providing information about a period concerning which little is known.

THE ANIMAL BONES

The identified animal bones are listed in table 1. Goats are very rare throughout the prehistory of Denmark, and it is assumed that only sheep are represented. Systematic sieving was not carried out, so fish, birds and smaller mammal bones will be underrepresented. Preservation was good.

Wild or Domestic?

All the cattle and all but one of the pigs listed in table 1 are regarded as domestic. This conclusion was arrived at by comparing the Kalvø cattle with the measurements of wild cattle (all periods) and domestic cattle (pollen zone VIII) given by Degerbøl and Fredskild (1970), and with those from Fannerup (Middle Neolithic II, Funnel Beaker culture) definitely regarded as domestic (Rowley-Conwy in press). The pigs were compared with those from Middle Neolithic (Funnel Beaker) Bundsø (Degerbøl 1939) and Fannerup. The Kalvø bones are discussed individually.

A. The Cattle

1. *Lower third molar.* Two Kalvø specimens could be measured for length.

		Length (mm)
Kalvø 1		38
Kalvø 2		40
Bos primigenius	males	42.5–52.2 (24)
Bos primigenius	females	44.3–52.2 (11)
Domestic cattle	males	37.5–41.5 (6)
Domestic cattle	females	35.0–39.5 (3)
Fannerup (domestic)		35–40 (9)

Both Kalvø specimens are clearly in the domestic range.

2. Scapula. One Kalvø specimen could be measured.

	Glenoid, length	Glenoid, width
Kalvø	57	46
Bos primigenius males	76–91 (22)	64–77 (20)
Bos primigenius females	66–75 (12)	58–62 (11)
Domestic cattle	50–65 (20)	40–55 (7)
Fannerup (domestic)	52–58 (2)	43–48 (3)

The Kalvø specimen falls clearly in the domestic range.

3. *Distal Humerus.* Three Kalvø specimens could be measured.

	distal articulation width	trochlea maximum thickness
Kalvø 1	71	41
Kalvø 2	–	39
Kalvø 3	–	42
Bos primigenius males	95–108 (23)	–
Bos primigenius females	81–98 (5)	–
Domestic cattle	75–90 (6)	–
Fannerup (domestic)	74–76 (2)	–

The complete Kalvø specimen falls clearly in the domestic range. The two incomplete but very similar specimens are thus probably also from domestic animals.

4. *Proximal Radius.* One example from Kalvø could be measured.

	maximum width	articular width
Kalvø	78	73
Bos primigenius males	107–122 (23)	96–110 (22)
Bos primigenius females	91–110 (7)	83–98 (7)
Domestic cattle	71–93 (9)	74–80 (3)
Fannerup (domestic)	71–79 (3)	66–71 (3)

The Kalvø specimen falls clearly into the domestic range.

5. *Magnum (carpale 2 and 3).* Four of these bones could be measured, and are compared with measurements of wild and domestic anmals taken by the author from the Sværdborg and Troldebjerg collections respectively (figure 1a and 1b). All the Kalvø specimens fall in the Troldebjerg range.

	measurement 1	measurement 2
Kalvø 1	50	21.5
Kalvø 2	47	22
Kalvø 3	42.5	19
Kalvø 4	41	19

6. *Distal Metacarpal.* Three examples from Kalvø could be measured.

	articulation width	medial condyle thickness
Kalvø 1	59	31
Kalvø 2	73	36.5
Kalvø 3	75	38

These measurements are plotted in figure 2, being compared to Degerbøl and Fredskild's (1970) measurements. The wild females and domestic males overlap in

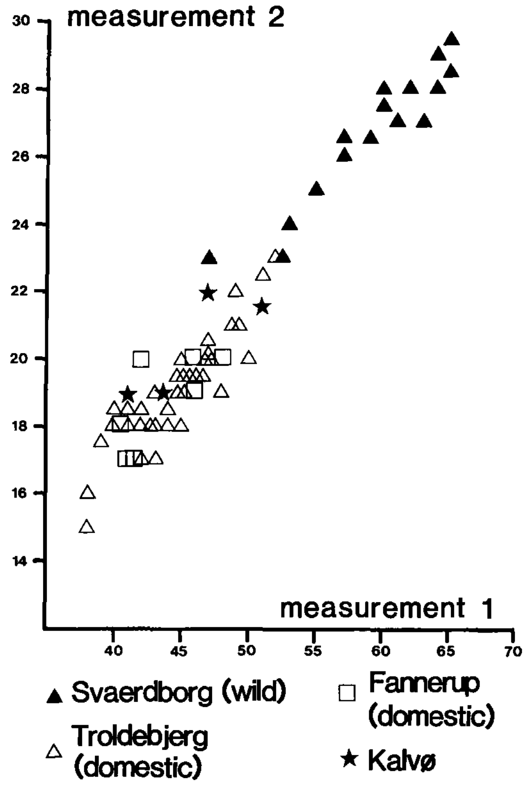

Fig. 1a. Magnum (Carpale 2 and 3) dimensions.

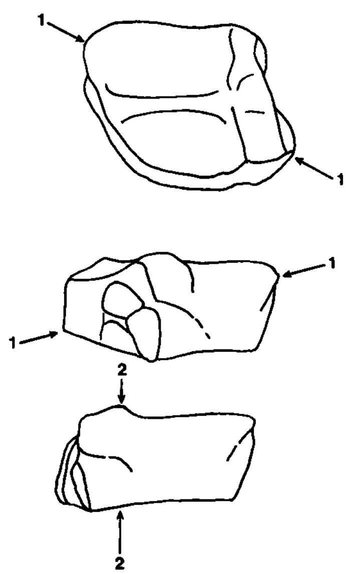

Fig. 1b. Magnum bone showing measuring points.

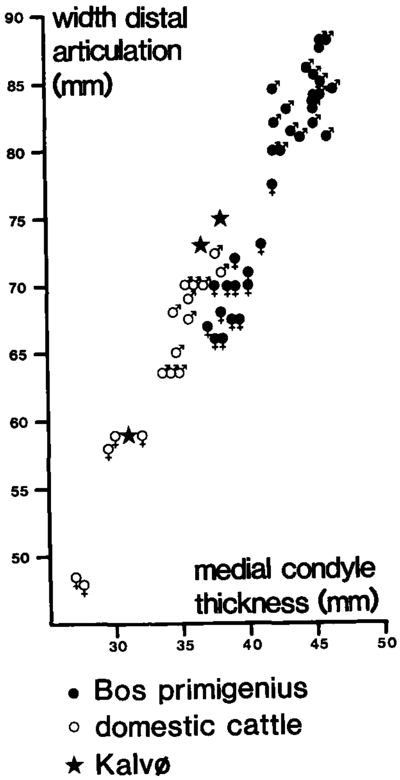

Fig. 2. Distal metacarpal dimensions. Wild and domestic cattle (and sexes) from Degerbøl and Fredskild 1970.

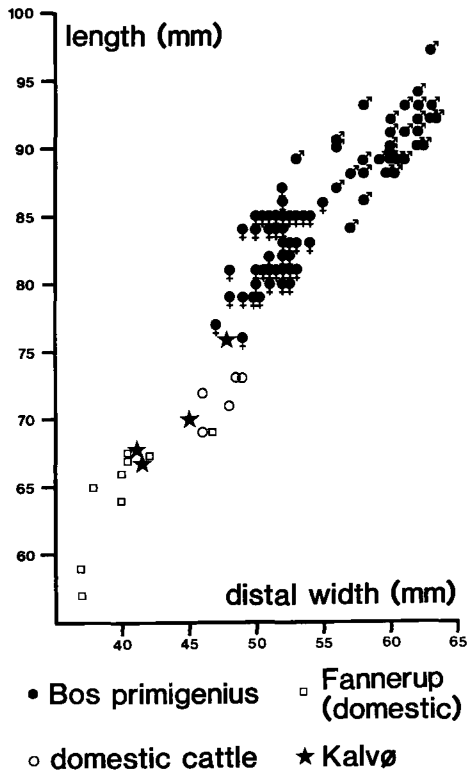

Fig. 3. Astragalus dimensions. Wild and domestic cattle (and sexes) from Degerbøl and Fredskild 1970.

size for each dimension, but when plotted together do show a degree of separation (cf. Degerbøl op. cit. p. 104). The largest Kalvø specimen seems more likely to form an extension of the domestic range than a wild female outlier, and the other two fall in the domestic range. The Kalvø specimens apparently consist of 2 males and 1 female.

7. *Astragalus.* Four bones from Kalvø could be measured.

	length	distal width
Kalvø 1	67	41
Kalvø 2	68	41
Kalvø 3	70	45
Kalvø 4	76	48

These are plotted in figure 3. Three of the Kalvø specimens fall into the domestic range, while the fourth is on the overlap between wild and domestic.

8. *Naviculo-cuboid.* Two Kalvø specimens could be measured.

	maximum width
Kalvø 1	55
Kalvø 2	63
Bos primigenius males	74–82 (18)
Bos primigenius females	63–72 (21)
Domestic cattle	57–62 (7)
Fannerup (domestic)	49–57 (5)

One Kalvø specimen is clearly in the domestic range, while the other falls close to the overlap between wild and domestic. Two other examples from Fannerup could also be measured (63 and 64 mm); although these could not definitely be called domestic (they are as big as the smallest wild females), they form a logical continuation of the domestic range and seem unlikely to be wild. This argument also holds for the Kalvø specimen, which may well be domestic.

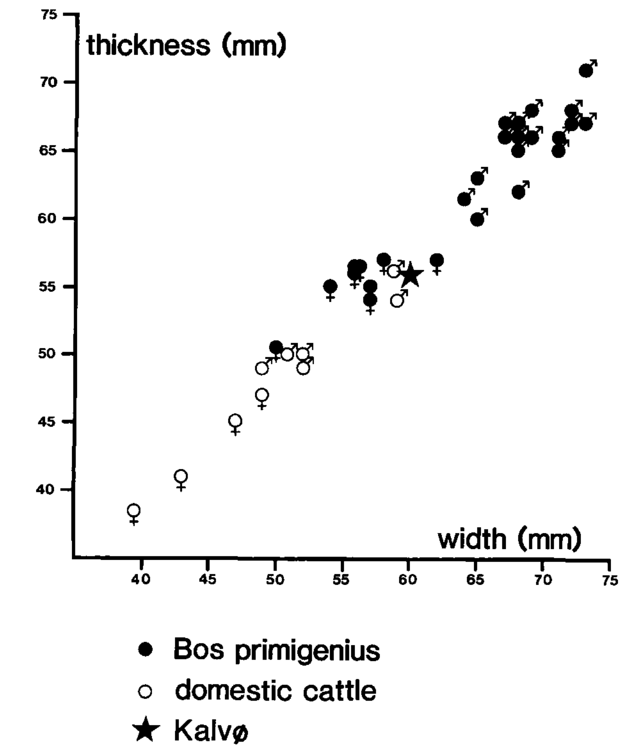

Fig. 4. Proximal metatarsal dimensions. Wild and domestic cattle (and sexes) from Degerbøl and Fredskild 1970.

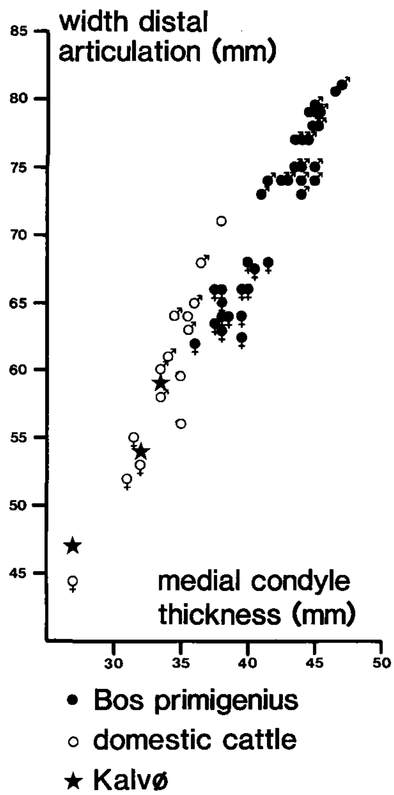

Fig. 5. Distal metatarsal dimensions. Wild and domestic cattle (and sexes, where indicated) from Degerbøl and Fredskild 1970.

9. *Proximal Metatarsal.* One Kalvø specimen was measurable.

	maximum width	maximum thickness
Kalvø	60	56

This bone is plotted in figure 4. When judged on size, the Kalvø specimen could clearly either be a wild female or a domestic male.

10. *Distal Metatarsal.* Three Kalvø specimens could be measured.

	articulation width	medial condyle thickness
Kalvø 1	59	33.5
Kalvø 2	54	32
Kalvø 3	47	28

These are plotted on figure 5, all falling clearly into the domestic range. When compared to the domestic specimens of known sex listed by Degerbøl, the Kalvø bones appear to represent one male and two females.

The Kalvø cattle bones described above divide up as follows:

	domestic	wild/domestic overlap	wild
lower M3	2	–	–
scapula	1	–	–
distal humerus	3	–	–
proximal radius	1	–	–
magnum	4	–	–
distal metacarpal	3	–	–
astragalus	3	1	–
naviculo-cuboid	1	1	–
proximal metatarsal	–	1	–
distal metatarsal	3	–	–
Total	21	3	–

The presence of aurochs bones at Kalvø cannot therefore be excluded. A few are known from coastal settlements of the Funnel Beaker culture, although domestic animals usually predominate. The 3 uncertain bones from Kalvø are tentatively referred to domestic cattle, however, on the grounds that the presence of 21 bones of domestic animals and the absence of demonstrably wild specimens makes this much the most likely. This is a similar line of argument to that used by Degerbøl regarding the *Bos* bones from the Ertebølle shell middens: the absence of any definite domestic animals on those sites, and the presence of numerous demonstrably wild ones, led to the conclusion that the doubtful animals were wild females, not domestic males (Degerbøl and Fredskild op. cit., p. 26).

B. The Pigs
Only six pig bones could be measured.

1. *Distal Humerus.*

	width articulation
Kalvø 1	28
Kalvø 2	42
Bundsø (domestic)	26 – 34 (10)
Fannerup (domestic)	26 – 31 (7)

The smaller Kalvø bone is clearly in the domestic range, while the larger is so large it must be wild. It compares well with bones of wild pigs from Ertebølle settlements.

2. *Upper Third Molar.*

	Length	Breadth
Kalvø 1	29	18
Kalvø 2	33	19
Bundsø (domestic)	29 – 35.5 (8)	17.5–21 (8)
Fannerup (domestic)	31 – 35 (6)	18 – 21 (7)
Bundsø (wild)	41	21
Fannerup (wild)	43	23

Both Kalvø specimens are clearly in the domestic range.

3. *Lower Third Molar.*

	Length	Breadth
Kalvø 1	36	16
Kalvø 2	40	17
Bundsø (domestic)	30 – 40.5 (12)	14.2 – 17.3 (12)
Fannerup (domestic)	30 – 39 (8)	16 – 19 (8)
Bundsø (wild)	41.5 – 47 (3)	17 – 20.8 (3)
Fannerup (wild)	43	19

Both Kalvø specimens are clearly in the domestic range.

Of the six measurable pig bones, therefore, five are from domestic animals, one from a wild animal. None of the other bones seemed on visual inspection large enough to have come from a wild animal.

Age at Death

A. The Cattle
Only two ageable cattle jaw fragments were recovered. One contained P2, P3, deciduous m3, M1, M2 and M3. The third cusp of M3 was not yet in wear, and P4 was visible beneath m3. This jaw falls into Higham's (1967) stage 17, aged at just under three years. The other fragment contained P3, P4 and M1. P4 was in an early stage of eruption. This jaw is only a little older than the first, falling into Higham's stage 18, aged around three years.

23 loose teeth were compared with the corresponding teeth in the first jaw fragment. Wear was estimated as follows:

worn less than corresponding tooth in complete jaw:	3
worn about the same as in complete jaw:	10
worn more than in complete jaw:	10

There are problems with this technique, because the degree of wear can be variable, and it is also difficult to distinguish between M1 and M2. It would seem, however, that few animals were killed much below about 2½ – 3 years.

Bone fusion is even more problematic. The age at which epiphyses fuse onto shafts is variable, and the ageing technique currently under discussion. No more than the most provisional conclusions can therefore be drawn. Table 2 lists the cattle bones against the conventional fusion ages given by Silver (1969). The early fusing bones are all fused; only when conventional fusion ages reach 2½ – 3 years are unfused bones found. Some of the unfused bones might of course have come from animals much younger than this; consistent absence of unfused bones with younger fusion ages suggests, however, that few animals were killed much under 2½ – 3 years.

B. The Pigs
One jaw fragment contained a worn M1 and deciduous m3, aged by Higham's (1967) scheme to about 7 – 12 months. A second fragment contained M2 and M3, the latter unworn, giving an age of about 17 – 21 months. 4 loose M3s were found, one with only the first cusp in

wear (age about 21 – 25 months), while three had all cusps worn (age over about 27 months). Three of the six ageable fragments thus come from animals aged less than about 2 years.

Bone fusion is listed in table 2 b.

C. The Sheep

Two ageable jaw fragments were found, one from a dentally mature animal (older than about 26 months on Higham's (1967) scheme), the other containing a worn M1, and deciduous m3 about to be replaced. Deciduous m3 is usually replaced at around 21 – 24 months.

Bone fusion is listed in table 2c. Unfused bones become more frequent when conventional fusion ages are around 2 – 2½ years, suggesting increased killing at this age.

ANIMAL	NUMBER OF FRAGMENTS
Cow, *Bos taurus domesticus*	120
Domestic pig, *Sus scrofa domesticus*	49
Wild pig, *Sus scrofa ferus*	1
Sheep, *Ovis aries*, or goat, *Capra hircus*	23
Red deer, *Cervus elaphus*	27 (+ 14 antler fragments)
Grey seal, *Halichoerus grypus*	2
Seal sp., Phocidae indet	8
Otter, *Lutra lutra*	2
Badger, *Meles meles*	1
Swan, *Cygnus* sp.	10
Duck, Anatinae	3
Red-throated Diver, *Gavia stellata*	3
Herring gull, *Larus argentatus*	4
Great Crested Grebe, *Podiceps cristatus*	1
Cod, *Gadus morhua*	56

Table 1. Animal bones from Kalvø. Changes in the cultural attributions of certain layers may mean minor changes in the numbers listed.

BONE	Conventional fusion age (months)	Fused	Unfused diaphysis	Unfused epiphysis
A. Cattle				
Radius, proximal	12–18	2	–	–
Humerus, distal	12–18	6	–	–
1st and 2nd phalanges, proximal	18	2	–	–
Metacarpal, distal	24–30	3	–	–
Tibia, distal	24–30	1	–	–
Metatarsal, distal	27–36	4	–	1
Femur, proximal	42	–	–	3
Femur, distal	42–48	2	1	1
Tibia, proximal	42–48	1	–	–
B. Pigs				
Humerus, distal	12	3 (+1 wild)	1	–
Radius, proximal	12	3	–	–
1st phalanx, proximal	24	–	1	1
Calcaneum	24–30	1	–	–
Femur, distal	42	1	–	1
C. Sheep				
Humerus, distal	10	3	1	–
1st phalanx, proximal	13–16	1	–	–
Tibia, distal	18–24	1	–	–
Calcaneum	24–30	1	2	–
Tibia, proximal	36–42	–	2	1
Femur, distal	36–42	–	1	–

Table 2. Bone fusion data from Kalvø. Fusion ages are from Silver (1969), and are only approximate estimates (see text).

THE PLANT REMAINS

260 litres of soil from the Single Grave level were put through a froth flotation system (Jarman, Legge and Charles 1972). This produced about 1 litre of charcoal. The most important result was the complete absence of cereal grains or chaff. Evidence of cereal agriculture might have been present elsewhere on the site, but if cereals were common at Kalvø it would be surprising for no evidence at all to be found.

Many seeds of other plants were found (cf Andersen 1982, 1983). Most of these were not charred, however, and so may well be intrusive into the Single Grave level. There are many ways in which such intrusions can occur, and this can lead to problems if due caution is not exercised. The best example of this is the case of cereals and other plant remains from Wadi Kubbaniya, near Aswan. These were found in a level dated to about 16,000 bc, but it has since been established that they are not charred (Hillman et al 1983) and are of recent origin (Gillespie et al 1984). The charred seeds from Kalvø consist of 8 *Chenopdium album*, 3 *Polygonum aviculare*, and 3 *Rumex acetosella*.

DISCUSSION

The information put forward above allows some suggestions to be made concerning the Single Grave economy at Kalvø.

So far as can be seen from the small sample, the cattle bones do not support the notion of a dairy economy.

Such an economy involves the high killing of very young male calves, and the maintainance of adult females and one or two breeding males (cf Legge 1981a, 1981b). No evidence of a high kill of very young animals was found at Kalvø. The fact that some animals were killed at around $2^1/_2$ – 3 years of age hints that meat production may have been a major aim of the Single Grave herdsmen. If so, then this is similar to the Middle Neolithic Funnel Beaker Sites of Troldebjerg (Higham and Message 1969), Bundsø (Higham 1969) and perhaps Fannerup and Sarup (Rowley-Conwy in press). In a dairy economy the majority of adult animals are females. Among the sexually dimorphic distal metapodials (figures 2 and 5), the Kalvø bones appear to contain a total of three males and three females. This even sex ratio among the adults also implies that a larger sample might show the cattle economy at this site to be based on meat rather than milk.

The little evidence available for sheep and pig also suggests meat as a major goal, as in the Funnel Beaker period (cf Higham 1969).

The apparent absence of cereals does not necessarily support the old view that Corded Ware groups were predominantly pastoralist. Economic remains cannot be viewed in typological terms. Pottery from a site may or may not (for various reasons) contain a wide array of current cultural traits, regardless of the type of the site. Economic remains on the other hand provide information about food consumption *at the particular site in question*; they cannot be assumed to reflect the economy of the culture as a whole.

If the absence of cereals in the flotation samples reflects a real absence of cereals at the site, then this absence provides evidence about Kalvø, not about the entire Single Grave economy. The absence of cereals at Kalvø is not at all surprising. The island on which the site lay was small (200 × 100 m), and had no source of water. It is therefore most unlikely that Kalvø was permanently occupied. It seems most likely that Kalvø was a temporary grazing station, the domestic animals being tended by perhaps only a very few people – and occupied maybe only for very brief periods. Such sites are documented in the recent ethnographic literature from for example Ireland (Severin 1978, 22) and Orkney and Shetland (Fenton 1978, 423) and are discussed in the archaeological literature (Bradley 1978, 58–9). Cereal cultivation at settlements on such briefly inhabited islets would be very unlikely.

Kalvø cannot therefore be used to argue for a decrease in agriculture and an increase in pastoralism and hunting in the Single Grave period. Similar economic activities were carried out at coastal sites of the Funnel Beaker culture, for example Fannerup (Rowley-Conwy in press), without the Funnel Beaker being regarded as a pastoralist culture. Much more must be learnt about the economies of inland Single Grave sites before conclusions can be at all definite; but for the time being Kalvø cannot be used to support the notion of an economic break between the Funnel Beaker and Single Grave cultures. Those aspects of the site discussed here were determined by the location, not the cultural affiliations, of the site.

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Settlement Sites with Middle Neolithic Houses at Grødby, Bornholm

by LARS KEMPFNER-JØRGENSEN and MARGRETHE WATT

Since 1979 large scale excavations have taken place on a settlement area at Grødby, Aaker parish, Bornholm (1). Until now the investigations have largely been concerned with extensive settlements and associated grave fields from the Iron and Viking Ages (Watt 1980a,b; Watt 1983).

As a by-product of these excavations traces of a considerable number of Neolithic settlements have turned up including several more or less well preserved house sites, numerous pits and odd graves, some of which have been investigated. Together they appear to span all main chronological phases from Early Neolithic B/C (EN B/C) until the late Neolithic (LN).

The settlement area at Grødby is situated on a low sandy ridge, 30–40 m above sea level and about 2 km from the present coast line, which in this region appears not to differ noticably from that of the later part of the Stone Age. Towards the north the settlement area is bounded by the stream of Grødby Å. Judging from numerous stray finds, land form, and soil type the total settlement area is believed to cover no less than 100,000 m^2.

The following is a preliminary account of the extent and character of the Stone Age settlement with a description of the house sites registered so far and a presentation of some of the more important finds which form the foundation for their dating.

Fig. 1 shows the situation and the approximate extent of the Neolithic settlement complex at Grødby. So far 25,000–30,000 m^2 have been investigated. The extent and intensity of the original settlement is indicated by the occurrence of much Neolithic material in the fill of the post holes and other structures of later date, even in areas where primary Neolithic layers have long since been removed by soil erosion and intense agricultural activity.

For practical reasons a considerable portion of the settlement area has been only partly excavated (Watt 1983, 138–140). It should also be stressed that the following discussion is based on a cursory examination of the vast material from Runegård and Grødbygård.

Much of the find material from the different Neolithic settlement sites is derived from naturally protected depressions in the originally undulating terrain. Much material has been redeposited in connection with agricultural and building activity in the Iron and Viking Ages. In some areas, however, pits, house remains and largely undisturbed Neolithic settlement floors have been preserved.

THE GRØDBYGÅRD SETTLEMENT

In connection with the investigation of an extensive grave field dating largely from the Roman Iron Age an area of approx. 1200 m^2 was stripped of its top soil. The majority of the exposure was taken up by 150 graves and various other structures of a later date (fig. 2). However, in the southwest corner the unmistakable outline of two houses (A and B) appeared, both of which can be dated to the Middle Neolithic period.

House A, orientated NNE-SSW, measured 7.0 m in width and had a length of at least 12.75–13.00 m. Along the axis of the house the holes for 3 large roof supports were placed at intervals of 4.50 and 4.75 m. A possible continuation of the line of roof supports to the SSW is obscured by the presence of a large inhumation grave of Early Germanic Iron Age placed in the line of roof supports. The imprints of the large posts themselves show a diameter of 40–45 cm and that they were sunk at least 1 m below the surface. The rectangular outline of the house itself was shown by a partially preserved, shallow wall trench with a width of up to 20 cm and a preserved depth of less than 10 cm fading in places to a slight discolouration of the subsoil. Occasional imprints of slender posts with a diameter of 8–10 cm were pre-

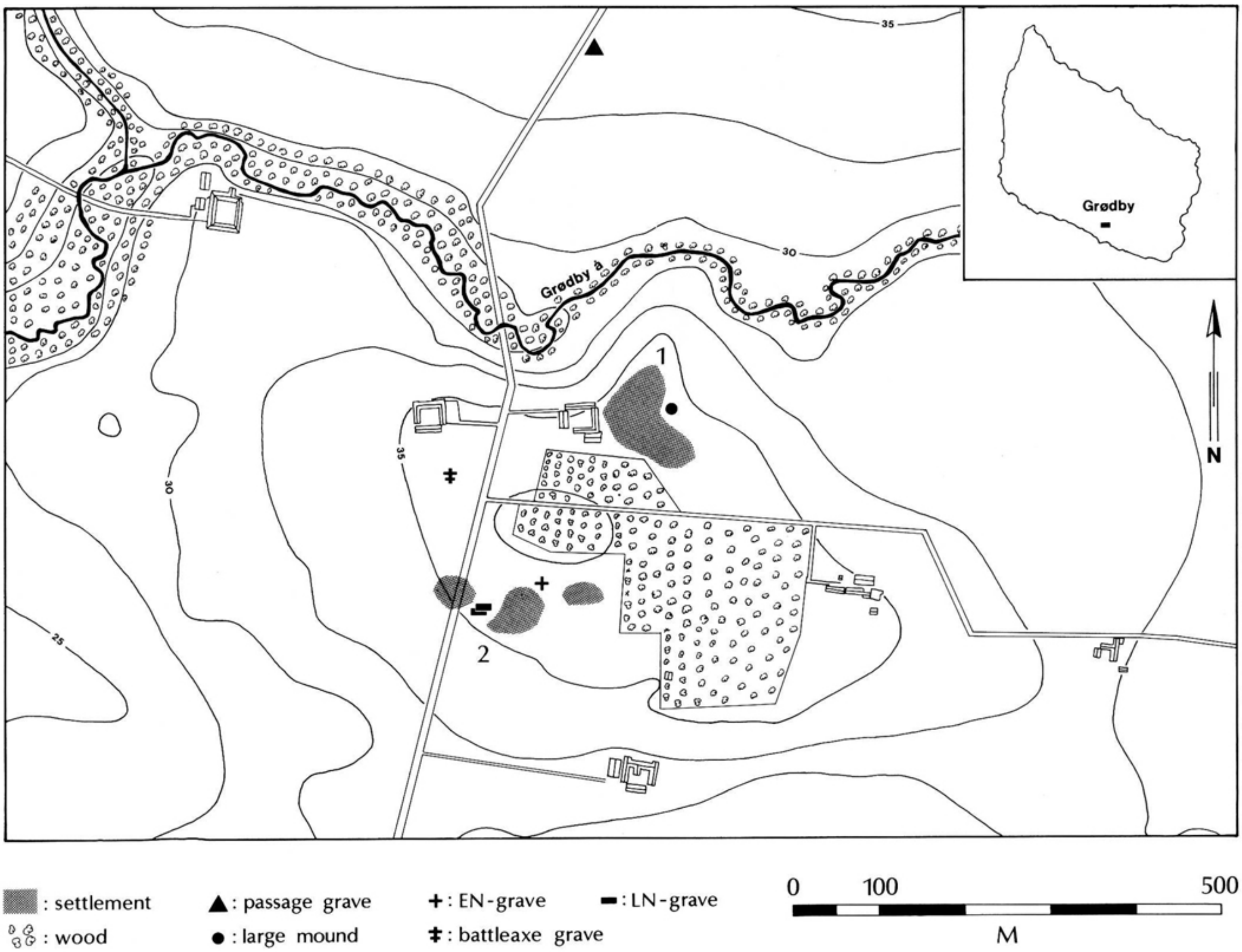


Fig. 1. The Grødby area showing the Neolithic settlement complex. 1-Grødbygård, 2-Runegård (East).

served in the bottom of the trenches. The posts appear to have been closely spaced. The absence of substantial posts in the line of the walls indicate that the capacity of the walls for supporting a roof must have been very limited. Hence it is not surprising to find a subsiduary line of supports placed 1.0 – 1.2 m inside the wall trench. These posts which may be described as of intermediate size with a depth of 15 – 25 cm were spaced at 2.50 – 2.75 m. Individual posts were not matched by one immediately opposite, but were placed obliquely in a zig-zag pattern. The internal posts are interpreted as supports for a "side-beam" construction taking the weight off the weaker walls (figs. 3-4).

House B was less well preserved and lacked any trace of a wall trench. As in house A the roof had been supported by 3 large posts orientating the building NNW-SSE. The posts were spaced at 3.50 and 3.75 m, i.e. slightly closer than those of house A. A number of subsiduary posts were placed in similar positions to those in house A. The absence of a wall trench in house B is easily explained as this house had suffered more damage by later ploughing. House B never had more than the three main roof supports and hence cannot have been more than 10–11 m long. The width of the house is estimated at 6.5 m, which makes it fractionally smaller than house A.

The dating of the Grødbygård houses A and B

Abundant ceramic material was found associated with the two Grødby houses. In the fill of the imprints of the major roof supports of house B were found a nearly complete "tulip-shaped" funnel beaker decorated below the rim with a faintly incised V-ornament (fig. 6a), fragments of a conical vessel with a slightly offset rim and a thick base (fig. 6b), and a fragment of a clay disc decorated with groups of parallel incised lines (fig. 6c). Among the flints was a fragment of a thick-butted axe of type B (fig. 6e) and a scraper made from a small flint nodule.

The better preserved house A only yielded an insignificant amount of primary material including a fragment of a vessel with an incised V-ornament below the rim from the infilling of one of the large roof supports (fig. 6f). The tempering and decoration are very similar to that of the "tulip-shaped" vessel from house B. The outer fill from the posts of house A contained odd

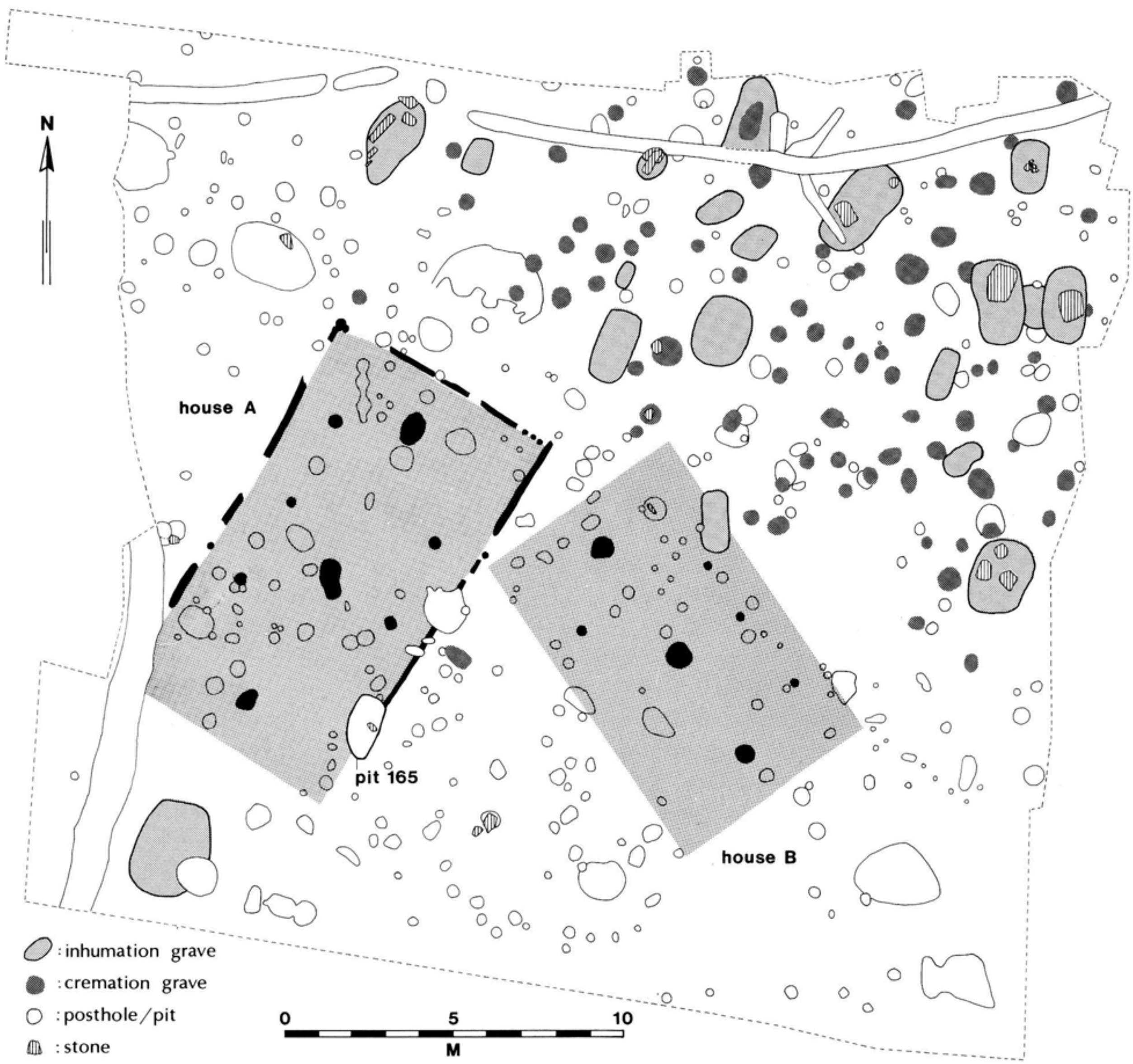


Fig. 2. Plan of the central excavation area at Grødbygård showing the Middle Neolithic houses A and B.

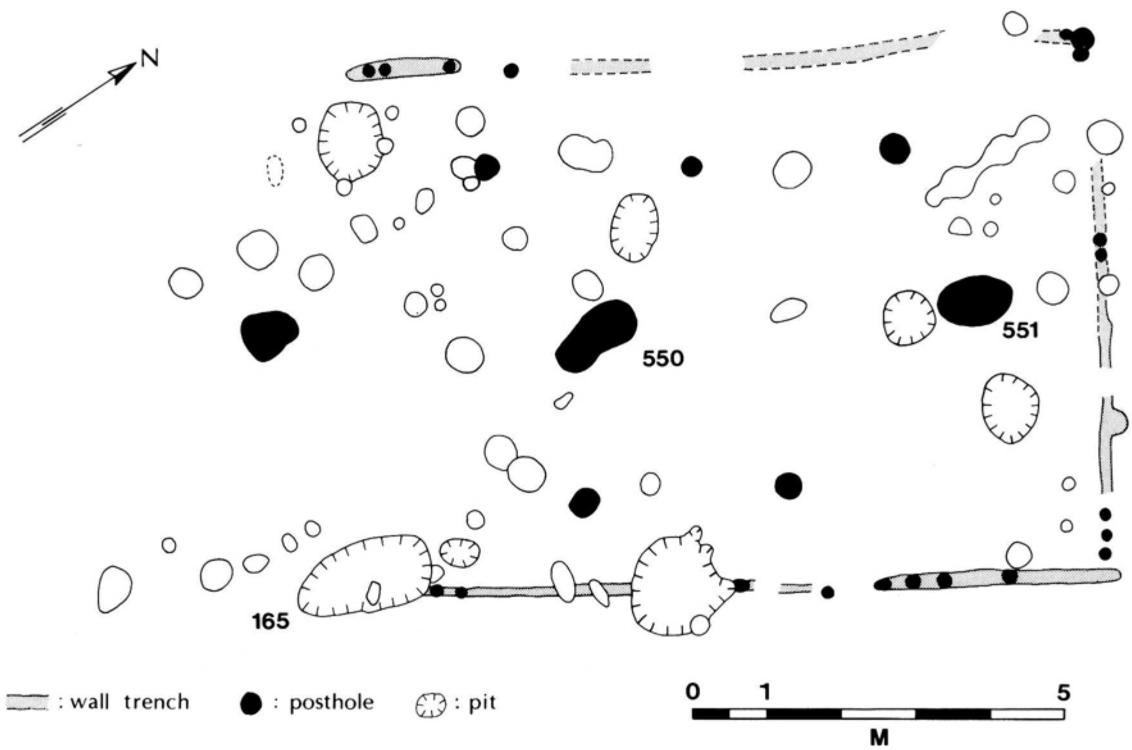


Fig. 3. Detailed plan of Grødbygård house A.

sherds and a fragment of a clay disc of Early Neolithic C/Middle Neolithic I (EN C/MN I) type.

In spite of the fact that house A did not provide much material for a primary date it is possible indirectly to establish an upper age limit for the construction of the house. A pit (165) containing abundant ceramic material of a homogeneous character cuts the wall trench. Apart from odd EN C sherds, which can be clearly separated from the bulk of younger material, the pit contained a number of noteworthy elements (figs. 7–8). The types of vessels include conical pots with a slightly accentuated transition from belly to neck decorated with horizontally arranged rows of pits below the rim (fig. 8 d, f, h, i), bowls with deeply inserted pits below the rim combined with obliquely incised lines bounded below by horizontal rows of small pits (fig. 8a, b), undecorated bowls (fig. 8g), and bowls decorated only with rows of pits (fig. 8e). Of particular interest in this assemblage are several fragments of a semi-globular bowl with a zone of horizontally impressed cord below the rim bounded by a fringe ornament consisting of short oblique cord impressions (fig. 8a). The latter is considered to be a vessel of early Boat-Axe type related to Malmer's early A/B type; though the vessel does differ slightly in the profile of the rim (Malmer 1962, 9 *et seq.*).

Other decorative elements derived from the pit 165 comprise incised vertical lines below the rim (fig. 8,l), nail impressions, the latter in combination with moulding and pits (fig. 8, c, i, k). A number of fragments of funnel beakers with incised V-ornaments below the rim are of the same type as that from one of the large roof-supports of house A (fig. 8b and c) (cf. fig. 6f). Clay discs of this type are common in a number of settlement sites in Scania and Blekinge. In the so called G-layers of Siretorp, normally ascribed to the Pitted Ware Culture, were found several fragments of similar clay discs (Bagge and Kjellmark 1939, Pl. 50:3–6). The type is also represented at Jonstorp M3 (Lidén 1940, fig. 68:2,4,6). Several examples are found on the settlement site of Sillnäs Udde in Blekinge (Lönnberg 1933, fig. 10:13). A single fragment is known from the site at Svanemøllevej on Sjælland (Davidsen 1973, fig. 12:5). Clay discs with

Fig. 4. Grødbygård house A with its wall trench. Seen from the north. BMR phot.

this type of decoration are now normally dated to MN V (Davidsen 1973, 29).

It is now generally agreed that the "tulip-shaped" beakers should be dated to the end phase of the TRB Culture (MN V) (Ebbesen 1975, 108).

With this background there can hardly be any doubt that the two houses Grødbygård A and B belong to the final phase of the TRB Culture and certainly no later than the transition MN V/ Early Boat-Axe Culture. Both phases are clearly represented at Grødbygård. Thick-butted axes of type B, which are attributed to the Boat-Axe Culture and Pitted Ware Culture, are also present in the Grødbygård material (fig. 10). All in all the pit 165 seems to represent the transitional phase Funnel-Beaker Culture/Boat-Axe Culture.

The final Funnel-Beaker phase, MN V, is well represented in the Grødbygård material in general (fig. 9). Especially characteristic are clay discs decorated with concentric semi-circles with a fringe of small strokes at right angles (fig. 9d). Clay discs decorated in a similar way occur in the settlements of Karlsfält 16:11 (Larsson and Larsson 1984, fig. 35) and Hagestad 7:6 (Hulthén 1977, fig. 93c). The incised V-ornament and "fir-twig" ornament below the rims of certain vessels (fig. 9a) seem specially common in Hagestad 7:6 (Hulthén 1977, fig. 95a-b and fig. 83e). Pottery with moulding and finger nail impressions similar to that of pit 165 (fig. 8c) is present at both Hagestad 7:6 and Jonstorp M3 (Hulthén 1977, fig. 94a-b). Hulthén suggests that the material from Hagestad 7:6 belongs to the Pitted Ware Culture, but indicates that it differs from both TRB and

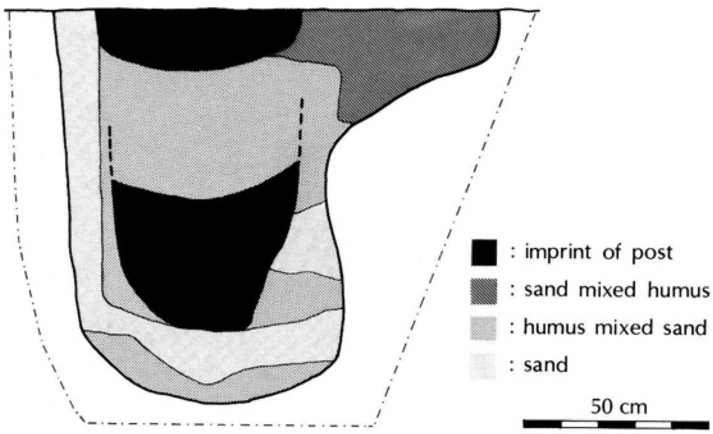
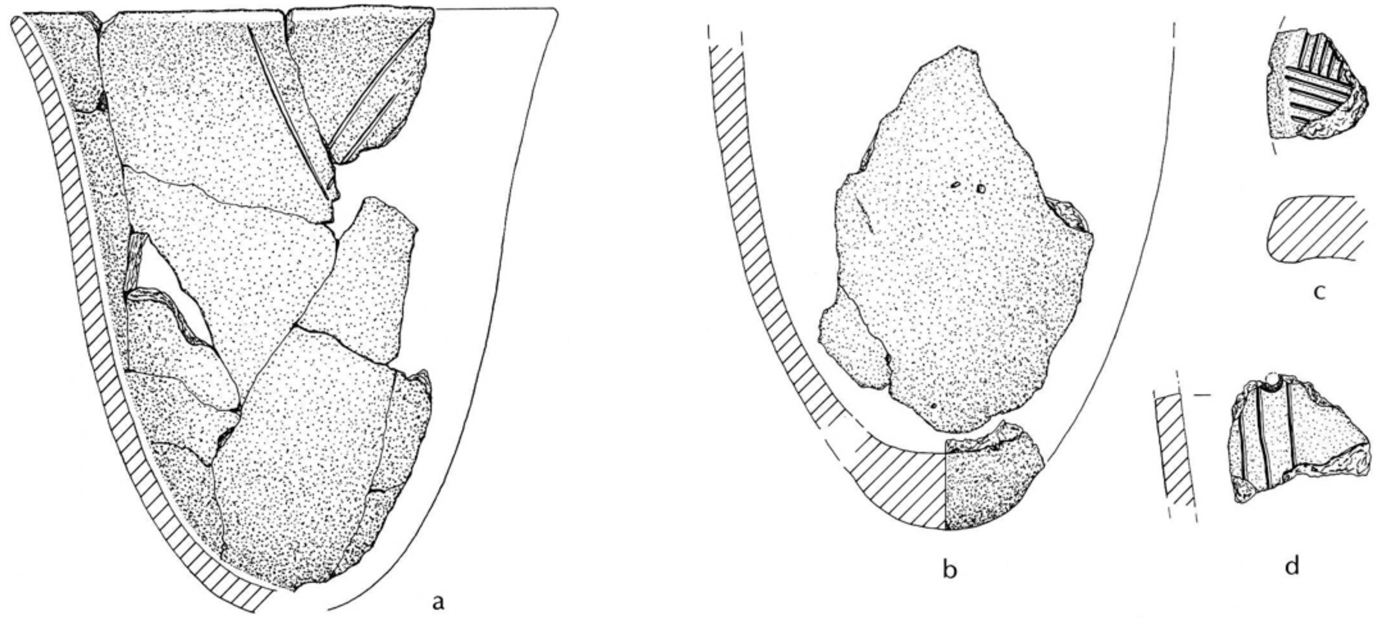


Fig. 5. Section through a large roof support (no. 551) of Grødbygård house A.



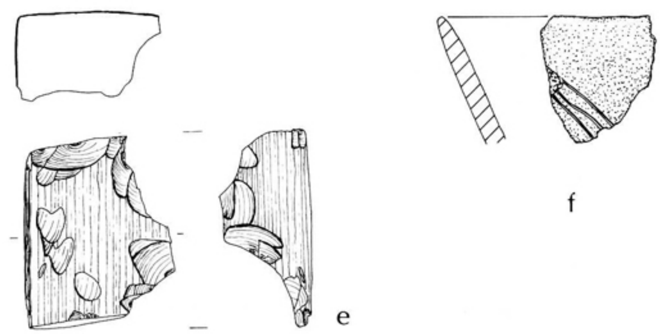


Fig. 6. Pottery from the Grødbygård houses. a–e from the imprint of post 541 (house B), f from the imprint of post 550 (house A). 1:2.

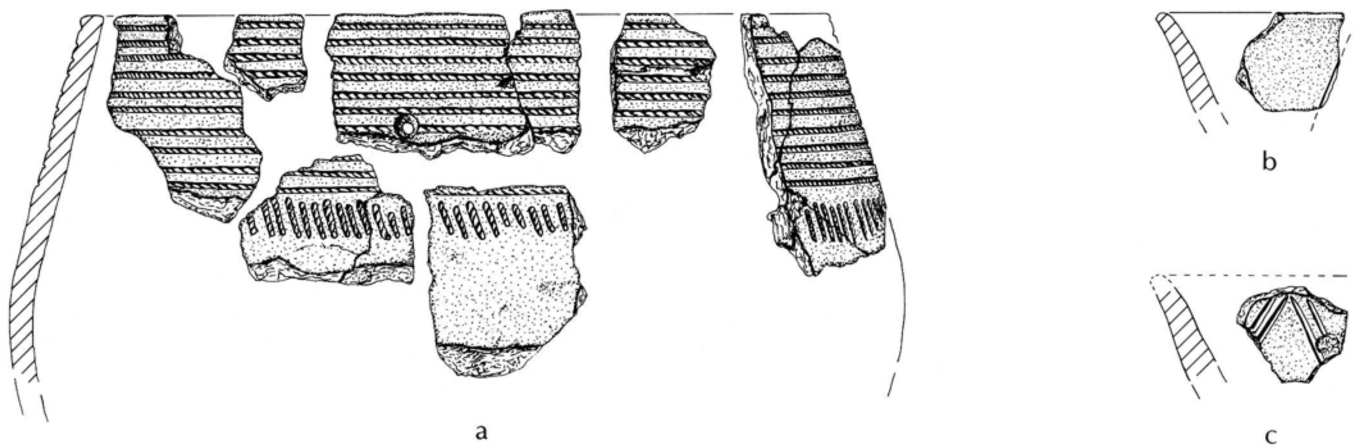


Fig. 7. Pottery from the pit Grødbygård 165. 1:2.

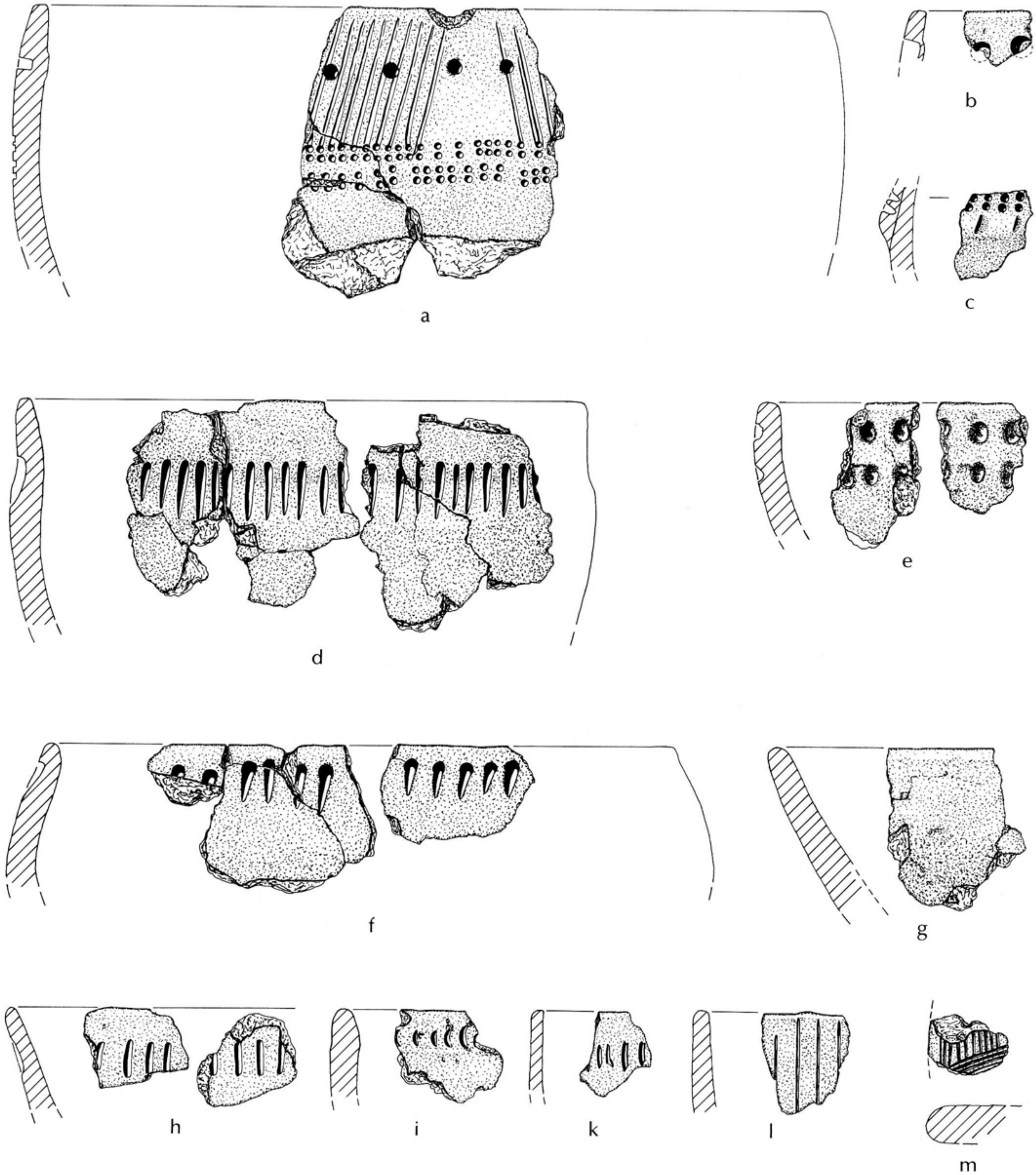


Fig. 8. Pottery from the pit Grødbygård 165. 1:2.

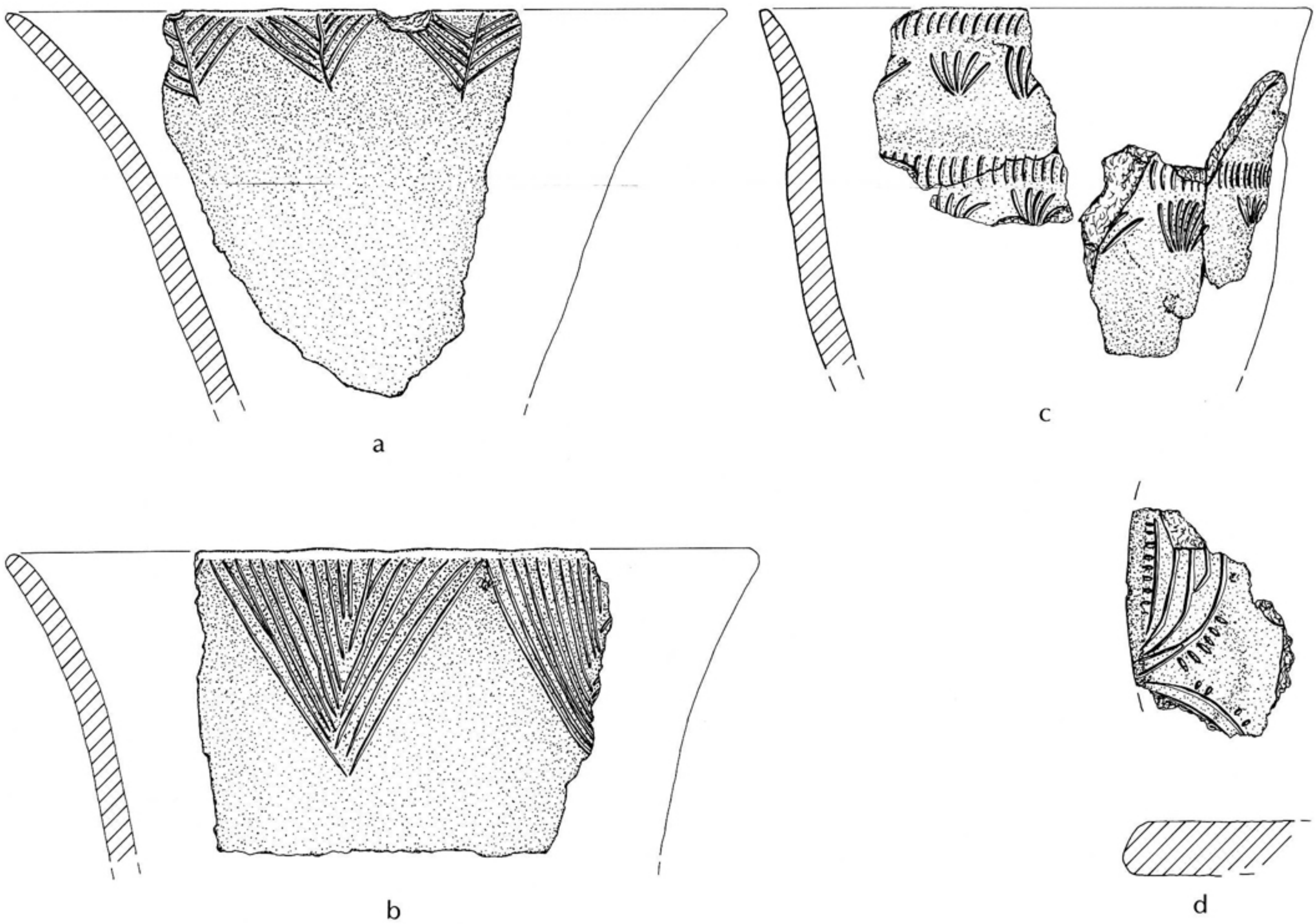


Fig. 9. Pottery from various post holes on the Grødbygård site. c and d were found in the same post hole. 1:2.

other material from the Pitted Ware Culture (Hulthén 1977, 123). Karlsfält 16:11 is regarded as late TRB (Larsson and Larsson 1984, 65). On the basis of the new material from Grødbygård and Limensgård (Nielsen and Nielsen, this vol. fig. 5–6) there seems no doubt that Hagestad 7:6 should be regarded as late TRB. This also implies that MN V, contrary to Davidsen's statement (1978, 163), *is* present in both Scania and Bornholm. It has already been suggested that the boundary between TRB and Pitted Ware Culture is difficult to define towards the final phases of the TRB. New material from both Scania and Bornholm suggests that the late TRB follows a different trend than in the rest of Denmark being clearly influenced by the Pitted Ware Culture. This is particularly obvious in the shapes of the vessels, which, however, *do* continue the TRB tradition.

To complete the presentation of the Neolithic houses from Grødbygård, it should be mentioned that the remains of several other houses were recorded, including at least one of Late Neolithic age. Due to the overlap with the Iron Age grave field no clear house plans could be established.

RUNEGÅRD EAST

The distribution of finds within the part of the investigated area of nearby Runegård, shown on fig. 12,

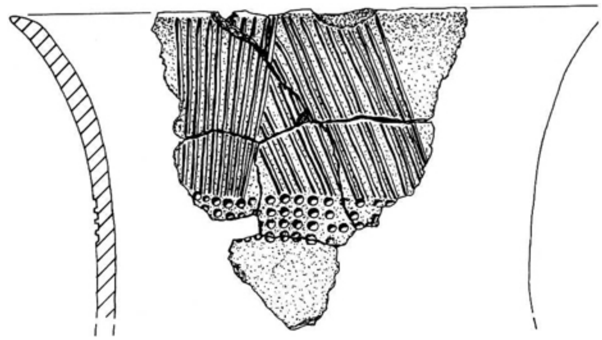


Fig. 11. Fragment of funnel beaker from Runegård East, site 4. 1:2.

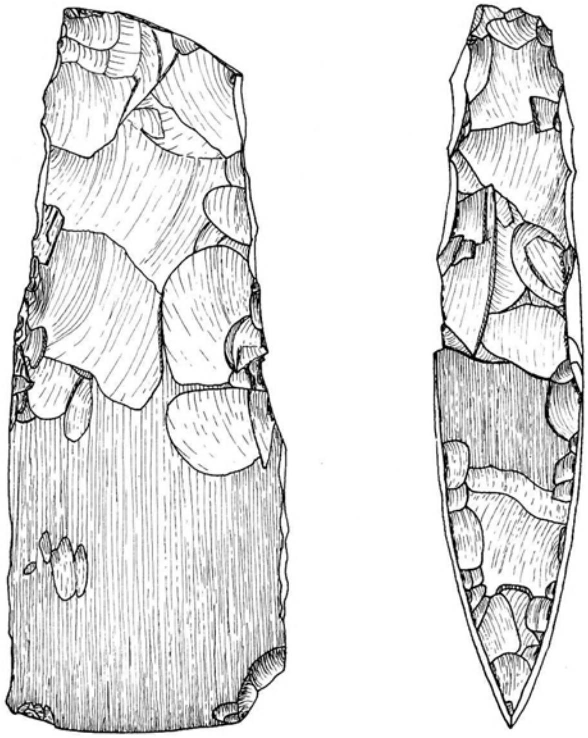


Fig. 10. Thick-butted axe of type B with secondary trimming of the butt end, possibly belonging to house B. 2:3.

indicates a number of well defined settlement areas each representing different and relatively "pure" phases of the Middle Neolithic TRB Culture.

Site 1 lies within a totally excavated area and consists of a large and fairly dense concentration of finds, partly protected, but also "perforated" by intense building activity in the Early Iron and Viking Ages. Much of the material originates from old soil horizons, but at least one definite house site can be distinguished among the remains of later date (fig. 13). The house appears to have had only two major roof supports each with a diameter of approximately 20 cm sunk at least 50 cm into the subsoil and a number of subsiduary posts of "wall-type". The house was orientated NW-SE measuring approximately 9.5 × 6.0 m. The fill of the post holes is of identical description consisting of a dark brown post imprint surrounded by a paler grey-brown sand. A second set of roof-supports, very close to the first, indicates that the house was either renewed or repaired. Though both holes for the second set of major roof supports closely match the first in both shape, size and fill, one of them (376) contained a large, bottomless, but otherwise complete vessel standing upright in the centre of the hole (fig. 14). Whether or not it had contained a post may be open to discussion, but its association with the house seems unquestionable. The slightly irregular line of wall posts indicates the presence of more than a single building phase.

The vessel from the hole (376) no doubt belongs to the funnel-beaker family, but is of a rather unusual type. However, parallels are known from southern Sweden. A vessel from Käglingavägen is of a similar shape but is undecorated (Larsson, M. 1984, 60). It was found in a pit associated with a sherd with whipped cord impressions. There were no signs of later disturbance which may have brought younger material into the pit indicating a date no earlier than EN C/MN I. Vessels of similar form occur in the upper "S-layer" of Siretorp (Bagge and Kjellmark 1939, Pl. 58). The characteristic decoration of small triangular pits marking the transition from belly to neck also occurs in the same strata at Siretorp (Begge and Kjellmark 1939, Pl. 68:5 and 68:10). The use of the Siretorp material for detailed chronological studies should be avoided due to its somewhat mixed character. It should be noted, though, that material of EN C and MN I character commonly occurs in the upper S-layers. Hence it seems most likely that the pot from the house at site 1 of Runegård East belongs to the transition period EN C/MN I or at the latest to the beginning of MN I. An earlier date

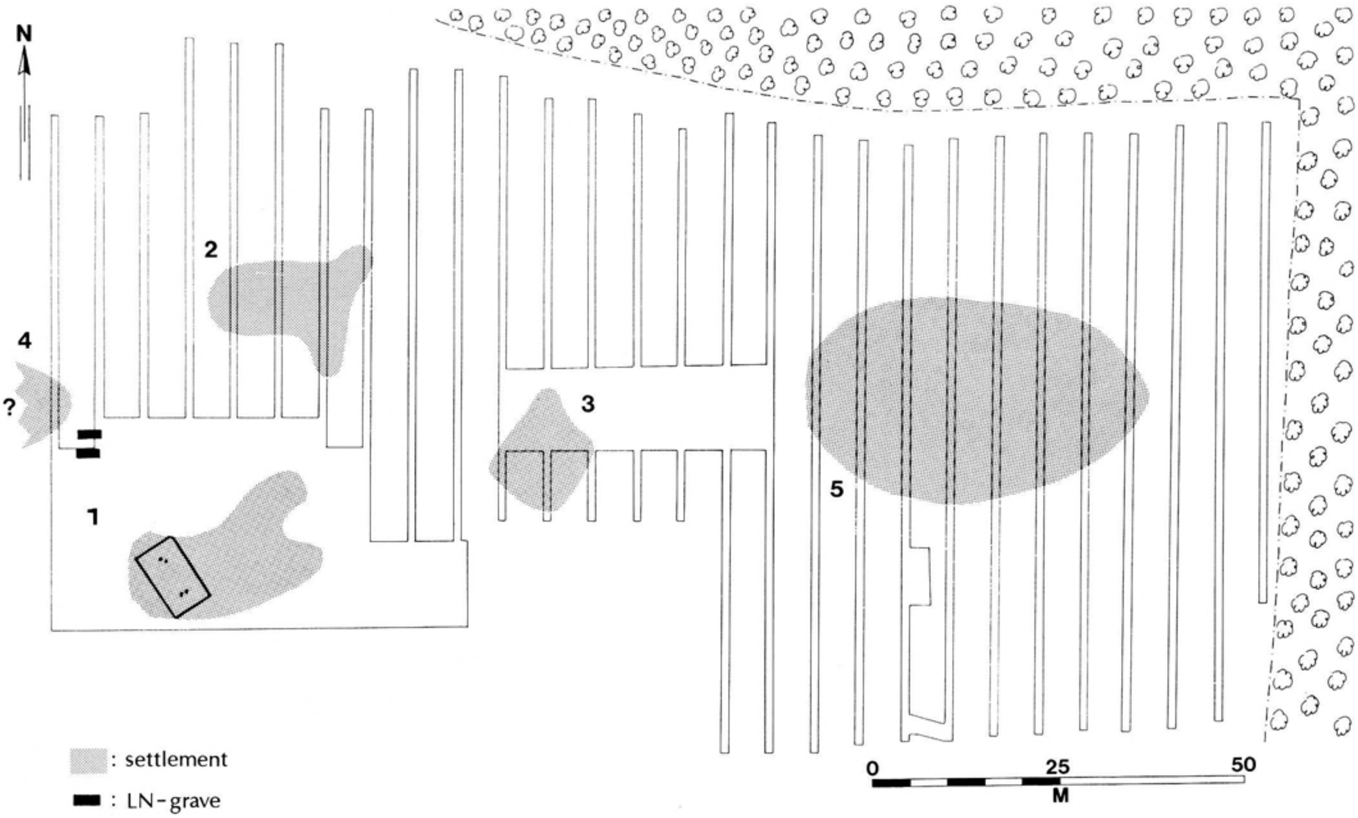


Fig. 12. Plan of the settlement area of Runegård East with indication of excavated areas and survey trenches.

may be precluded due to the absence of unmistakable EN C material on the site. Considering the density of finds of MN I character in the immediate vicinity of the house at Runegård site 1 it seems unavoidable that at least some of the immense number of sherds would have got into the fill of the post holes during the construction of the house, if it had taken place later than MN I. In this connection it should be noted that large numbers of sherds of MN pottery occur in the fill of nearly all later structures including Iron and Viking Age post holes. With this background it seems most likely that the Runegård house was built about the transition EN C/ MN I.

Large, compact heaps of sherds clearly belonging to MN Ia and MN Ib show that the settlement on site 1 continued and was intensified during the early MN. But so far no houses from this phase have been recorded. Among the more common types of vessels are funnel-beakers with a line of pits below the rim and vertically striped bellies (fig. 15a). Whipped cord ornamentation occurs on a number of pots, sometimes in combination with other elements (fig. 15e, f, g). A bowl with an almost cylindrical neck is covered with a two strained cord ornament (fig. 15d).

Pottery of MN Ib type is represented by pedestalled bowls and clay discs. While pottery of unquestionable MN II character does not appear in this concentration a small part of the material may be ascribed to MN III. This includes bowls with a combination of pits and triangular or zig-zag bands filled with dentate stamp ornamentation.

Site 2 includes a concentration of finds spanning 3–4 survey trenches, corresponding to 15–20 m (fig. 12). The site, which comprises several compact heaps of sherds, has been only partly excavated. The presence of several major roof-supporting posts seems promising for future detailed excavation of the site. Compared to site 1, site 2 seems clearly younger with fragments of shouldered vessels with a rather slack or indistinct profile. The decorative elements comprise zig-zag bands

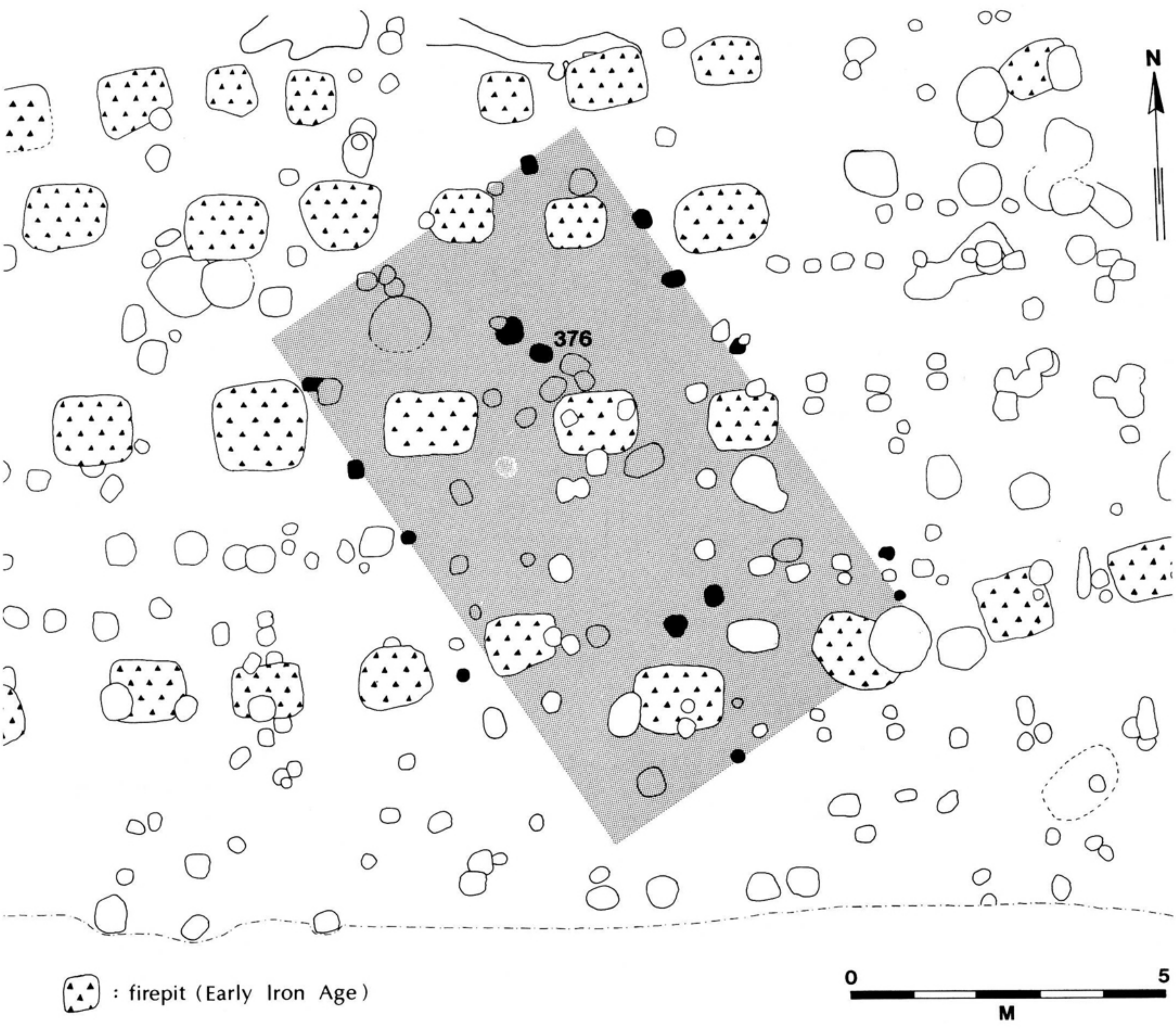


Fig. 13. Part of the totally excavated area of Runegård East with the early Middle Neolithic house (site 1).

below the rim and vertical bands filled with dentate stamp impressions on both neck, shoulder and belly. Belly decoration includes vertical "stab-and-drag" lines and occasional whipped cord. A fragment of a pedestalled bowl is considered to be introduced from site 1. Large storage vessels were also found on site 2 lying in thick and completely undisturbed heaps. The same applies to some clay discs covered with deeply cut circular stamp ornaments or with deeply incised concentric circles.

As a whole the finds from site 2 may be placed within MN II and possibly MN III.

The finds from *site 3* are much more imperfectly preserved originating from a redeposited soil horizon. However, the selection of ornament types differs clearly from the previous sites. Most common are different sorts of zig-zag lines below the rim, incised triangles and pits. Fragments of clay discs with cross-hatching or groups of incised lines occur. A tentative date of MN IV is suggested for this material.

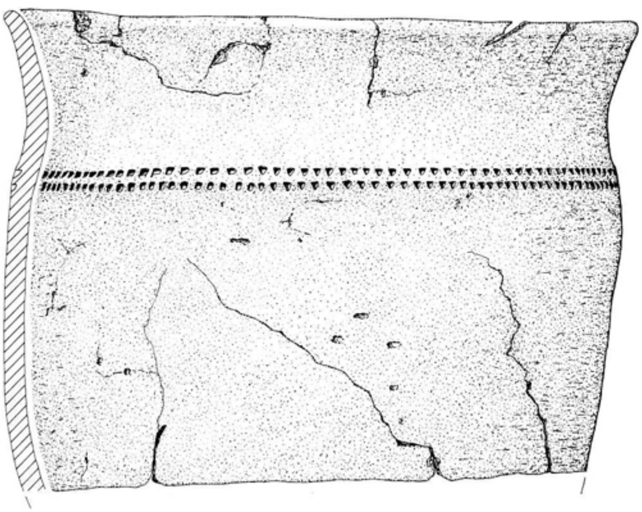


Fig. 14. Vessel from post or pit 376 of early Middle Neolithic age from Runegård East, site 1 (House A). 1:3.

The material from *site 4* is at present limited to finds from an at least slightly redeposited layer in the westernmost of the survey-trenches (fig. 12). The concentration appears to represent the edge of a larger, yet uninvestigated site. Of particular interest are fragments of a pot with a strongly everted rim decorated with groups of obliquely incised lines bordered below by a band of small circular pits (fig. 11). This form of decoration is matched in detail on semi-globular vessels from pit 165 at Grødbygård (fig. 8a) and from site 5 (below) as well as in the late MN house at Limensgård (Nielsen and Nielsen, this vol. fig. 5f-g). The material available meantime from Runegård site 4 indicates a date towards the end of the TRB.

Site 5 comprises finds from primary layers as well as old soil horizons in the survey trenches (fig. 12). The occurrence of post holes indicates the presence of houses which may be worthy of future investigation.

Much of the material available originates from a single pit (1108), the contents of which are closely related to that of Grødbygård pit 165 (cf. fig. 7–8). An additional element here is a rim fragment of a vessel of apparent Valby-type A (Davidsen 1978, 97 and fig. 50a). Vessels of this type have so far not been recorded on the Grødbygård site. Site 5 as a whole, and pit 1108 in particular, seems to belong very late within the TRB Culture.

DISCUSSION

The finds from the pits Grødbygård 165 and Runegård 1108 in particular indicate greater complexity when attempts are made to define chronological phases against "cultural" units towards the end of the MN. Further progress may be made only through continued investigation of closed and uncontaminated units. The interaction between the late TRB on one side and the Pitted Ware Culture on the other and their combined relationship to the Boat-Axe Culture seem most feasibly studied in close correlation with the development in southeast Scania.

The above selection of finds shows that settlement in the Grødby area must have been continuous starting some time during the Early Neolithic Period. While finds of EN B character occur only sporadically EN C is well represented at several localities by fragments of characteristic pottery as well as thin-butted axes.

The Early Neolithic settlement is supplemented by an inhumation grave with a cord-ornamented "B-beaker" closely resembling the one often depicted from Kofoedgård (i.a. Glob 1952 no. 7).

The presence of at least one passage grave (Jættedal) 500 m WNW of the settlement area fits the above evidence of a massive and stationary settlement established already in the early MN. The possible site of another megalithic tomb in the vicinity is mentioned by E. Vedel (1886, 248–49, 259), but no details of this are known. It may be worth noting that both megalithic tombs are situated on the far side of Grødby Å.

Burials from the later phases of the TRB Culture are so far not documented in the area, while one burial in a stone cist may be ascribed to the Battle-Axe culture. The grave was first investigated in 1876 and in it was found a flint axe with a hollow-ground edge (Vedel 1886, 250). During excavations in 1984 in the area "Runegård West" the remains of a stone cist was discovered showing signs of disturbance which may well have been caused by the earlier excavation. Close to the remains of the cist, and possibly in a secondary position, was found a flint axe of B-type attributed to the Boat-Axe Culture and the late Pitted Ware Culture (Nielsen 1977, 52).

A Late Neolithic settlement in the Grødby area is recorded sporadically by the presence of, for example, coarse bucket-shaped vessels with moulding. So far no house remains, even remotely comparable to those at

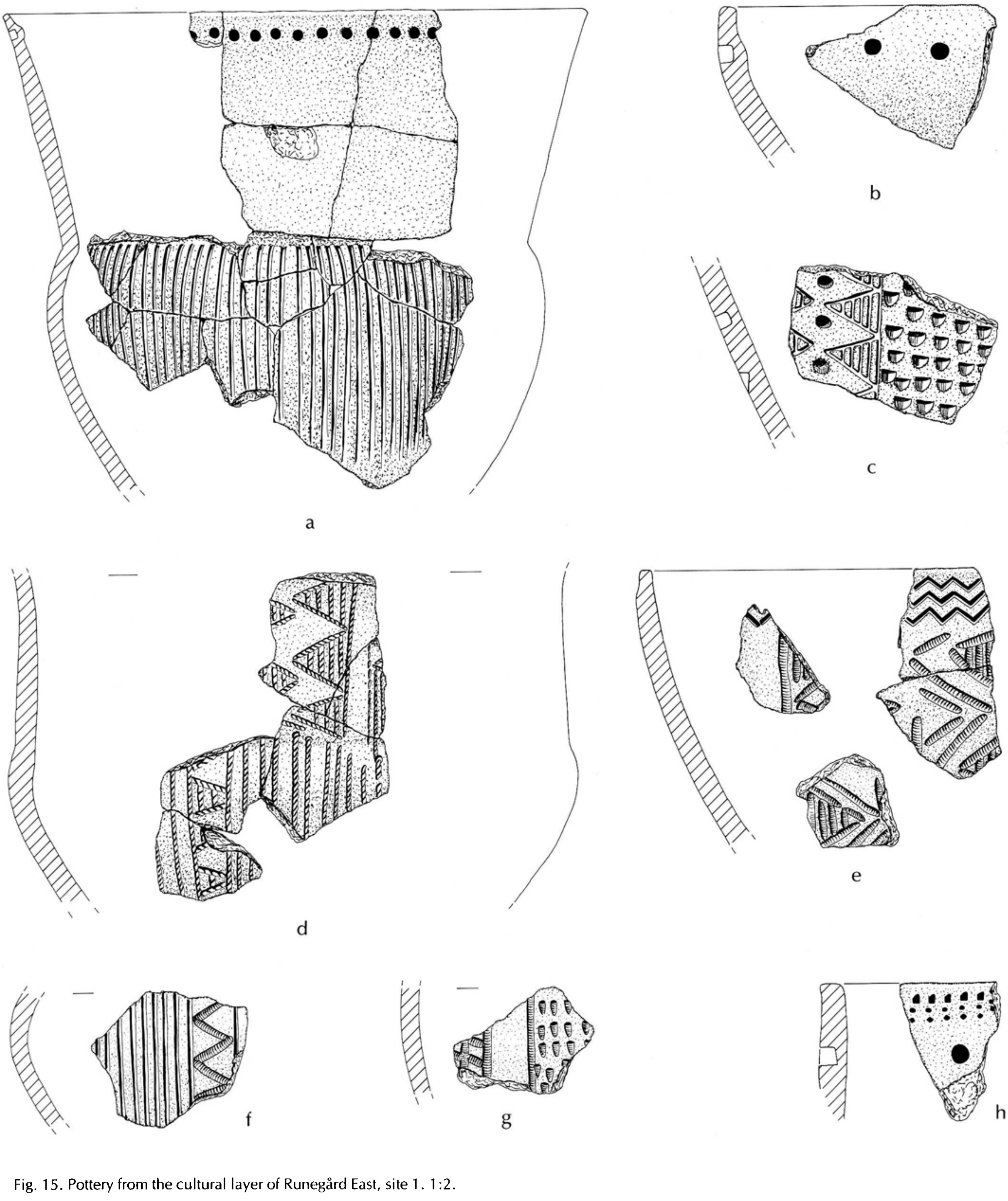


Fig. 15. Pottery from the cultural layer of Runegård East, site 1. 1:2.

Limensgård, have been recognised, but two stone cists placed side by side may be dated to this period on the basis of a flint dagger of Lomborg's type IIA (Lomborg 1973, 44). Stray finds indicate that the settlement may have consisted of several smaller units similar to those known from the later Middle Neolithic period.

In their presentation of the MN I settlement at Hanstedgård Eriksen and Madsen summarise and discuss the hitherto known or postulated houses of Middle Neolithic Age (Eriksen and Madsen 1984, 81). They reach the depressing conclusion that so far no satisfactory documentation has been presented for substantial houses of this period.

The presentation of several near contemporaneous houses from Grødbygård (above) and Limensgård (Nielsen and Nielsen, this vol.) built on an apparently identical plan, is considered sufficient evidence for the presence of fully developed post-built houses in the Middle Neolithic. Late Neolithic houses of the Limensgård type form a natural further development on the same basic pattern. The remains of houses dating from the onset of the MN period (Runegård site 1) indicate that the development of substantial post-built houses had begun already at this early age.

Skaarup's unwillingness to accept that the builders of intricate megalithic tombs for the dead were incapable of building substantial dwellings for the living has fortunately proved justified (Skaarup 1982, 39–52).

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NOTE

1. Sognebeskrivelsen (Central Register) nos. 202 and 205, Aaker parish; Bornholms Museum j.nr. 677 (Runegård East and West), j.nr. 948 (Grødbygård), j.nr. 944, 1004 and 1105 (various minor sites). The excavations were financed by *Bornholms Museum*, *Rigsantikvaren*, *Fredningsstyrelsen*, The Danish Research Council for the Humanities, and *Harboes Fond*.

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Journal of Danish Archaeology vol. 4, 1985, pp 101–114

Middle and Late Neolithic Houses at Limensgård, Bornholm

A Preliminary Report

by FINN OLE NIELSEN and POUL OTTO NIELSEN

Traces of Neolithic habitation on the island of Bornholm have most often been found during excavations with remains from the later prehistoric periods as their main objective (1). The first Neolithic house-sites appeared in much the same way being by-products of excavations conducted recently at Runegård, Grødbygård and Limensgård, all in the southern part of the island. The Middle Neolithic houses at Runegård and Grødbygård are dealt with in a separate paper (Kempfner-Jørgensen & Watt, this volume), whereas an account of the Middle and Late Neolithic houses at Limensgård is presented here in preliminary form.

SITE LOCATION

The settlement at Limensgård lies 37 m above sea level on a sandy ridge east of the river Læså c. 2 km from the south coast (2). Burial mounds are situated near Limensgård on both sides of the river. One of these, *Bøsthøj*, c. 200 m W of the settlement, contained stone cists with Late Neolithic and Early Bronze Age burials (Aner & Kersten 1977: 33–44). About 300 m E of the settlement are the ploughed-over remains of another mound, *Fonghøj*. According to a report from 1880 by the school teacher and archaeologist J. A. Jørgensen, this was the location of the finds from Store Munkegård with flint axes, chisels, and stone battle axes of the Battle Axe Culture, acquired by the Museum of Northern Antiquities (the National Museum) in 1836 (3). The artifacts were reported found in a stone cist. Stone cists have also been located in a now completely levelled mound at the top of the hill, *Rævekule Bakke*, where the excavation took place in 1984. A number of large cists contained artifacts of stone and bronze (4). Stray finds from the ploughed fields indicate that most of the area between Bøsthøj and Fonghøj was settled in the Neolithic (see fig. 1). The soil is mostly light and sandy but patches of fine, calcareous clay reach the surface here and there. Within parts of the excavated area the sand only covers the clayey subsoil in a 0.2 – 1.0 m thick layer. Some of the prehistoric features were dug through the sand into the clay below. The local geology offers favourable conditions for the excavators because precipitation is allowed to sieve away from the surface, while at the same time the subsoil keeps moisture longer in dry periods. The naturally drained ground may have been advantageous for the prehistoric occupants as well. The site was settled repeatedly in the Early, Middle, and Late Neolithic, the Bronze Age and the Early Iron Age. North of the settlement lies the *Ugleenge*, a formerly waterlogged area on a tabular formation of sandstone. The natural environment thus offers favourable conditions for a rural economy: light, arrable land, freshwater, green meadows for pasture.

THE EXCAVATION

When Bornholms Museum in 1983 undertook an excavation to recover a series of cremation graves from the Late Bronze Age – Early Iron Age it was discovered that there were postholes and other features from a Neolithic occupation at the site. Trial trenches revealed that the settlement was extensive and partly exposed to disturbance. In 1984 the investigation was continued jointly by Bornholms Museum and the National Museum, covering an area of c. 1,600 sq.m. (5) (fig. 2).

The topsoil was removed with a caterpillar excavator. A cautious use of machinery was necessary as numerous secondary features appeared, including cremation graves, fire pits from the Bronze Age, and house-remains from the Early Iron Age. Consequently a large amount of topsoil had to be removed with the showel. The absence of any preserved house-floors allowed the site to be cleared to the surface of the subsoil once the

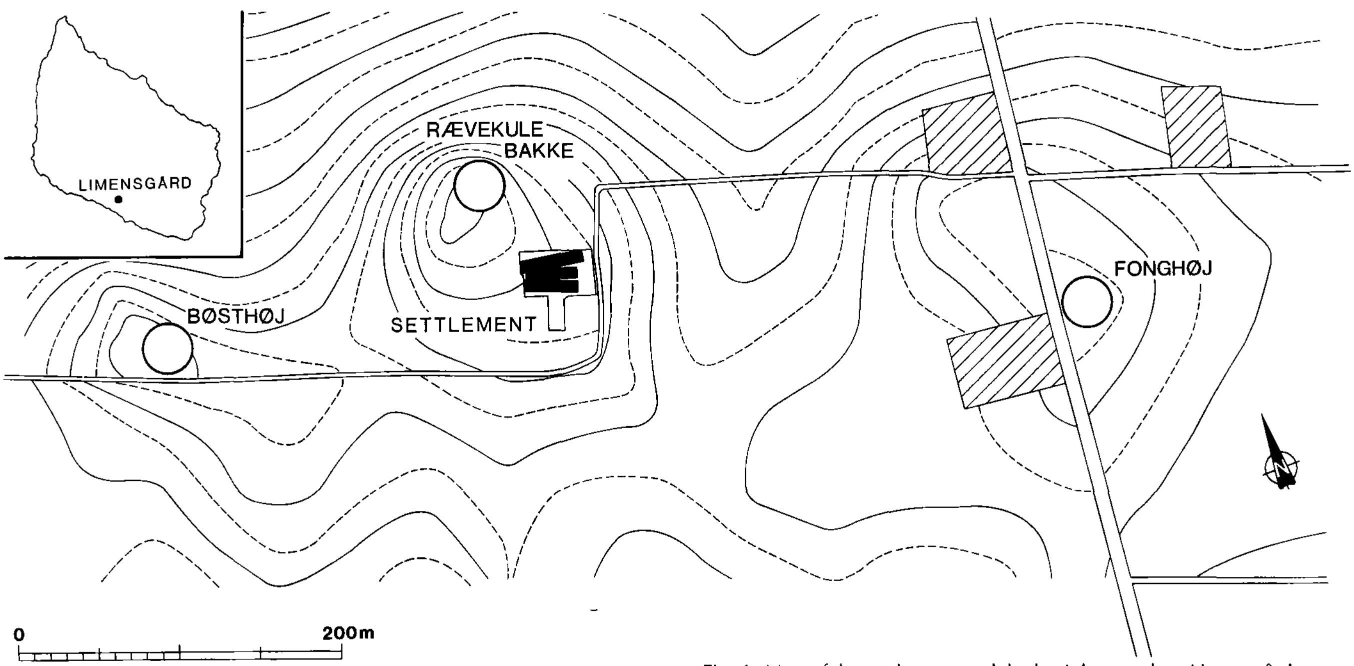


Fig. 1. Map of the settlement and the burial mounds at Limensgård.

secondary features had been recorded and excavated. All pits, postholes, and remains of structures were drawn and sectioned. Special attention was paid to overlapping features where horizontal clearing and cutting of sections were often repeated. As for the majority of the postholes belonging to the Neolithic buildings there was a clear distinction between the fill of the holes and the imprints of the posts. From the sections of the postholes it was often possible to determine whether posts had been removed or whether they had decayed in their original position. Finds from the fill of the holes and from the back-fill in the cavities after removed posts were collected and recorded separately. The fill of the postholes differed both in the degree of colouring and in their contents of settlement debris. The date of the finds from the fill and the back-fill of the postholes, and the characteristics of the postholes and their intersections, provide the basis for conclusions about the relative age of the buildings.

THE MIDDLE NEOLITHIC HOUSE

The stratigraphic position of this building, House Y (fig. 3), is determined by the intersecting postholes and pits belonging to the Late Neolithic Houses S and T and by a small pit intersected by the house and containing an Early Neolithic cord ornamented potsherd. House Y was badly disturbed by later digging activities, and its southern end had recently been damaged by ploughing. Beside the disturbances caused by modern cultivation more irregular plough-marks were detected over the house-site to the south-east, probably traces of ard-ploughing in prehistoric time. The full length of the house cannot be determined. In its preserved state it measures 6.2 by 18 metres, being NNE-SSW alligned. The living-floor is confined by a narrow trench best preserved at the northern end and interpreted as the foundation of the walls (fig. 4). The remaining parts of the trench were only a few cms deep. A longitudinal section was made but no stakeholes were detected in the trench. The fill of the postholes and of the wall had a uniform, light greyish colour different from the fill of later postholes and pits at the settlement.

There are five central postholes placed on a nearly straight line along the long axis and spaced with 2.5 – 3.0 m intervals. They are from 0.2 to 0.5 m deep and the two northernmost holes have a darker core which repre-

Fig. 2. Plan of the 1984 excavation at Limensgård. Beside the Neolithic houses marked on the plan there were numerous secondary features, i.a. 27 cinerary graves of the Late Bronze Age/Early Iron Age, two Iron Age houses, 27 fire-pits, and a number of pits and postholes, shown on the plan in neutral outline. 1:200.


House S
House T
House
Y
House AB
House R
10 m

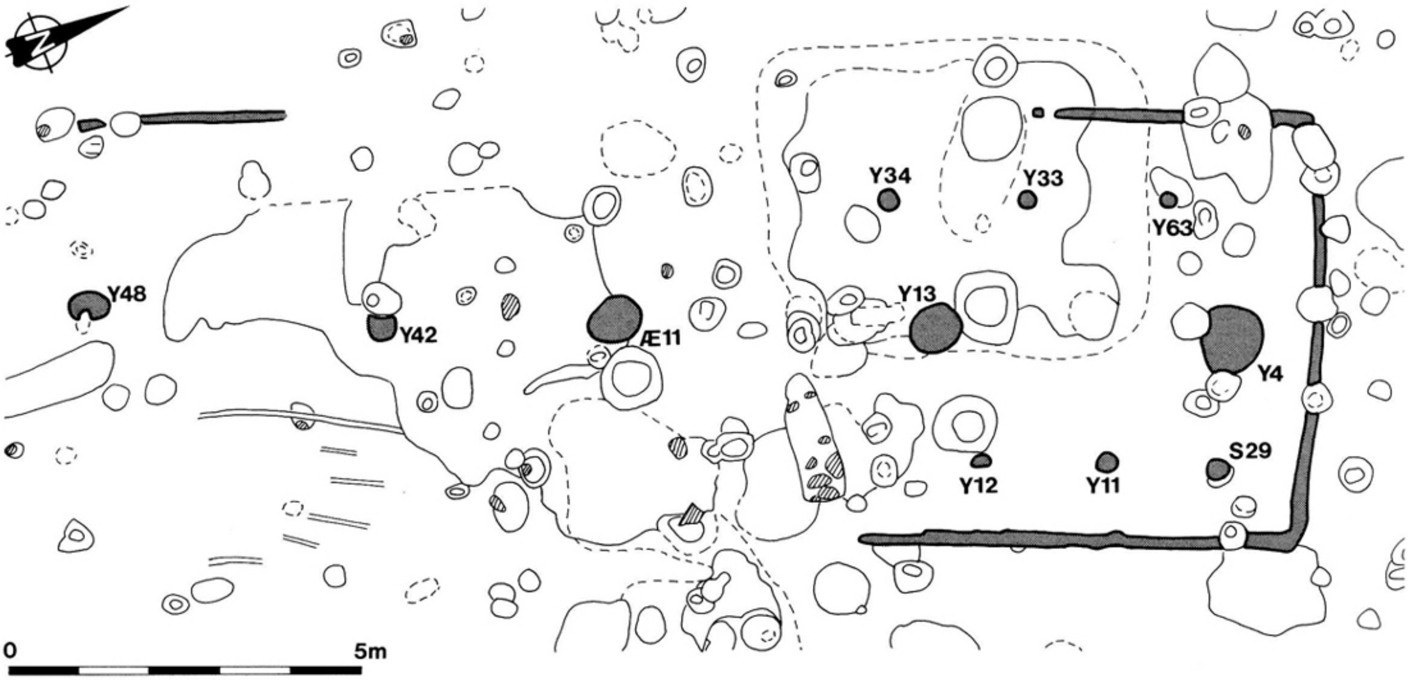


Fig. 3. House Y, the Middle Neolithic house at Limensgård. The postholes and the wall trench are shaded. Secondary features are shown in neutral outline. 1:100.

sents the back-fill from pulling up the posts when the house was abandoned. There were no clearly preserved imprints of posts left *in situ* in the central postholes, so the diameter of the original posts could not be established.

Six smaller postholes were distributed along two roughly parallel lines c. 1 m inside the walls and spaced with c. 1.5 m intervals. The depths of these holes were quite uniform, four measured c. 0.15 m, two only 0.10 m.

It is estimated that the length of House Y cannot have been less than c. 19 meters, and the term 'long-house' should therefore be appropriate. The principal elements of its construction are clear in spite of the many disturbances. The solid central posts would have supported a ridge beam (*ås*), while the more slender posts parallel to the walls probably carried the weight of side beams (*sideåse*) supporting the lower part of the rafters of the roof. In this way the roof would rest on the interior posts alone and not on the walls which apparently lacked posts with a solid foundation. The internal posts are not placed opposite each other and could not have been interconnected with tie beams. However, the supposed longitudinal side beams supported by the internal uprights were possibly connected in some way by transversal beams to sustain the weight of the roof. No further details of the house can be deduced, nor were any doorways, fire-places, or internal partitioning observed.

Finds

Flint. Because of the scarcity of natural flint resources in Bornholm, no great amount of flint tools and waste is usually recovered at the Stone Age settlements on the island. Discarded flint was kept and reused until the flakes and cores were reduced to finger-nail size. Whole tools made from imported flint are likely to be found only when lost by accident or when buried intentionally in the ground. Associated with House Y were only one whole blade and 85 pieces of worked flint, mostly flakes from small flint nodules. No datable artifacts of flint were found.

Pottery. Four of the five central postholes contained pottery fragments:

Major parts of three vessels were found in *posthole Y.4*: 1) Fragments of the upper part of a vessel with an inward curved profile and decorated with a single row of circular impressions below the rim. The impressions are stamped into the clay with a hollow instrument (fig. 5:a). – 2) The upper and lower parts of a bowl with a wide, in-curving rim and a protruding foot. It has a single line of circular impressions below the rim. The vessel is rather fragmentary, and a full reconstruction is not attempted although the parts illustrated in fig. 5:c and d both belong to it. – 3) Sherds of a funnel-shaped beaker ornamented with a horizontal zone of small, square impressions and with fine, parallel lines grouped in bands on the upper part (fig. 5:h). – Nos. 1 and 2 are made from an almost clean clay substance but tempered with very large grains of granite measuring up to 0.5 cm. This tempering is so conspicuous that we may speak of a 'stone-tempered' ware. No. 3 is made in a finer technique and the ware is very hard and compact showing no coarse tempering.

Posthole Y.13 contained a small sherd of a vessel (fig. 5:f) decorated like fig. 5:h.

Posthole Æ.11 produced one small sherd with a similar decoration and two fragments of a clay disc with a casual line ornamentation (fig. 6:a–b).

In *posthole Y.48* there was a sherd of a beaker with slightly out-curved rim and decorated with a hanging triangle motif (fig. 5:e).

From one of the small postholes, *Y.11*, comes the narrow, rounded base of a small beaker (fig. 5:g).

The wall trench contained a small fragment of a clay disc with linear ornamentation and sherds of a beaker-like vessel with bands of fine, vertical lines (fig. 5:b).

Dating

The pottery assemblage from House Y includes shapes, techniques, and ornamental design showing close similarities with the pottery from the two house-sites at Grødbygård (Kempfner-Jørgensen & Watt figs. 6–9). Pottery of this type has not been found before in a clear settlement context in Bornholm and it differs in almost every way from the TRB pottery previously known from the periods I–III of the Middle Neolithic. The dating proposed here therefore has to be of a preliminary nature. There are indications, however, of stylistic connections with both the late TRB pottery and with the Pitted Ware pottery.

Fig. 4. The northern part of House Y with the wall trench seen from the east.

Formerly, pottery of the MN V was assumed not to be present neither in Scania nor Bornholm (Davidsen 1978: 163). But recently Lars Larsson has presented a number of Swedish settlement finds with MN V pottery associated with Pitted Ware Culture material (Larsson 1982). In Bornholm still no pottery is found that shows the characteristic features of the MN V as far as the coarse, bucket-shaped pots with finger-impressions and -grooves are concerned. With the small tulip-shaped beakers from Limensgård and Grødbygård we may nevertheless find resemblances with the small, often unornamented beakers of the MN V from western Denmark (i.a. Davidsen 1978 Pl. 76:d, 85:o, and Ebbesen 1975 Fig. 89:9).

If we turn to the Pitted Ware Culture, comparison has to be made with pottery from Swedish sites as we fail to find suitable reference material on Bornholm. First we should mention the only partly published settlement material from Hagestad 7:6 in SE Scania

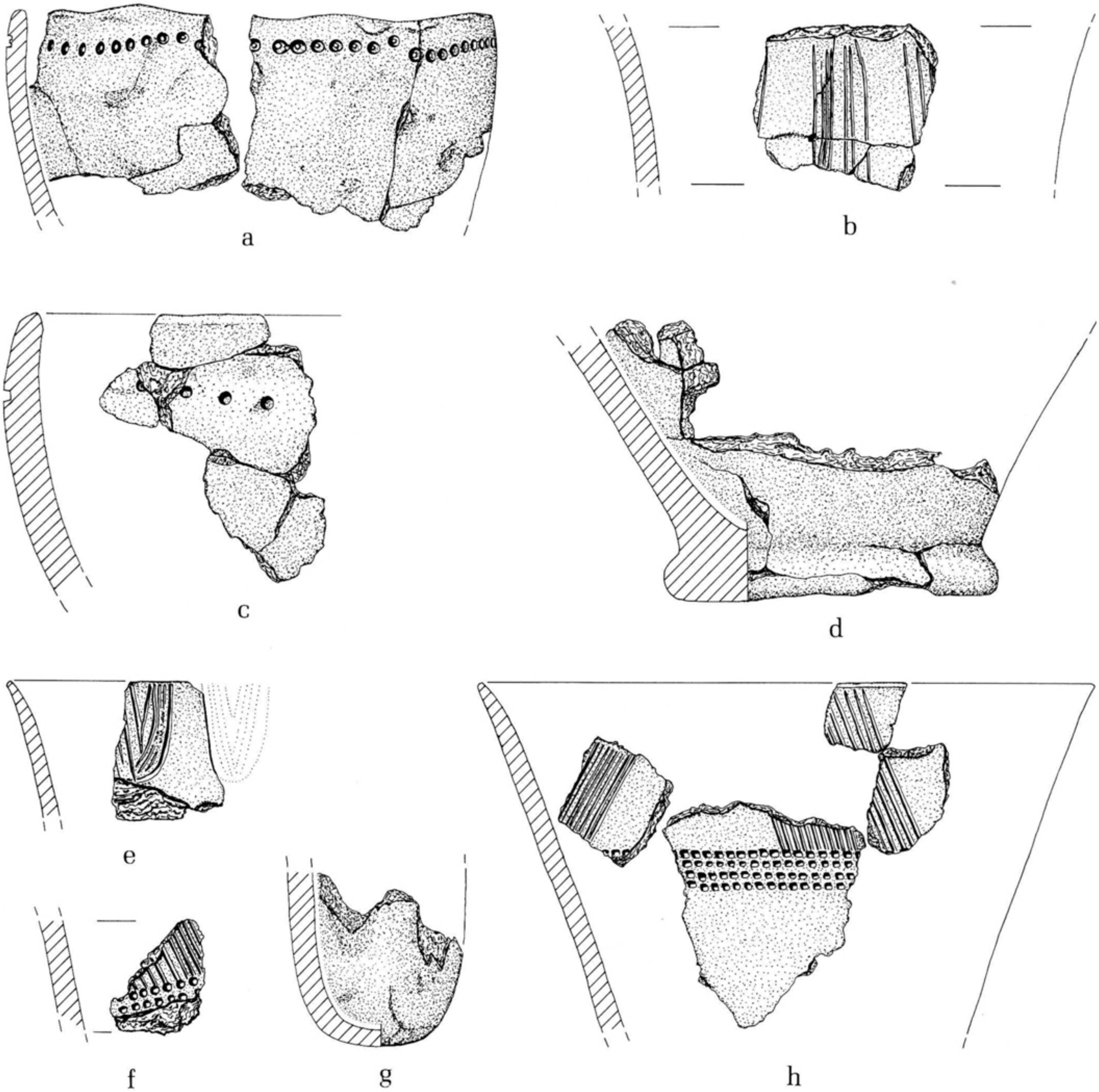


Fig. 5. Pottery from House Y. 1:2 (drawn by Lars Kempfner-Jørgensen).

which has been attributed to the Pitted Ware Culture by Birgitta Hulthén. It includes i.a. sherds of beakers with a hanging triangle motif very similar to the beakers from Grødbygård (Hulthén 1977: 140, figs. 85, 95). Hulthén proposes a Globular Amphora origin for this motif. The beaker fragments from Hagestad 7:6 are otherwise comparable with the Limensgård and Grødbygård beakers having the same profile and a thick, rounded base (cp. Hulthén fig. 84a). A beaker fragment of related form was recently found at Karlsfält near

Ystad. This specimen has a belly-ridge and a decoration executed with a toothed stamp (Larsson & Larsson fig. 33:1). At both Hagestad 7:6 and Karlsfält thick clay discs of the MN V type with concentric arcs are common. The same kind of ornamentation on clay discs is known from Jonstorp M3 and Stävie in western Scania where MN V pottery vessels are also documented, notably at Stävie (Larsson 1982). Vessels with protruding foot like the one from Limensgård (fig. 5:c–d) are also paralleled at Pitted Ware sites in Sweden, i.a. at Jonstorp M3 where, according to Lidén (1940: 170), 50 % of the pottery bases exhibit this feature.

There are a few settlement finds from Bornholm with pottery of the Battle Axe Culture (Becker 1947: 163, Fig. 38; 1982a Fig. 5). They seem to belong to a developed stage of that culture while the early phase is still not documented. It is not irrelevant, therefore, to point out the special character of the cord-ornamented vessel from pit no. 165 at Grødbygård (Kempfner-Jørgensen & Watt fig. 7a) and other parts of vessels from the same pit showing a bowl-shaped profile recalling the pots from the early Battle Axe Culture in Sweden (Malmer 1962, vessel types A and B).

With the Middle Neolithic pottery from Limensgård and Grødbygård we are dealing with a distinctive local pottery manufacture influenced, however, to a certain degree by contemporaneous pottery styles especially in neighbouring South Sweden and maybe on the Continent, too. During the period in question stylistic links with the Danish islands to the west may be less distinct. At the present stage of research we would suggest a date for the Limensgård and the Grødbygård pottery close to the end of the TRB Culture and the start of the Battle Axe Culture. Further research at the Neolithic settlement sites in the island may give an opportunity to observe the changes in material culture that took place during this much disputed transitional period.

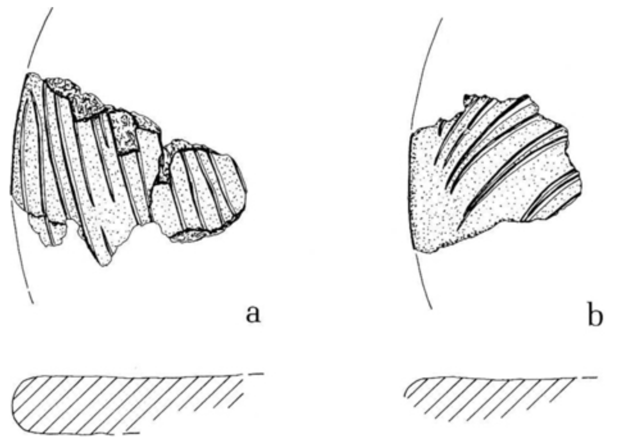


Fig. 6. Clay disc fragments from House Y. 1:2 (drawn by Lars Kempfner-Jørgensen).

LATE NEOLITHIC HOUSES

During the 1984 excavation four partly overlapping, Late Neolithic long-houses were investigated: House R, S, T, and AB (see plan fig. 2). Apart from a depression in House S which is interpreted as a sunken floor, only the postholes of the buildings are preserved. Although the dimensions differ, the houses display striking similarities in construction. This is clearly seen when comparing the plans of the three best preserved houses (fig. 8): the main roof-supporting posts are arranged at irregular intervals along the longitudinal axis, flanked on both sides by lateral supports placed close to the walls. The wall posts are set at 1.5 – 2.0 m intervals. No doorways were identified with certainty, and the gable-ends were not always clearly defined. As for House S, T, and AB, the distance between the side walls increased by 0.5 – 1.0 m towards the ends.

House R is situated in the partly excavated area to the south where there were most disturbances. The length of the building is not determined but it is documented over a distance of 28 m. The posts of the southern wall were not identified. The distance between the central posts and the northern wall was 2.0 – 3.25 m, making the total width no more than c. 6.5 m. House R is determined to be older than the overlapping House S. This conclusion is based on both stratigraphy and on the fill in the postholes.

Finds: The central postholes of the house contained sherds of a coarse ware, i.a. fragments of a large vessel with barbed wire decoration (fig. 10), and sherds of pots with condoned rim. The limited number of flint tools include two large, oval flake scrapers of Late Neolithic/ Early Bronze Age type and a small, 9.4 cm long flint axe.

Fig. 7. Late Neolithic house during excavation, seen from the east (House S).

House S is 40 m long (fig. 7). At the middle it is 7.5 m wide, while at the ends it measures 8.0 m. Between the roof-supporting posts approx. in the middle of the house there was a rectangular depression, 4.5 by 5.5 m, with a dark fill, which we interpret as a sunken floor.

Finds: The depression contained a large amount of settlement debris. Among the finds were hammer-stones, an edge fragment of a stone battle axe, and a single handle fragment of a flint dagger, type I. Beside an admixture of earlier Neolithic pottery the depres-

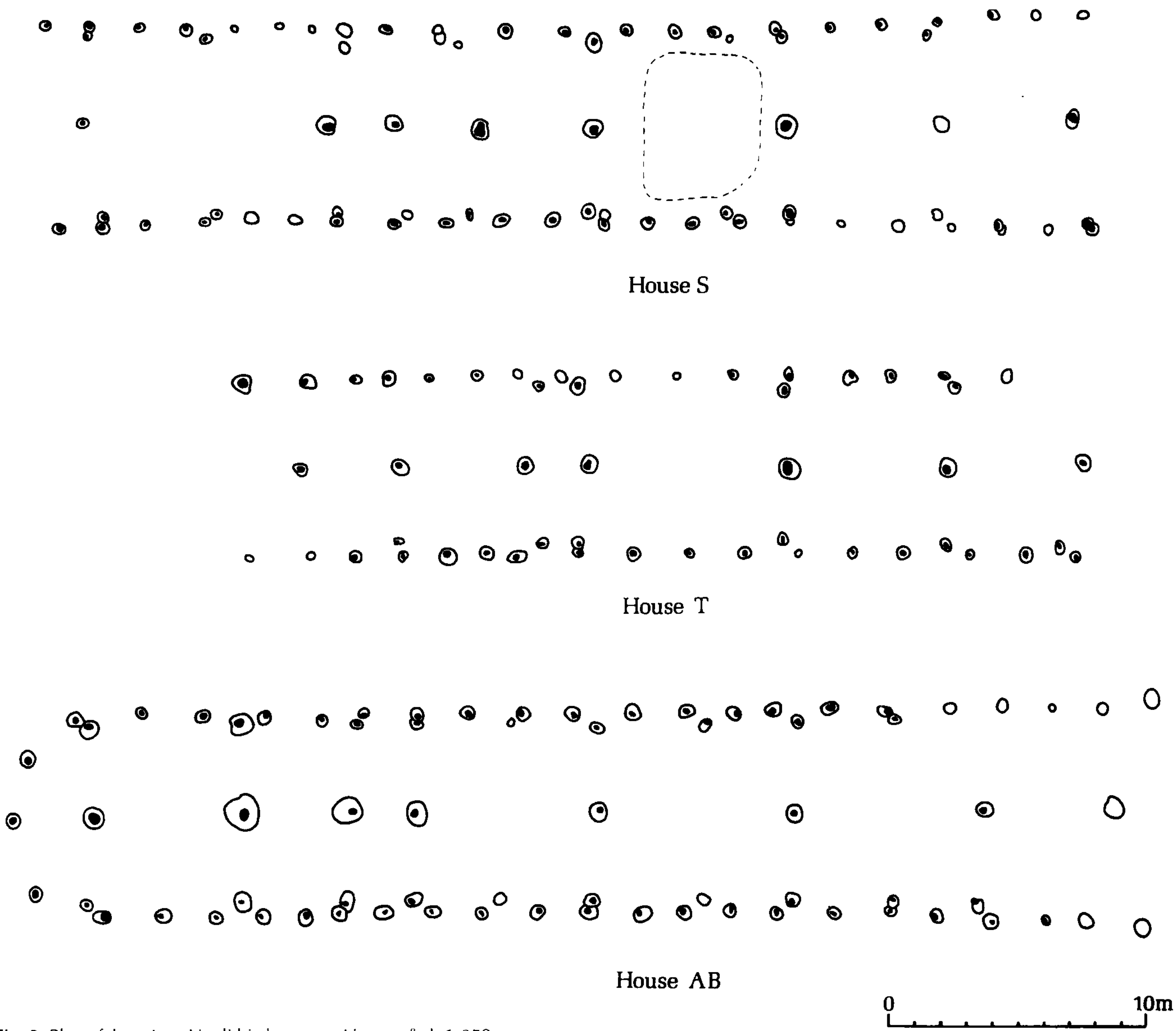


Fig. 8. Plan of three Late Neolithic houses at Limensgård. 1:250.

sion contained small fragments of cordoned vessels and barbed wire ornamented sherds. From one of the postholes of House S comes a sherd of a small pot with the unusual combination of a cordon and a lug below the rim (fig. 11b).

House T. The two houses, S and T, are not overlapping but are lying so close together that they could not have been coexistent. House T is stratigraphically older than House AB. Over its eastern end two long-houses were built during the Iron Age. The later disturbances account for the missing postholes at the eastern end of House T. The house is 32 m long. It is 6.5 m wide at the western end and 7.0 m at the eastern end.

Finds: A modest quantity of flint and pottery was recovered from the postholes of the house. A few potsherds belong to vessels with cordoned rim, and one sherd had barbed wire ornamentation. A fragment of a loomweight of lightly fired clay was found in a posthole at the western end of the house (fig. 11c).

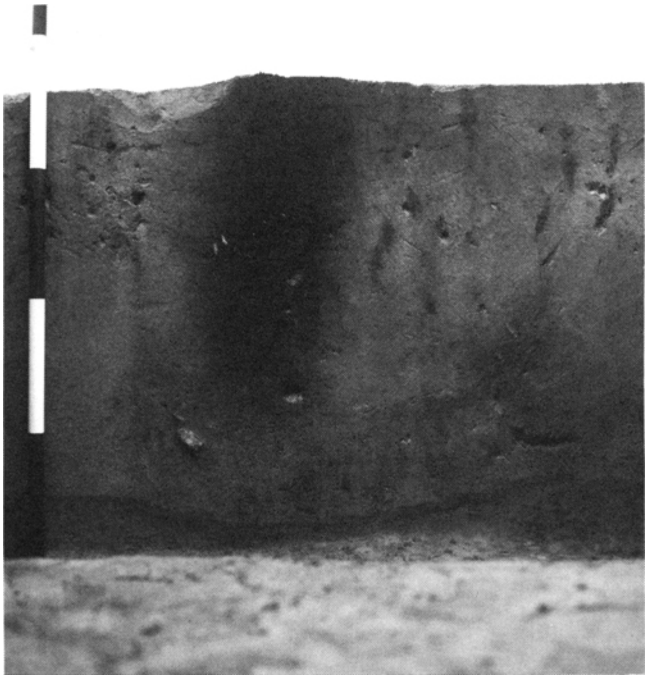


Fig. 9. Section of posthole in House AB. Lateral support no. AB26 inside the northern wall. Seen from the west.

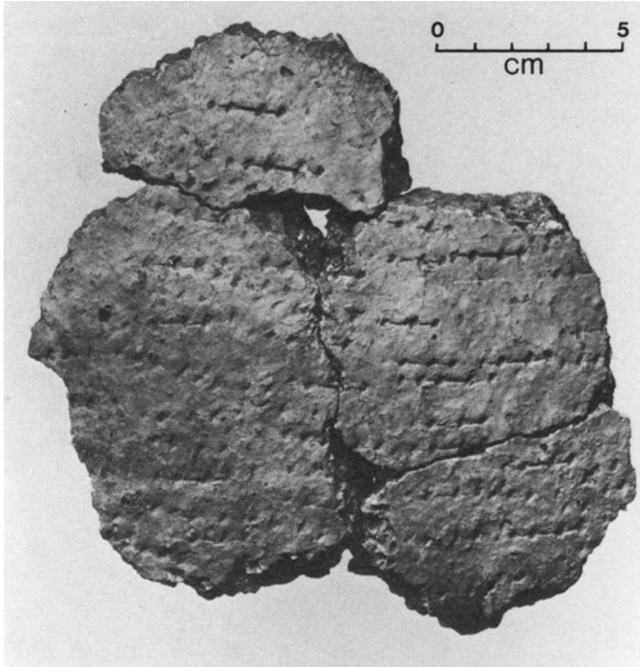


Fig. 10. Fragment of a large vessel with barbed wire ornament from House R at Limensgård (L. Larsen photo).

House AB is the largest and possibly the latest of the four houses excavated. At the eastern end observations were unfavourable due to later disturbances and to a change in the character of the subsoil. The western end has a rounded gable. The length of the house is 44 m. It is 7.5 m wide at the western end and exceeds 8.0 m at the eastern end. House AB is the only house with paired, lateral supports placed inside the walls in the intervals between the central, roof-supporting posts.

Finds: Fragments of a large storage vessel with outturned rim and a cordon was found in a posthole at the western end (fig. 11a).

In all of the Late Neolithic houses, the imprints of the posts offered details about the size and quality of the timber-work employed. All observations, except perhaps at the corner-posts, indicate that the posts had been vertical. However, no remains of the actual posts were left in the sandy subsoil. The reason why the imprints of the posts appeared so distinctly in many of the sections as dark, vertical stripes (cf. fig. 9) may be the result of charring the surface of the wood as a means of conservation before it was set in the ground. There were no traces of posts being replaced in any of the houses.

In the horizontal cuts the cross-section of the wall posts could often be clearly discerned. In House R, S, and T the posts were either circular, oval, or rectangular in cross-section. In House T rectangular posts were used regularly for the lateral supports. In House AB the majority of the wall posts were triangular in cross-section which is suggesting the use of timber split along the pith. The wall posts were 10 – 15 cm in diameter. The greatest depths of the postholes were measured in House AB where the imprints of the wall posts reached down to c. 70 cm below the surface of the subsoil. There appeared to be a connection between the depth and the diameter of the postholes. As is seen from the plan fig. 2, the postholes of House AB were larger than those of the other houses. The depths of the holes were also clearly a function of the dimensions of the house. The lateral supports that were part of the roof-supporting construction were in general of the same depth as the wall posts. Only in House AB some were slightly

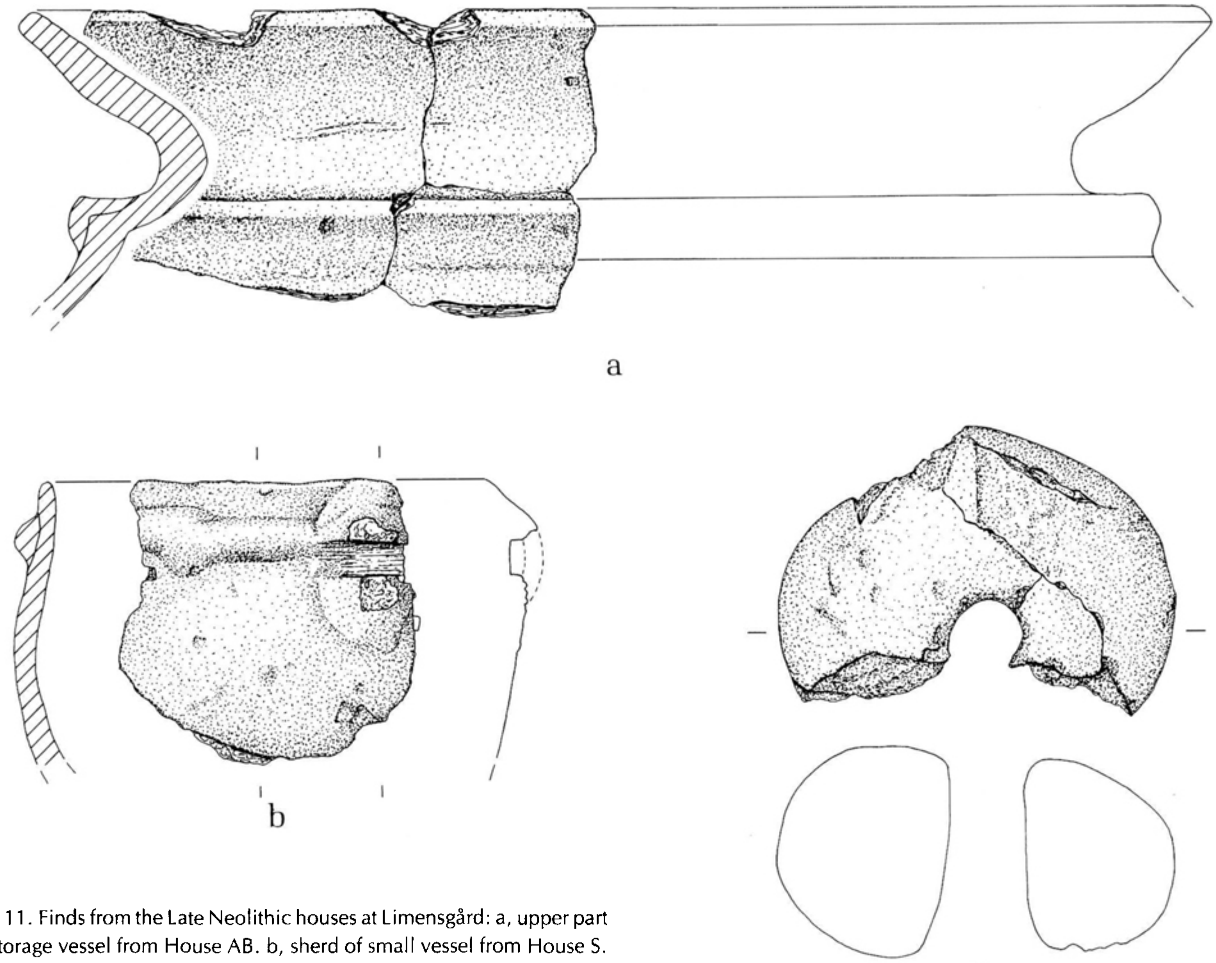


Fig. 11. Finds from the Late Neolithic houses at Limensgård: a, upper part of storage vessel from House AB. b, sherd of small vessel from House S. c, loom-weight from House T. 1:2 (drawn by Lars Kempfner-Jørgensen).

deeper. The central posts were all circular in cross-section and were 15 – 20 cm in diameter. In House AB some of the holes dug for the central posts exceeded 1 m in diameter and in depth.

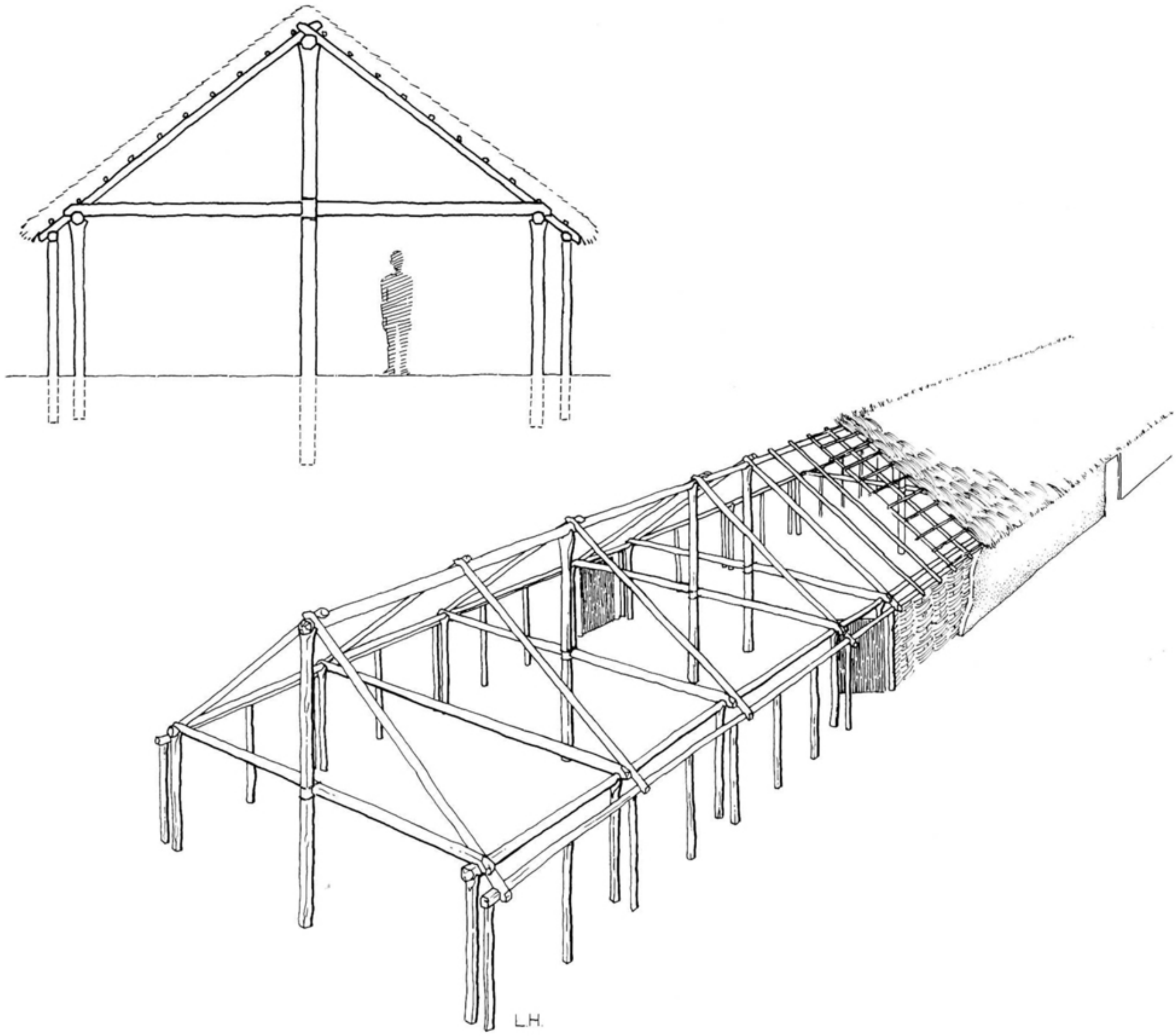
A reconstruction sketch of House AB is attempted to illustrate the constructional principle of the Late Neolithic houses (fig. 12). This interpretation is, of course, open to discussion, which it is primarily intended for.

Dating. The artifacts of flint and stone from the Late Neolithic houses are too few and uncharacteristic to indicate a more precise date within the time Late Neolithic – Early Bronze Age. Rim sherds with a single or a double cordon found in all four houses speak in favour of a Late Neolithic date, although cordoned rims occur on vessels of the first period of the Early Bronze Age (see i.a. Boas 1983 Fig. 10: 6–7). More conclusive is the pottery with barbed wire decoration which is known from an early part of the Late Neolithic in Denmark including Bornholm (Lomborg 1973a: 137, Fig. 81; 1977: 32–33). The barbed wire technique is much more commonly found in Sweden (cf. Oldeberg 1954: 35–39) and probably had a longer duration there – which may be relevant to Bornholm as well. At Limensgård the barbed wire decorated pottery was most numerous among the finds from House R. This house is regarded as the oldest of the four Late Neolithic houses. We assume that it was in use during an early part of the Late Neolithic.

PERSPECTIVES

In our part of the World the house must be viewed as Man's most important 'artifact'. How and where houses were built shows to what extent people were perma-

Fig. 12. Reconstruction of House AB at Limensgård (drawn by Leif Hammelev).



nently settled in a given environment and reflects priorities towards land use and production. The arrangement and size of the house are functional solutions that fit the behaviour and the social groupings of its inhabitants. House-building also demonstrates the capacity of handicraft and the level of technology. Architectural tradition embodies the cultural heritage of the people and lasts longer than most other traditions. It is therefore equally important to observe the permanence of tradition and the evidence of change and reorganization of house-building throughout Prehistory.

One of the most persistent traditions in South Scandinavia was the building of long-houses with wooden posts set in the ground. The three-aisled long-house with paired internal roof supports is documented from the Early Bronze Age period II (Lomborg 1973b, 1976; Boysen & Andersen 1983) and can be followed through various stages of development until the early Medieval Period (see i.a. Becker 1982b). Houses different from this tradition and older than period II of the EBA are now known from a number of settlements. The evidence shows that the houses of the Late Neolithic and the first period of the Bronze Age had a single row of roof-supports. This is observed at Late Neolithic settlements in North Jutland where rectangular houses measuring up to 18 m in length and with sunken floors have been excavated (Simonsen 1983, with references). This house-type is known from South Sweden as well (Strömberg 1971; Calmer 1973) and is regarded as the typical house-form in the Late Neolithic. In most cases details of the construction of these houses are absent or few because postholes are either not found or they seem to be disorderly arranged. Often the sunken floors give the only basis for estimating the shape and dimensions of the building.

As for the EBA per. I the settlement excavation at Egehøj in East Jutland has produced substantial house-remains which prove the existence of long-houses at the beginning of the Bronze Age (Boas 1983). The Egehøj houses have a single row of central roof-supports and partly sunken floors like the Late Neolithic houses. A continuation of constructional principles of house-building is thus apparent from the beginning of the Late Neolithic till somewhere in the EBA per. I–II. It should be mentioned, that claims have been made for long-houses in the Late Neolithic/EBA of Norway (Østmo 1979).

Regular long-houses earlier than the beginning of the Bronze Age were not known in South Scandinavia until recently. In 1979 Late Neolithic long-houses were excavated at the site of Fosie IV near Malmö in Scania (Björhem & Säfvestad 1983). The houses from Fosie IV and from Limensgård have basic features in common, only the Limensgård houses are larger (6).

There is a remarkable contrast between the Late Neolithic long-houses and the hitherto known, smaller buildings with sunken floors. The Limensgård houses can be compared with the largest known Bronze Age houses and their size is really not surpassed until the appearance of the long farm-houses of the Late Roman Period. It raises the question whether the small Late Neolithic houses with sunken floors represent complete buildings at all, or whether they are just parts of larger buildings (compare above, House S) – or they might be interpreted as buildings with special functions within a settlement complex. Alternatively, we have to view the difference in house-size in terms of social or economic differences. To solve the problem we would need more extensive excavations at Late Neolithic sites in the future.

Just as unexpected as the large Late Neolithic houses was the discovery of the Middle Neolithic house at Limensgård. Despite some obvious differences the Middle Neolithic houses at Limensgård and Grødbygård share basic elements of construction with the Late Neolithic houses, such as the central roof-supports and the lateral supports. It is anticipated, therefore, that the two house-types may be linked by a continuous tradition through the later part of the Middle Neolithic, irrespective of the cultural changes otherwise observed.

Further investigations at settlement sites of the Single Grave and Battle Axe Cultures may add more substance to this point. Till now one of the most intricate problems in archaeology has been to locate residence sites with dwelling structures of these two culture groups. It may be inferred that occupation left little refuse during that particular period or that settlement was less permanent. The settlement sites that are now being investigated on Bornholm offer the advantage of having been used continuously through periods of the Neolithic including the time of the Battle Axe Culture, as well as through later periods. This creates, however, a complex situation for the excavators.

One of the objectives for future research in the Neolithic on Bornholm is to work out a chronological sequence based mainly on the pottery from the settlements. In this respect the individual Neolithic occupations at Runegård offer certain possibilities (Kempfner-Jørgensen & Watt, this volume). The current pottery chronology and culture designations used for the Middle Neolithic periods in Denmark may be used here only as a reference. For most of the Neolithic, Bornholm follows the development on the Swedish mainland. As shown by the Middle Neolithic pottery assemblages at Limensgård and Grødbygård, we may also have to face local variations due to the geographical position of the island.

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NOTES

Grants for the illustrations were offered by *Dronning Margrethe II's Arkæologisk Fond.*

1. Of the previously known Neolithic settlements on Bornholm we mention the following: *Hammeren* (Becker 1947: 161–164; 1951: 179). – *Nørre Sandegård* (Frödin 1916; Becker 1947: 165; 1951: 179–180). – *Lilleborg* (Davidsen 1977: 9–22). – *Grønnebæk* (Becker 1951: 177–178; 1982a: 20–21). – *Rispebjerg* (Ringborgen) (excavated by O. Klindt-Jensen, unpublished). – *Runegård* (Watt 1980: 67–76; Kempfner-Jørgensen & Watt, this volume).
2. Sb (Central Register) no. 198, Åker parish.
3. Vedel 1886: 250. – Malmer 1962: 935, *Grab* 241. – Sb no. 40 = 179, Åker parish.

4. Sb no. 44. – In 1958 some remains of stone cists were discovered but only a limited excavation took place.
5. Financial support was granted by *Rigsantikvaren*, the National Museum 1st Dept., and *Bornholms Museum*. Ken Hedegaard, Torben Sode, and Brita Dam assisted at the excavation.
6. A house-site at Piledal near Ystad in Scania may be a related structure, see Larsson & Larsson 1984: 38–44.

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A Burial Mound with Culture Layers from the Early Bronze Age near Torslev, Northern Jutland

by ERIK JOHANSEN

In the spring of 1982 Aalborg Historiske Museum excavated a small ploughed-down burial mound located in Torslev parish in the district of Øster Han (1).

The mound was one of many situated on the high, hilly moraine that extends towards the Limfjord from the north in a tongue-shaped formation and is surrounded on three sides by the raised Stone Age sea bed.

Fig. 1. Bronze dagger in wooden sheath. Length 11.7 cm. From grave 2. Photo Jan Slot Carlsen.

The reason why this particular grave mound was excavated – as distinct from many other mounds levelled to the same extent – was that permission had been granted for gravel extraction in the area. The mound was therefore about to be totally demolished rather than slowly but progressively destroyed by ploughing.

A small-scale unauthorized excavation of the southern side of the mound in 1967 had revealed that underneath the mound fill there was a black culture layer, whose contents of oysters, bones, pottery and flint suggested that it dated from the Late Neolithic/ Early Bronze Age (2). The unauthorized excavation was stopped as soon as the Museum became aware of it. The artefacts already recovered gave rise to plans for a complete excavation of the mound, but the limited economic resources did not permit it at the time. The excavation of 1967 was confined to the south side of the mound and revealed no graves.

The method of the 1982 excavation was obviously influenced by advance knowledge of the culture layer, and only the modern topsoil was removed mechanically. This proved to be a fortunate arrangement since the remains of an inhumation grave (grave 1) were discovered just below the topsoil in the centre of the mound. In addition to this secondary inhumation grave, a primary grave (grave 2) was also found to be intact.

Grave 1

Immediately after the topsoil was removed, a faint, c. 2.5 × 1.3 m large, east-west orientated course of fill became visible in the centre of the mound. The fill was the remains – the bottom 2 to 4 cm – of an almost completely levelled inhumation grave. Considering how little was left, the finds it contained were rather surprising. During the cleansing process a bluish-violet material appeared, which was thought to be highly cor-

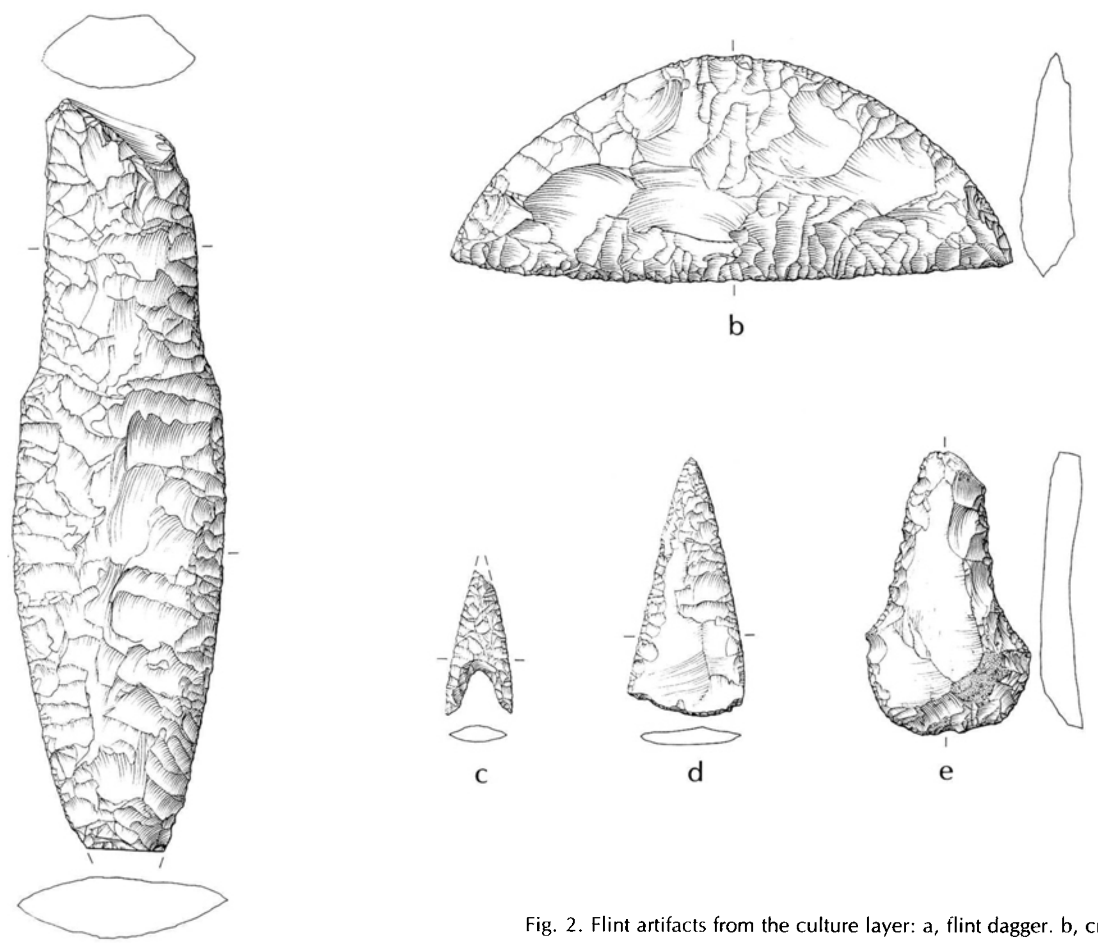

Fig. 2. Flint artifacts from the culture layer: a, flint dagger. b, crescent-shaped flint sickle. c, hollow-based flint arrowhead. d, arrowhead preform. e, scraper. Drawn by Orla Svendsen. 2:3.

roded silver and was therefore at once put in a preparation and taken to the conservation laboratory. The subsequent retrieval of the bluish-violet material showed, surprisingly, that it was not silver but the remains of a wooden shield painted blue. In addition to the blue colour the retrieval process also produced traces of red paint (3). Also recovered from the inhumation grave, and placed in a preparation, was a small amount of heavily corroded bronze, which is probably the remains of the shield boss (4). The transition between the grave fill and the topsoil contained a few potsherds, which are undoubtedly the remainder of pottery vessels from the grave, destroyed by ploughing. The pottery must be dated to some time after the beginning of the Late Roman Iron Age and indicates the age of the inhumation grave, though with the reservation that the dated pottery was not found *in situ*.

The artefacts just mentioned, combined with a local oral tradition about the discovery of "ornaments" forty or fifty years ago during ploughing of the mound, suggest a fairly well-furnished inhumation grave with a blue-painted shield from the Late Roman Iron Age. As already mentioned, the grave was a secondary one, and it would not have taken many years of ploughing for the last traces to disappear. One can only guess at the number of inhumation graves from this period, constructed as secondary graves in mounds, that have been ploughed away over the years.

Grave 2

The primary grave was found intact directly underneath the Late Roman secondary grave, separated from it by a thin layer of primary mound fill. It was outlined

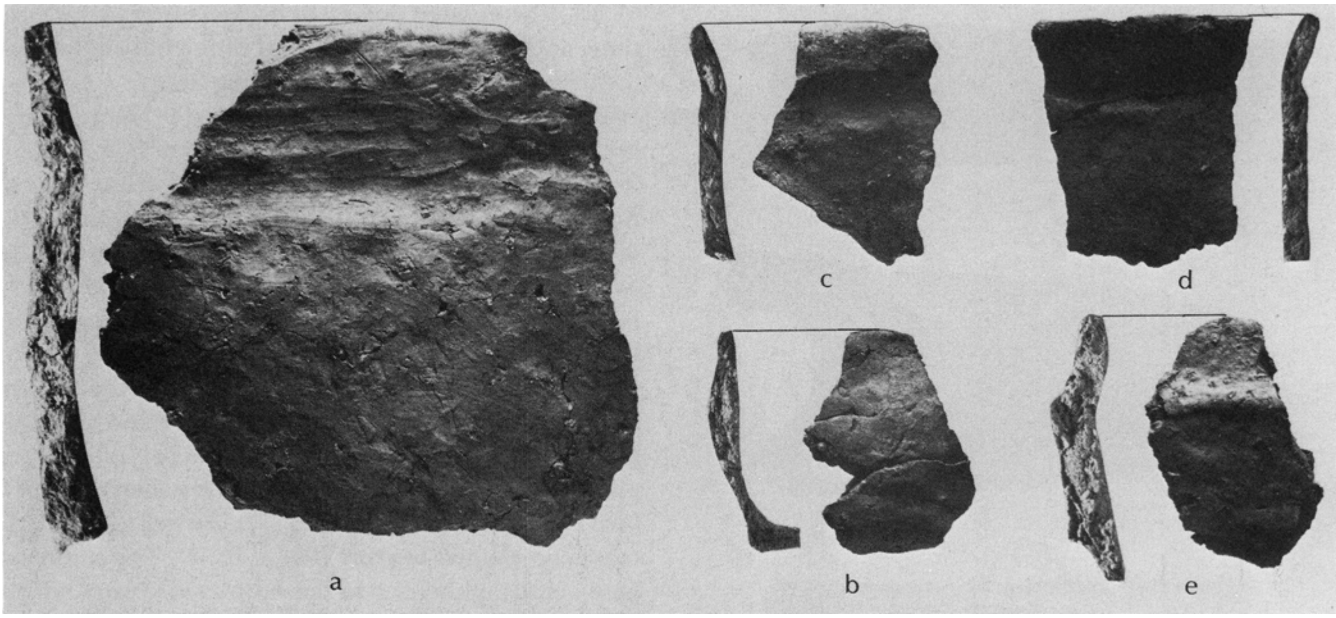

Fig. 3. Pottery from the culture layer: a, rim sherd from bucket-shaped pot; b, beaker; c–e, rim sherds. Photo Jan Slot Carlsen. Circa 2:3.

as a 1.9 × 0.4 m large course of fill with rounded corners, orientated east-west. Along the edge there was a 3 to 4 cm wide, dark stripe which followed – also in cross-section – the bottom of the trough-shaped pit. The grave contained a log coffin which had crumbled completely and showed only as a dark colouring in the mound fill. The layer of stone that is often associated with log coffins was completely absent. The grave was dug slightly into the culture layer discussed below and then covered by the primary mound. A little dental enamel was uncovered in the western end of the grave, and just east of it was found the only burial deposit, an 11.7 cm long bronze dagger with a trapezoid guard. Most of the sheath, made of thin wooden plates, remained (fig. 1). The hilt, which was made of organic material and has therefore completely disappeared, was fastened to the blade with two rivets. The dagger was placed lengthwise in the grave, its hilt facing west. The location in the grave indicates that it was not placed at the belt, but rather that it was put on the chest when the burial took place.

The dagger belongs to a type which Sophus Müller identified in 1909 as a foreign small dagger and dated to his period 3 (Müller 1909: 56 ff.), a dating supported by Broholm in 1944, who however assigned it to his second period of the Bronze Age (Broholm 1944: 120 f., 212 ff.). More recent studies have supported the assignation of these small daggers to period II (Lomborg 1959: 135 f.). Based on the dating of the dagger the log coffin can thus be assigned to the Early Bronze Age, period II.

The culture layer

As mentioned above, we knew before the excavation about a culture layer under the mound fill. As the excavation progressed, a black culture layer, up to 20 cm thick, was revealed underneath the whole of the primary mound fill. The thickness of the layer decreased towards the edge of the mound and could not be traced outside the borders of the mound. The edge between culture layer and mound fill was sharply defined throughout, with no trace of a transitional vegetation layer. It is important for an assessment of the mutual connection between the various phenomena in the mound that the construction of the mound apparently occurred very soon after the accumulation of the culture layer. When we speak of accumulation, it is because the culture layer everywhere rested directly on top of the sandy subsoil; nowhere could a buried soil be found. Whether the old topsoil was removed is impossible to determine today, but it seems likely. Although conditions were ideal, it proved impossible to detect

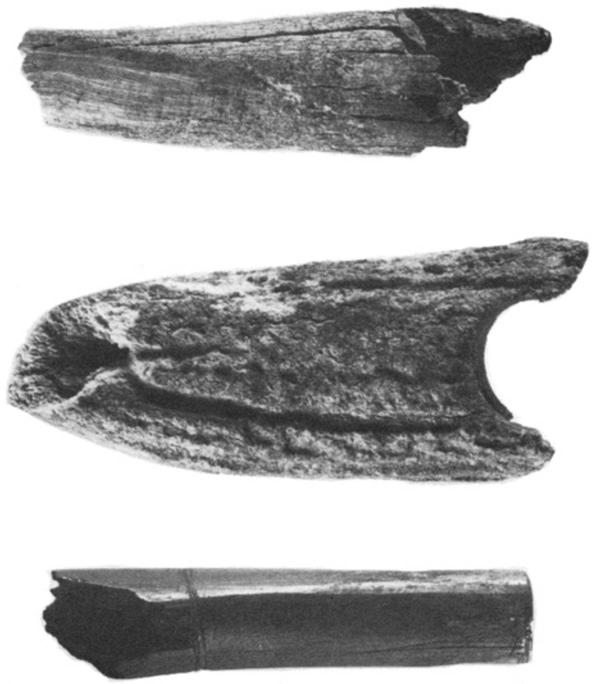

Fig. 4. Bone and antler from the culture layer. Above, fragment of antler with trimming on both sides towards the tip. Length 7.2 cm. Middle, fragment of antler with shaft-hole. Length 7.9 cm. Below, long-bone with traces of working. Length 6.5 cm. Photo Jan Slot Carlsen.

post holes or pits in the subsoil, so any building at the place must have been so light that it left no traces in the subsoil.

The layer contained flint, pottery, bones and charcoal throughout, while oyster shells were found only in the southern part. Flint is the most numerous and includes waste fragments, flints with preliminary working and chips, suggesting that the flint was worked on the site. The predominant technique is pressure flaking: the whole layer does not contain a single flake. Much of the flint retains a thick, soft crust of chalk which is identical to that found on newly quarried flint from the Late Neolithic flint mines near Aalborg. This soft, thick crust indicates that the raw flint was extracted from chalk deposits, and it may be mentioned that chalk in fact emerges at the ground nearly 1 km south of the grave mound.

The flint dagger (fig. 2, a) serves to date the layer. It is a 15.2 cm long flint dagger, type VI A (Lomborg 1973: 61 ff.). The missing point was broken off in prehistoric time, and some wear on the butt of the hilt shows that the dagger was also used for striking fire.

The dagger was found deep down in the layer and can not be a secondary intrusion. Daggers of type VI date from the early period I to late period II of the Bronze Age (Lomborg 1973: 69 ff.). This dating is not contradicted by the flint sickle and the flat-trimmed flint arrow-head (fig. 2, b–c) which were also found deeply imbedded in the culture layer, but several metres from the flint dagger (Lomborg 1960: 164ff.).

Pottery was found scattered throughout the culture layer and, apart from some potsherds lying close together, no sherds could be reassembled into larger pieces. The find includes large and very coarse-grained bucket-shaped clay vessels (fig. 3, a) as well as small, almost cup-shaped beakers (fig. 3, b) (5). The surviving base sherds all belong to flat-bottomed vessels with a slightly everted base. The bones were well preserved in the area of the culture layer containing oyster shells, but more or less dissolved elsewhere. The layer contained a fair number of bones, among them two worked antler points. One of them has a trimming on both sides towards a broken-off tip (fig. 4, above); the other has a shaft-hole. The latter must have broken at the shaft-hole and been rejected in prehistoric times (fig. 4, middle). The long-bone (fig. 4, below) has been sawn through at one end, where there is an incipient conical extension of the marrow cavity, while the opposite end shows signs of being partly sawn off. On the basis of the flint dagger the culture layer can be dated to the Bronze Age, periods I–II.

Ard marks

Already while the culture layer was being excavated it was possible to see in it very faint criss-cross marks which suggested the existence of ard marks underneath the layer. This turned out to be the case. The black culture layer had been ploughed with an ard, and the tip of the ard had drawn black soil down into the light subsoil. A complete exposure of the area showed that it had been ploughed criss-cross only once, and that only the area covered by the culture layer and mound fill had been ploughed.

The excavation in 1967 had destroyed the ard marks at the southern end because the digging penetrated c. 10 cm into the subsoil, as shown by the north-south

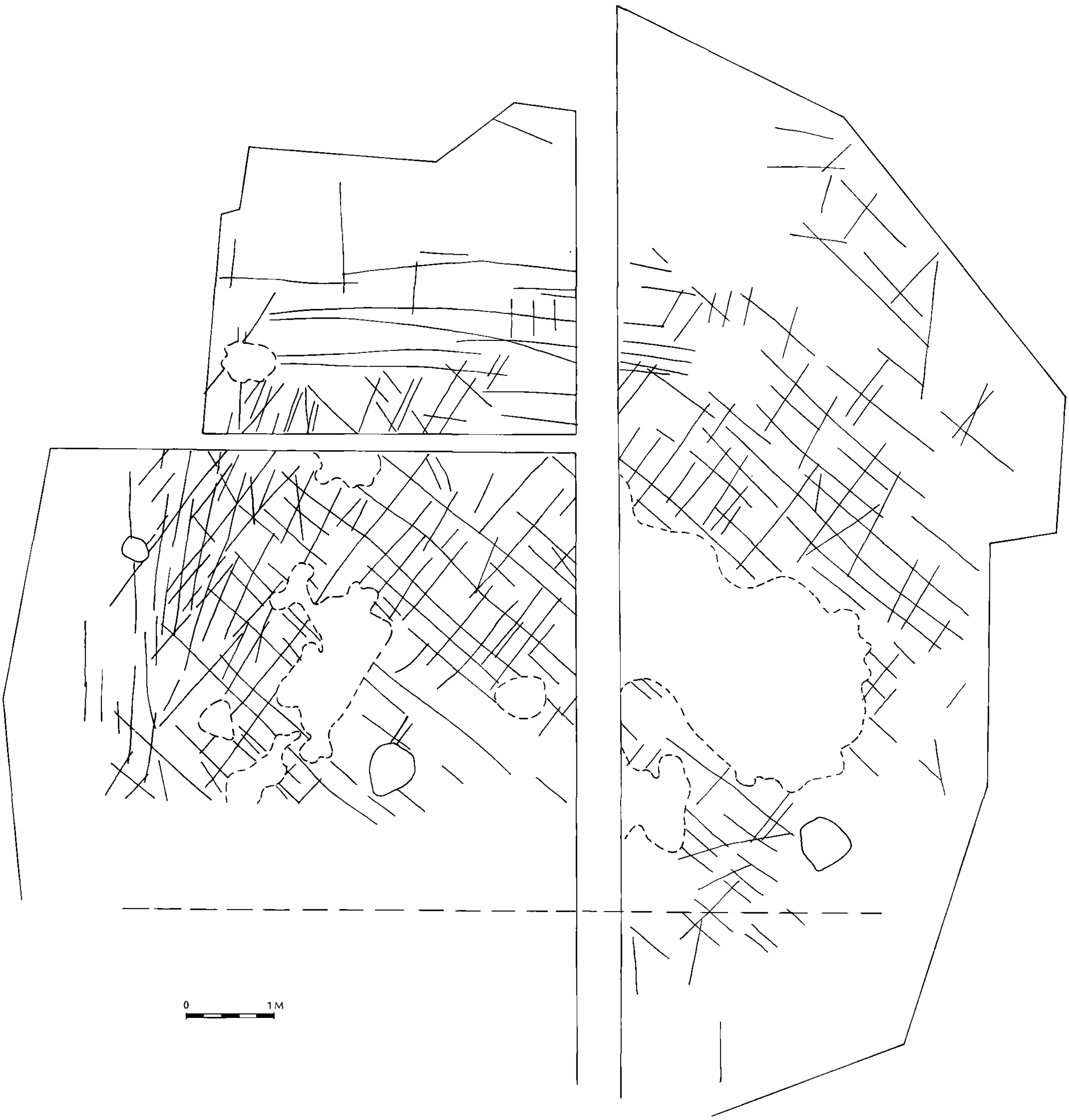

Fig. 5. Ard marks in the subsoil under the culture layer. Drawn from vertical photographs (mosaic). The blank spaces represent low depressions in the subsoil. Drawn by Jan Slot Carlsen.

section. By contrast, the ard scratches were clearly visible in the area uncovered in 1982. It was especially easy to see how the converging lines of the ard defined the ploughed area to the west and north, whereas this is somewhat harder to detect to the east and north-east (fig. 5).

The single ploughing and the intentional delimitation near the later base of the mound suggest a ritual ploughing of the area later used for a mound after a burial. In recent years a couple of constructions of this type have been investigated (S. Wiell 1976: 83 ff.), and in these cases there can be little doubt that the circular ploughing is connected with the interment. In the present case there is no regular, circular ploughing, but the conditions are nevertheless fairly similar.

At any rate, it is a fact that the ploughing took place after the accumulation of the culture layer and before the burial in the log coffin, as the area under the coffin had also been ploughed. The results of the excavation lend support to the view that the interval between these two events was probably short.

To sum up, the excavation results suggest the following course of events: the old topsoil is removed; the culture layer accumulates within the area later covered by the mound; the culture layer is ploughed ritually with an ard, once only in a criss-cross pattern, and the border lines are also marked by ard ploughing. Then the log coffin is placed in a shallow pit in the middle of the culture layer, and a mound is built over the coffin and the culture layer. The artefacts recovered and the dating given above are consonant with the possibility that these events may have occurred in rapid succession in connection with the interment, during period II of the Bronze Age.

Because of the extensive ploughing it is impossible to say whether the mound was used for burial from the Early Bronze Age until the Late Roman Iron Age.

Translated by Ole Bay-Petersen

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NOTES

1. Aalborg Historiske Museum. File No. 946. The National Museum, Copenhagen, No. 19.
2. Aalborg Historiske Museum. No. A. 972–77.
3. The blue and red paint and the remains of the shield are being analysed. A surface of c. 200 cm^2 is available.
4. Information from Elmer Fabech, conservation expert at Forhistorisk Museum, Moesgård (Århus). The remains of the shield boss is being restored.
5. Compare the pottery material from Egehøj (Boas 1983), Røjle Mose (Jæger & Laursen 1983) and Vejlby (Jeppesen, this volume).

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A Pollen Analytical Investigation of a Bronze Age and Pre-Roman Iron Age Soil Profile from Grøntoft, Western Jutland

by BENT VAD ODGAARD

In an investigation of the postglacial vegetational history of western Jutland (Odgaard 1985) sites for regional and local pollen diagrams are selected. The regional sites chosen are lakes with non-calcareous (C-14-datable) deposits like lake Solsø (fig. 1, Odgaard 1981, Andersen et al. 1983) and lake Skånsø near Skive (working project). Local sites are kettle holes or undisturbed acid soils. Small kettles often contain lake or fen deposits from the entire postglacial period and are very suitable for describing local landscape development (Andersen 1985), but unfortunately they are very rare in the even landscape of western Jutland. Thus soil profiles containing records of former soil and vegetational stages must be used as local sites. Recent podzols in the area contain records of usually the last few centuries but fossil soils may provide pollen assemblages from older periods (Odgaard 1985). Archaeological investigations regularly reveal undisturbed fossil soils buried by prehistoric monuments and furthermore often provide dates of the time of burial. Thus the well-known escavations at Grøntoft (fig. 1, Becker 1965, 1968, 1971) uncovered a number of such dated prehistoric surfaces, a few of which are still preserved. As part of the description of the postglacial landscape development of western Jutland the present paper presents the main results of a pollen analytical investigation of one of these fossil soils.

The site

Grøntoft is situated in an area of Saalian (last-but-one glaciation) sandy till. Though the morphology of the landscape has been levelled by solifluction during the Weichselian (last glaciation), the relief is still strong, exhibiting some of the highest hills in western Jutland. The Grøntoft locality is situated on a west-facing slope and on the plateau behind this (fig. 2). Map no. 7 by *Videnskabernes Selskab* (1803) shows a landscape dominated by heaths and almost devoid of forests. The area is today intensively cultivated for agriculture with small scattered stands of coniferous plantations and heathlands. Small stands of semi-natural forests – oak-shrubs – are still found in the vicinity (Degn og Emsholt 1983).

The celtic field system at Grøntoft was originally described by Hatt (1949). The large excavations by Becker (1965, 1968, 1975) revealed traces of a large number of houses dated to the pre-roman Iron Age as well as a few houses dated to the Bronze Age (fig. 2). The majority of the Pre-Roman Iron Age houses are from period I (c. 500 – 300 BC) while only the village A (fig. 2: *landsby* A) is from period II (c. 300 – 150 BC, Becker 1965, 1968, 1971).

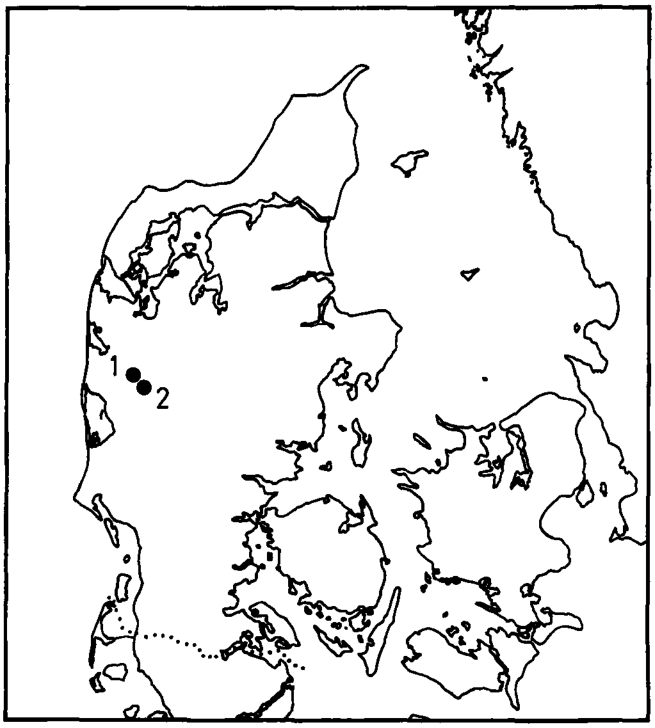

Fig. 1. The location of Grøntoft (1) and lake Solsø (2).

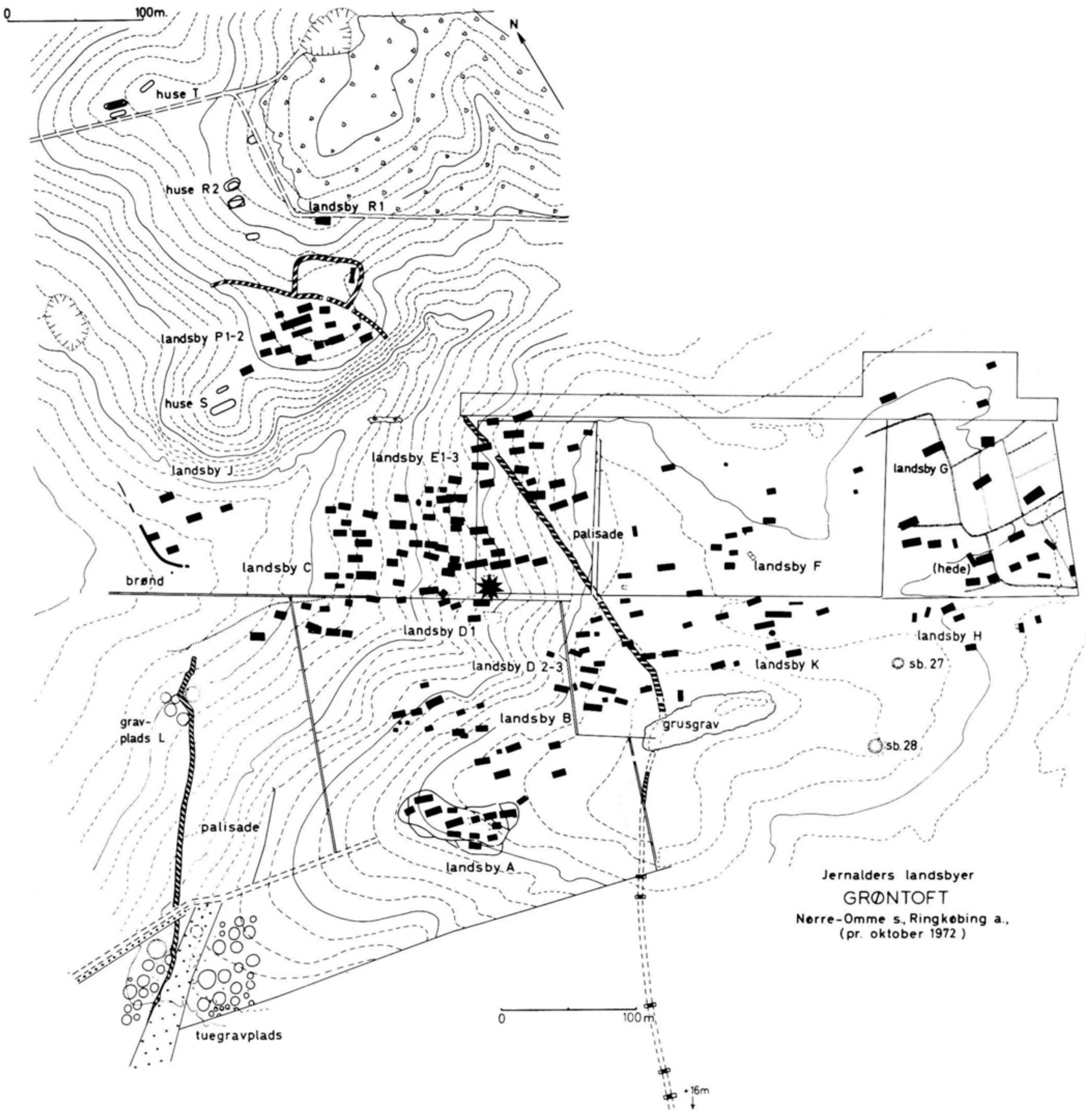

Fig. 2. The area escavated by Becker at Grøntoft with indications of the houses found. Solid signature: Pre-Roman Iron Age houses, open signature: Bronze Age houses. *huse* = houses, *landsby* = village. The position of the section E XV D is marked by an asterisk. Courtesy of C.J. Becker.

Methods

Two sections at E XV, B2 and D, described during the 1967 excavations (Becker 1971) were relocated and sampled from open profiles. The results presented here are based on the section D, which gave the most complete soil profile. Continous samples of one to a few centimeters thickness were taken and at the laboratory they were divided into subsamples for pollen analysis, loss on ignition, grain size analysis and chemical analysis. Al and Fe were extracted by boiling 20% HCl and measured by atomic absorption. P was measured spectrofotometrically as P_2O_5 after extraction by cold 1% HNO_3 (Christensen 1935). An additional 1.5 kilogram sample of the O/Ah horizon taken as close as possible to the other samples was fractionated according to the scheme of fig. 3 and fractions 1, 2, and 3 were radiocarbon dated separately. Pollen grains of cereals were identified according to Andersen (1979b).

The soil section

The section E XV D is situated on a west-facing slope (fig. 2) and is orientated in north-south direction. In the right part of the section a buried podzol profile with an O-horizon is seen (fig. 4). In the central part of the section the podzol profile is truncated by ard ploughing, the typical marks of which can still be seen in the top of the Ae horizon. In a small area to the left also the Ae layer has been removed. This erosional furrow is better developed in other sections a few meters downslope and is probably formed by water erosion during heavy rainfalls. The podzol is covered by humic sand with an intercalated layer of sandy, humic clay containing ceramics. In the profiles downslope this sandy clay layer is broader and thicker.

The position of sampling is marked on fig. 4 and a description of the profile at this point is given below.

0 – 40	Ap. Dark greyish brown, loose, humic, medium-grained sand. Recent tillage horizon.
40 – 79	Ap. Greyish brown, somewhat compact, humic, medium-grained sand with a little gravel and some pebbles. Old tillage horizon.
79 – 84	Ap. As above but colour very dark grey.
84 – 87	O. Black, greasy, sandy humus. Upper limit sharp.
87 – 92.5	Ah. Dark grey, loose, humic, medium-grained sand with a little gravel and a few pebbles.
92.5 – 100	Ae. Light grey, loose, medium-grained sand. A few pebbles.
100 – 102.5	Bh. Very dark, greyish brown, very compact, humic, greasy sand.

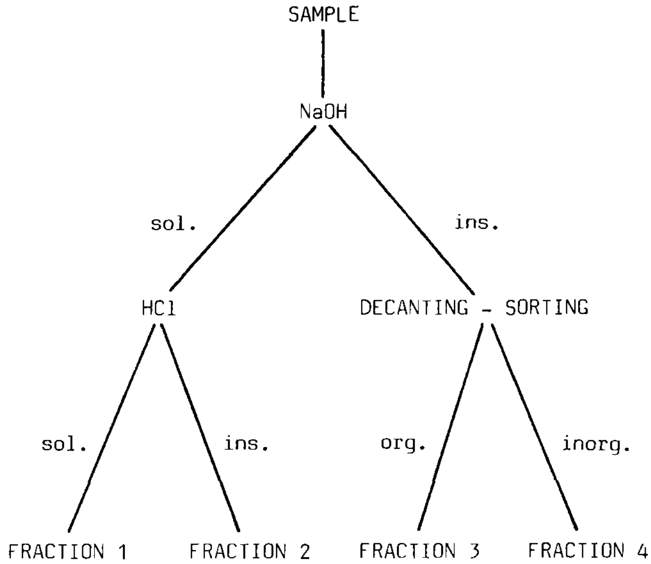

Fig. 3. Fractionation of radiocarbon sample from the O/Ah layer. sol. = soluble, ins. = insoluble, org. = organic, inorg. = inorganic.

102.5 – 106	Bhs. Dark, rusty red, very compact, medium – grained sand with a few pebbles.
106 – 114	Bs. Brownish red, rather compact, medium-grained sand with thin dark bands. A few pebbles.
114 – 150	Bs – C. Reddish yellow, medium-grained sand with a few pebbles.
150 –	C. Yellow, loose, medium-grained sand.

The profile is developed in rather homogenous medium-grained sand but the silt/clay fraction is almost lacking in the C layer (fig. 5). The pH is about 5 in the Ap to Ae horizons but lower in the B and higher in the C layers. Iron and aluminium show the minima in the Ae horizon typical for podzols. The phosphorus values are low in the podzol but about 7 times as high in the Ap layer above.

FRACTION	C-14 YEARS BP	CALENDER YEARS BC
1. Acid soluble	2010 ± 210	20
2. Base soluble	3260 ± 80	1610
3. Insoluble	3340 ± 80	1700

Table 1. C-14 dates of three fractions of the O/Ah layer (see Fig. 3).

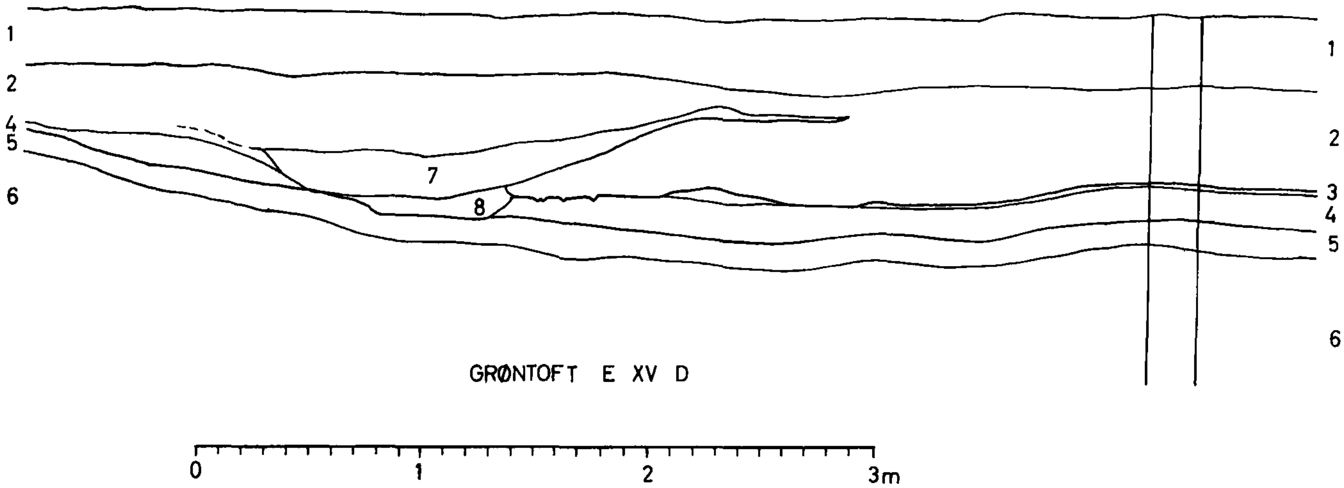

Fig. 4. Section E XV D redrawn and amended from Becker (1971). 1: Ap (recent), 2: Ap (Pre-Roman Iron Age), 3: O, 4: Ah + Ae, 5: Bh/Bs, 6: Bs/C, 7: dark, brownish-grey, clayey sand with ceramics, 8: dark, greyish-yellow sand.

The radiocarbon dates of the fractions 1, 2, and 3 are shown in table 1. Since the datings are done on material accumulated during a longer period of time the smooth curve of Clark (1975) has been used for calibration to calender years instead of the wriggled curve of Pearson et al. (1983).

The ceramics of the sandy clay horizon in the Ap layer is dated by Becker (1971) to an early part of period II of the Pre-Roman Iron Age (c. 300 – 200 BC).

The pollen diagram

Most deposits chosen for pollen analytical studies are sedimentated in cumulative geological systems with no or insignificant postdepositional disturbances. Such systems are i.a. bogs, fens and lakes but not mineral soils. Pollen deposited on a soil surface is liable to transportation during bioturbation and to a smaller degree also to downwashing. Although soil pollen diagrams cannot be interpreted as straigthforward as can pollen profiles from peat and gytja, former local vegetational stages may nevertheless be reflected in the pollen assemblages of acid soils (Andersen 1979a, Aaby 1983).

In the Grøntoft diagram (fig. 6) the pollen spectra are almost identical throughout the podzol with high values of heather and single grains of bearberry (*Arctostaphylos uva-ursi*), a plant of dry heathland. At 99 cm there is a single-sample maximum of spurrey (*Spergula arvensis*). The lime curve shows decreasing values up through the podzol profile. In the Ah and O horizons the curve of plantain (*Plantago lanceolata*) is rising. Barley (*Hordeum*-type) occurs as single grains in the Ah and O horizons.

At the transition to the Ap horizon the curves for sum trees, plantain and bracken (*Pteridium*) change abruptly. Through the lower part of the Ap layer there is a gradual rise in the curves of grasses, sorrel (*Rumex acetosella/ thyrsiflora*) and spurrey accompanied by a decrease in sum trees and heather. Pollen types occurring with low values are i.a. annual knawel (*Scleranthus annuus*) spotted persicaria (*Polygonum persicaria*-type), knotweed (*Polygonum aviculare*), goosefoot family (*Chenopodiaceae*), sheep's bit (*Jasione montana*) and hemp-nettle (*Galeopsis*).

Discussion

The radiocarbon age of the acid-soluble fraction of the O/Ah horizon is younger than the age of the other fractions. The most reliable date is the one of the insoluble fraction but the base-soluble part gives approximately the same age. The acid-soluble fraction contains young organic material dissolved at higher levels in the profile and precipitated in the O/Ah horizon. Ellis and Matthews (1984) in a series of radiocarbon datings of a fossil mor layer in Norway, found the base-soluble and insoluble fractions to give correct ages, while the acid-soluble fractions were mostly too young. Since there is no reason to suspect the reliability of the C-14 dates there exists a conflict between the early Bronze Age

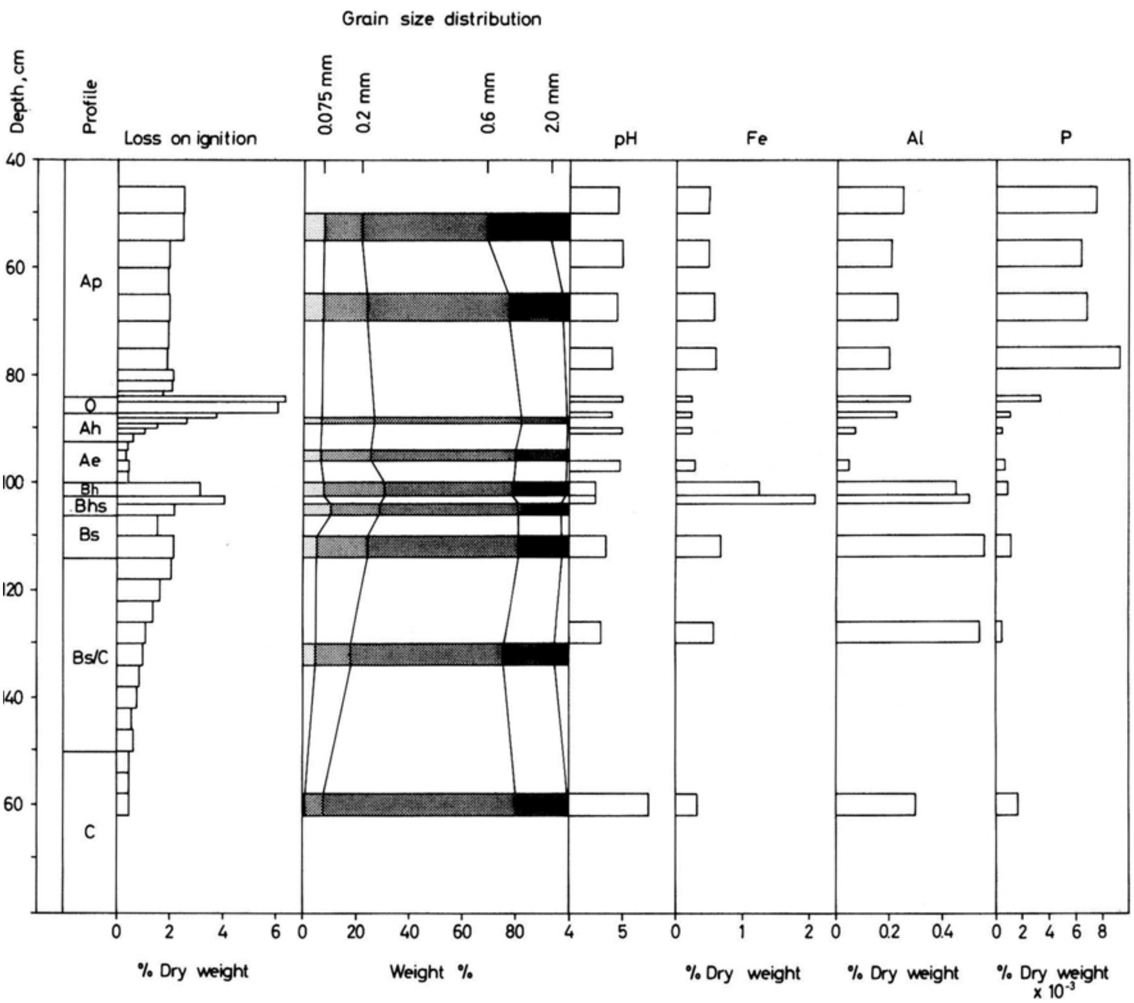

Fig. 5. Physical and chemical analyses from section E XV D.

dating of the O/Ah horizon and the Pre-Roman Iron Age period II dating of the ceramics found in the sandy clay layer in the Ap horizon. There is a timespan of about 1500 years between these two horizons, otherwise expected to be almost synchronous. There are two possible explanations of the conflicting dates:

1. The podzol profile was buried long before tillage began at the site.
2. The topmost part of the O horizon has been removed.

Becker's (1965, 1968, 1971) finding of a large number of Iron Age Houses but only a few rather distant Bronze Age Houses (fig. 2) makes a burial of the podzol profile before the Iron Age improbable.

Removal of the mor layer (Danish: *fladtørv*) of heaths is known from historic time from western Jutland. In the opinion of Iversen (1964) the well-known remark of Plinius concerning the soil used for fuel by the german tribes refered to *fladtørv*. However, Plinius explicitly states that the soil was taken from swamps and he simply refered to ordinary peat digging. The practise of *fladtørv* digging seems to be rather young, connected with medieval agricultural techniques (cf. Behre 1979). It seems much more probable that at the point of sampling the O layer has been removed by the ard ploughing and incorporated in the Ap horizon above.

The podzol profile thus seems truncated at the point of the C-14 sampling and therefore probably also at the point of pollen sampling.

The pollen spectra of the podzol reflect an open landscape locally dominated by a dry *Calluna*-heath. The single-sample maximum of the insect-pollinated

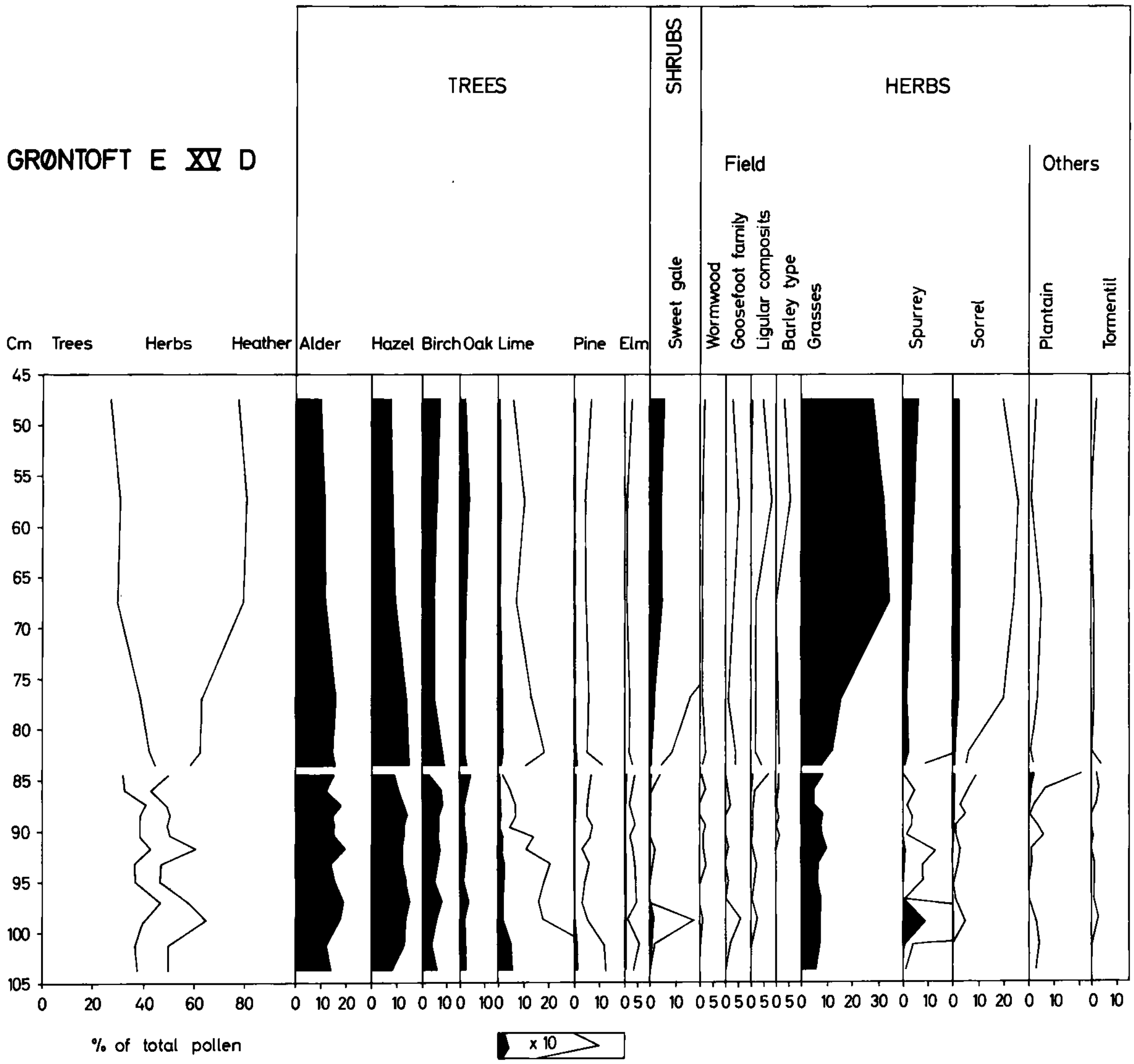

Fig. 6. Pollen diagram including a survey diagram (left) and separate curves for selected trees, shrubs and herbs.

spurrey is probably the effect of burying bees having collected pollen in the later field stage when spurrey was common. The decreasing lime values indicate that this tree was getting more rare during the formation of the profile. The rising curve of plantain and the single grains of barley-type in the Ah and O horizons reflect increasing human activity in the area.

The distinct ard marks at some places in the top of the podzol profile shows that the Ap horizon was undoubtedly tilled and this layer is probably colluvial in origin. The overall similarity of the pollen spectra of the lower Ap horizon and the spectra of the O/Ah layers indicates that the former consists of topsoil transported downslope during ploughing. The pollen spectra of the upper Ap horizon seem mostly to reflect the pollen rain on the field and thus give information about the agriculture in the Pre-Roman Iron Age.

The values of cereal pollen grains seem very low. However, cereals – except rye (*Secale*) – are autogamous plants and do not spread pollen until the harvest is thrashed, a work often done near the dwellings (Behre 1981). Andersen (in Andersen et al. 1983) found very few cereal pollen grains in the sediments of a small kettle-hole in Geel Forest, northeastern Zealand, although the site is surrounded by a Pre-Roman Iron Age field system. Thus, despite the low pollen values, barley may have been a major crop at the field of Grøntoft.

Spurrey has long been known to have played a not insignificant role in Bronze and Iron Age agriculture. Thus Jessen (1933) found 6 liters of pure spurrey seeds in a Roman Iron Age house. Seeds of this plant were also frequent or even dominating in the stomach contents of the bog corpses of Borremose (Brandt 1950), Tollund and Grauballe (Helbæk 1958), which have been C-14 dated to the late Bronze Age and the Pre-Roman Iron Age (Tauber 1980). The high pollen frequencies of spurrey in the Ap horizon at Grøntoft may be due to the occurrence of the plant as a weed, but it seems more likely that spurrey was one of the crops grown on the field.

The pollen analyses do not indicate that other crops were cultivated on the field.

The high frequencies of grasses reflect a very weedy field. Other weeds present, though only with low pollen frequencies, were annual knawel, spotted persicaria-type, knotweed, goosefoot family, sheep's bit and hemp-nettle. The value of sorrel are strikingly low bearing in mind that sorrel until fertilizers and pesticides became common practise was one of the dominating weeds in western Jutland. Thus the author (in Vejbæk 1984) found 8 percent of sorrel pollen in a soil sample from an early medieval field at Filsø, Varde. However, sorrel is especially favoured in fields with winter crops and intervening fallow years and the low values in the Ap horizon at Grøntoft simply reflect a different practise. Probably one of the differences were that Iron Age crops were spring-sown forms.

Since phosphorus is quickly immobilized in the soil after supply the high phosphorus levels in the Ap horizon cannot be due to modern application of fertilizers. Instead the P values indicate a high nutrient status of the Pre-Roman Iron Age field and it may have been possible to have crops on the field almost every year with only short periods of fallow. The phosphorus enrichment may be due to deliberate manuring of the field during the Pre-Roman Iron Age but may also be the result of more casual disposal of waste products around the houses, which were – or had been – closeby (fig. 2).

Conclusion

The Grøntoft diagram gives local details about the Bronze Age heathland and especially about agricultural practise of the Pre-Roman Iron Age. The crops were probably barley and spurrey and the nutrient status was presumably high enough to allow tillage during longer periods perhaps with only short or even no fallow periods.

The regional pollen diagram from lake Solsø (Odgaard 1985), 6 km SSE of Grøntoft (fig. 1), mirror an open landscape with large heathland areas during the Bronze Age and Pre-Roman Iron Age. Barley-type pollen and the sorrel curve reflect agriculture during these periods but the values are low indicating that fields only occupied a small part of the pollen source area. There are hardly any differences between the pollen spectra of the Bronze Age and those of the Pre-Roman Iron Age except that the plantain values are slightly lower during the Iron Age. Thus if there was any change in land use during these periods this was not dramatic enough to be reflected to any extend in the regional pollen diagram. From the large heathland areas it may be suspected that animal husbandry was of great importance during both periods.

Local and regional pollen diagrams supplement one another but several local diagrams are nescessary to understand the developments reflected by the regional diagrams. Thus for instance the Grøntoft diagram gives no information about the vegetation type that preceded the Bronze Age heath and it tells very little about the looks and use of the comtemporary forests.

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The Iron Age Village Mound at Heltborg, Thy

by JENS-HENRIK BECH

For more than half a century, Thy has occupied a special place in the study of settlements of the Early Iron Age. The National Museum's excavations of the Ginnerup settlement in southern Thy, initiated in 1922, revealed for the first time in Denmark well preserved house remains, yielding a wealth of new information on the construction and internal arrangement of Iron Age houses (Kjær 1928, 1930; Hatt 1935, 1936). Subsequently, a number of major settlement investigations were carried out at other localities in southern Thy: Vestervig 1961–1965, Hurup 1965–1969 and Tåbel 1971, to name the most extensive (see i.a. Vebæk 1971, 1976; Kann Rasmussen 1968; Salewicz 1976).

These settlements are characterized by massive culture layers, which in some cases may attain a thickness of over 2 metres. This is primarily due to two circumstances. In the first place, Iron Age settlement was very stable for a period of at least 300 years, throughout which the individual units remained in the same place and seem to have been in continuous use. However, this was not in itself enough to form the thick occupation layers, and another circumstance played a role, namely the type of house construction, which employed turf walls up to 1 metre thick. When houses built in this way were demolished and the walls razed, the thickness of the occupation layer was considerably increased. Although there is some doubt as to the original height of the walls, there can be little doubt that it is this combination of factors – permanent settlement and turf walls – that has led to the fact that the settlements even today may appear as distinct elevations 1 to 2 metres above terrain. The application of the terms "settlement mounds" and "village mounds" to settlements of this character is thus not without foundation (1).

Considering the great concentration of settlement mounds in the south of Thy (fig. 1a), it was not entirely unexpected when *Museet for Thy og Vester Hanherred* observed in 1981 that a projected by-pass north of Hurup would cut directly across a previously unrecorded mound. As it was not possible to let the road skirt the settlement, the museum started in the same year a so-called § 49 excavation, which was terminated in October 1982. It is this investigation which will be described here (2).

The mound is situated at Heltborg, just over 1 km NE of Hurup. The surrounding area is an undulating moraine landscape with deep valleys and high-lying hills, where the terrain to the east falls towards the Lim Fjord and to the west is bounded naturally by the rather narrow and deep Visby river valley. As fig. 1 c shows, the settlement is placed on a high-lying hill overlooking the river valley; at the same time there is only 2.5 km as the crow flies to the Lim Fjord, which is clearly visible from the most elevated parts of the site.

EXCAVATION METHOD

The surface of the projected by-pass would at the point where it cut the settlement be about 5 m under surrounding terrain and, with the sides of the cutting, the road would therefore take a 32–35 m wide swath out of the settlement. As culture layers of up to 1 m thick could be determined by means of bore probes over a stretch of about 70 m, it was apparent that over 2,000 m^3 of culture layer with houses, pavements and detritus in the southern part of the settlement would be directly affected.

The time factor common to all § 49 excavations necessitated the extensive use of earth-moving machinery. The excavation of the Tåbel village mound had previously made successful use of machinery, employing a large earth-mover with lateral shovel. The same type of machine was used at Heltborg.

It was clear from experience gained with the earlier settlement excavations that the greatest problem would be of a purely stratigraphic nature: how to separate coeval structures at the site. Cobbled pathways made it

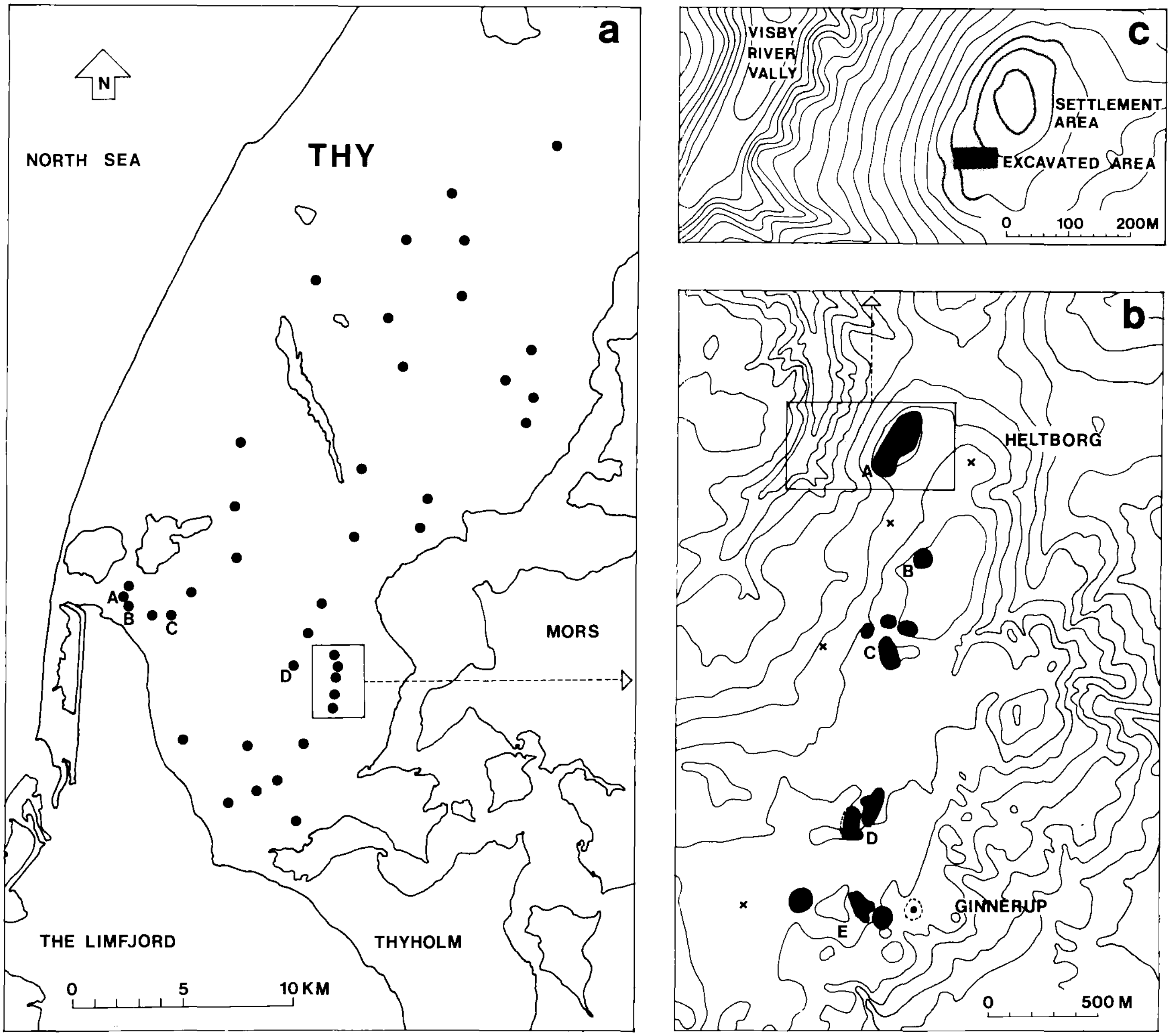


Fig. 1a. Map of settlement mounds in central and southern Thy. A, Tåbel. B, Mariesminde. C, Vestervig. D, Hurup. – Fig. 1b. Provisional map of the settlement pattern in the area between Heltborg and Ginnerup. 5 m equidistance. A, the Heltborg village mound. B, isolated settlement mound. C–E, settlement mound complexes (E, Ginnerup). X, various traces of settlement without or with only a thin culture layer. – Fig. 1c. The Heltborg village mound. 2 m equidistance.

possible at Vestervig to connect a number of contemporaneous houses, whereas at the Hurup mound, house correlation seemed to be possible in only a very few cases. With this in mind, it was natural at Heltborg to use profile sections to a much greater extent than had previously been practised in such excavations. Thus the use of machinery, in conjunction with a wish to establish a network of sections covering the whole area of study, led to a special excavation procedure with areas of a fixed size separated by usually 1 m wide profile balks. The problem of machine movement within the excavation area was solved by aligning the balks parallel to the road's projected axis, which lay exactly E-W in the area involved, and by starting with a number of

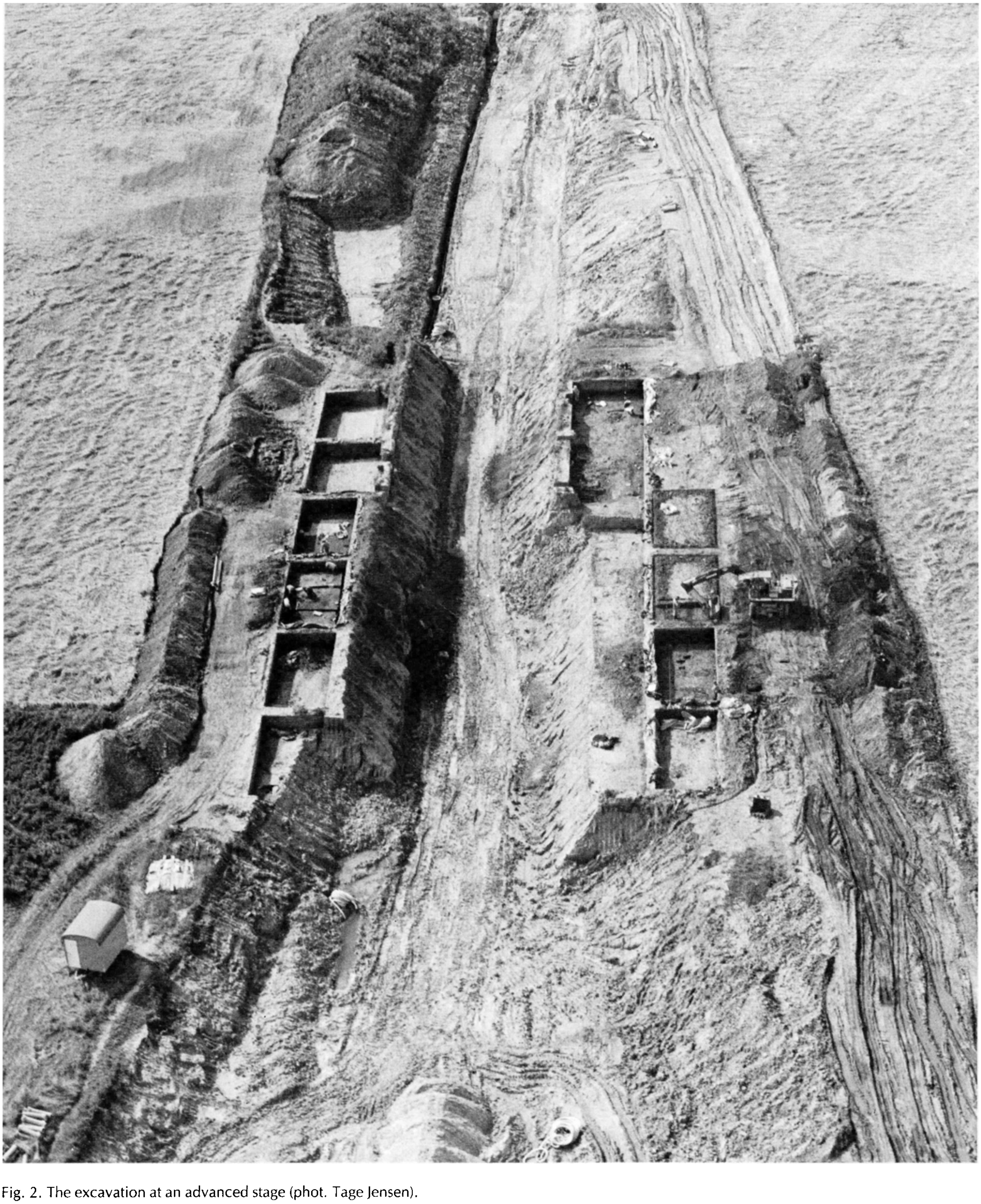


Fig. 2. The excavation at an advanced stage (phot. Tage Jensen).

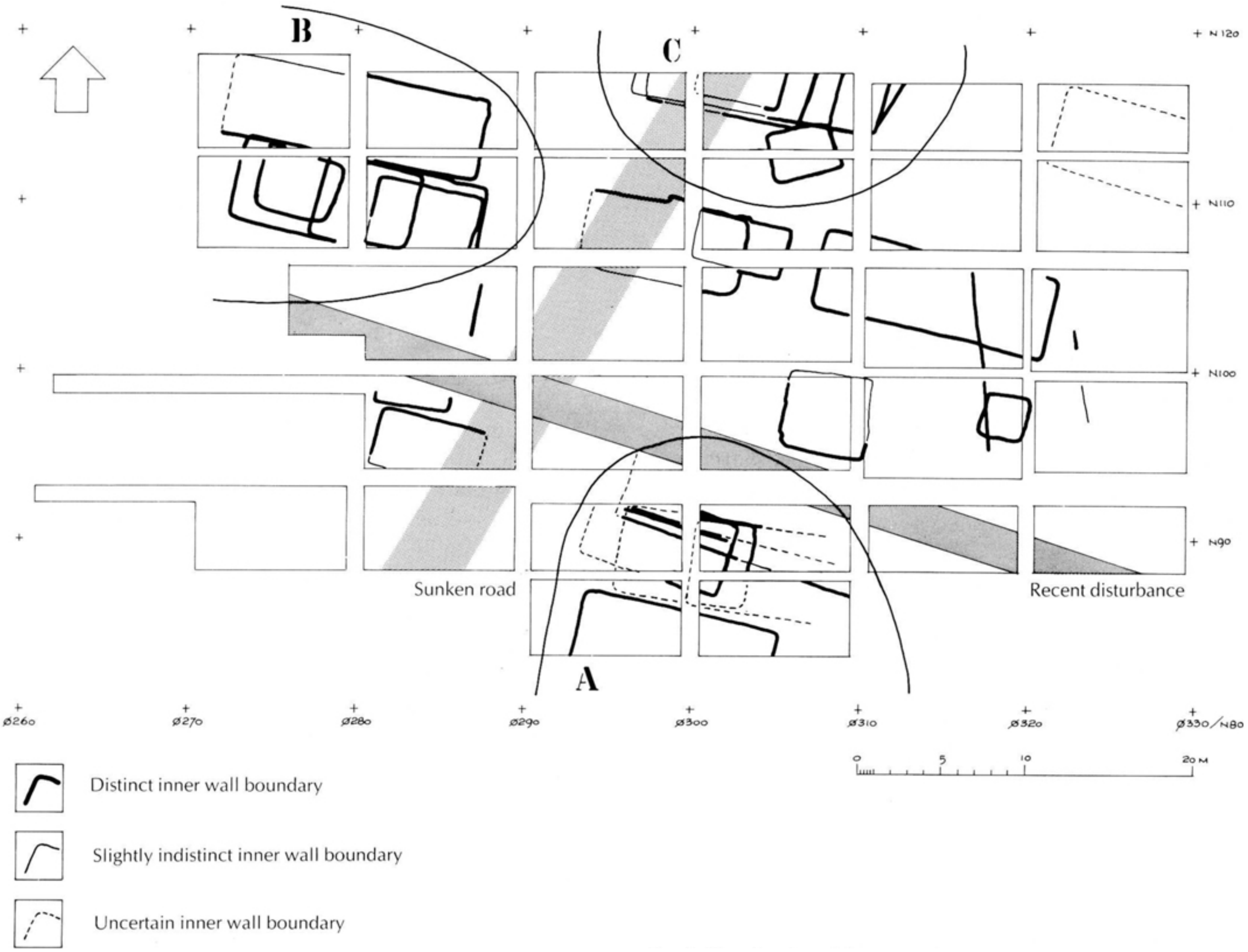


Fig. 3. Plan showing all the excavated houses.

segments on either side of the mid-line, excavating these to virgin subsoil, and then row by row working out to the edge of the area (fig. 2).

In order to maintain as close a check as possible on the machine excavation, a c. 25 cm wide trench was cut by hand along the sections, to a depth of about 30 cm under the already exposed surface, for each pit and every machine traverse. Observations on layers which would be uncovered with the next traverse could thus be made in the sections, and from the appearance and inclination of the layers it was then decided how much should be removed in each part of the pit. With the generally adopted pit dimensions of 9 × 5.5 m, a new house could in most instances be observed in at least one of the sections. This procedure usually permitted the houses to be roughly cleared by machine, after which further excavation turned to hand shovel and trowel.

There are, of course, things to be said for and against every excavation method. A number of the advantages with the present method are apparent from the above, but a further advantage was that the oldest layers, too, were investigated satisfactorily. If excavation had started with a major continuous surface clearance, there would have been the risk that at the end of the allotted period there would at best have been time only for a summary documentation of the oldest phase of the mound.

Among the disadvantages, must be reckoned the totally random way in which the sections intersected the

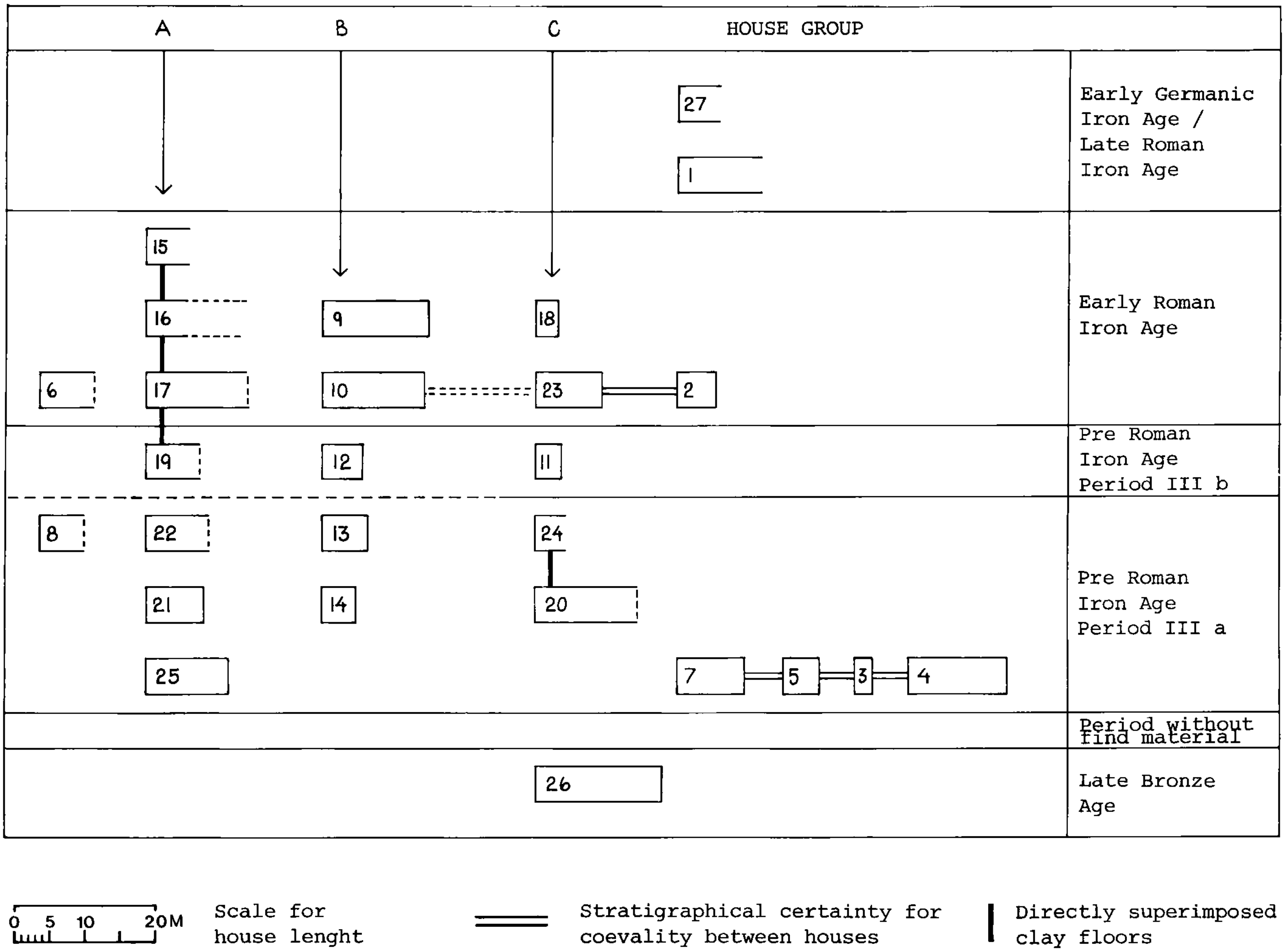


Fig. 4. Suggested relative chronology for the Heltborg houses.

houses, and that it was rarely possible to document a house in one operation: more often than not a house extended over several pits, the excavation of which due to the imposed constraints was not necessarily synchronous. As byre ends with earthen floors might be only slightly in evidence in the culture layers, it was often difficult to recognize the structure for what it was, if a byre was encountered before the corresponding dwelling part had been cleared. With traditional methods of clearance, this would have been less problematic.

STRATIGRAPHY AND DATING

From bore probes in the Heltborg village mound it can be determined that the culture layers stretch unbroken over an area of about 325 × 125 m (fig. 1c). In the light of the other known village mounds, this mound must be described as the largest of its kind, the investigated area covering less than 1/10 of the total extent of the settlement (3).

The thickness of the culture layer within the excavation area varied from 40 to 130 cm, least at the eastern edge of the settlement. On account of the fall in terrain, the layers attained a considerable thickness at the settlement's western edge, but without evidence of other than refuse layers with varying content of charcoal.

Within the investigated area, the placement of the individual houses followed a pattern previously ob-

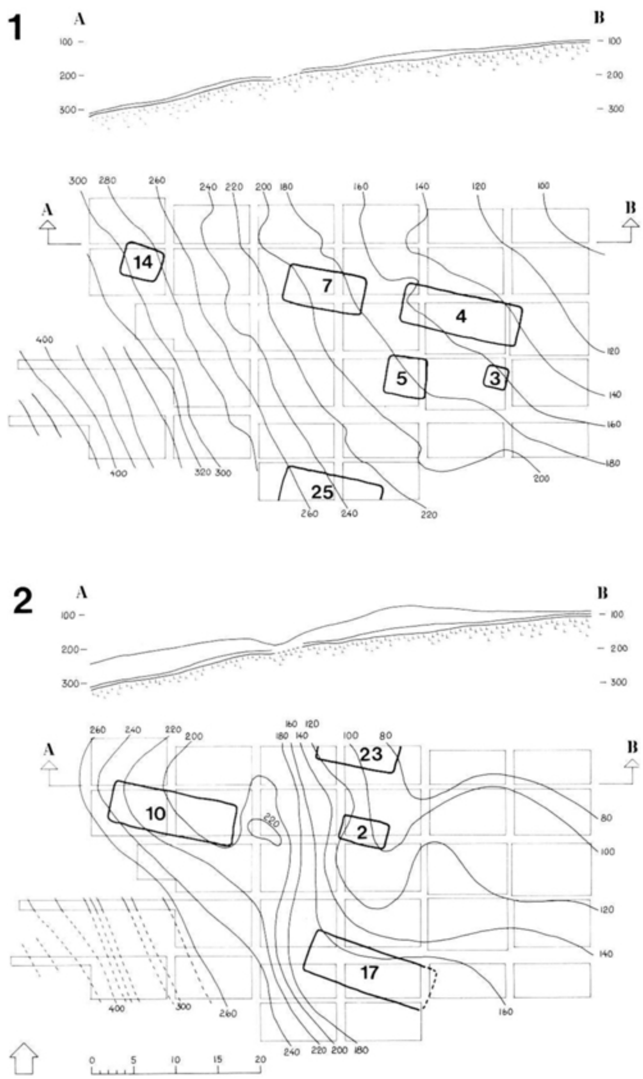


Fig. 5. Terrain surface at different points of time in the development of the Heltborg village mound. 20 cm equidistance.
1: At the establishment of the village in period IIIa showing the houses resting on the ancient topsoil. In the section A–B the thickness of this layer has been exaggerated by a factor of 4.
2: At the beginning of the Early Roman Iron Age showing contemporaneous houses. In sectionA–B, thickness of the ancient topsoil and the culture layers accumulated during the Pre-Roman Iron Age have been exaggerated by a factor of 4.

served in other village mounds, namely a localization of houses in particular areas of the settlement (fig. 3). Thus in the southern part of the excavation, we have a sequence of no fewer than 7 houses in chronological succession (house group A). In the north-western part a similar series of 5 houses (house group B) could be distinguished, and finally, about 10 m from there a further sequence of 5 houses (house group C). That a few other houses were placed elsewhere on the site does not affect the general picture.

This placement of houses raised stratigraphical problems. Whereas a determination of the chronological relationships between the houses within a group did not present particular problems, it proved extremely difficult to establish contemporaneity between houses belonging to different concentrations, on a stratigraphical basis. This was primarily due to the often strongly variable terrain conditions within the settlement area, where no stratum could be followed for any distance. The problems of correlation were further aggravated by the discovery of a modern ditch and a sunken road cutting across the middle of the excavation. It was thus only in a very few cases possible to follow the refuse layers with sufficient certainty to demonstrate coevality.

Fig. 4 is an attempt to establish a relative chronology for the investigated houses. In the vertical columns, the houses are seen in the individual sequences. The horizontal connecting lines show the cases where evidence of coevality could be adduced from the stratigraphy (4). But, based on the pottery, it has been possible to date the houses to the Late Bronze Age, Pre-Roman Iron Age period IIIa and IIIb, Early Roman Iron Age, and Late Roman Iron Age/Early Germanic Iron Age, respectively, so the possibilities of ascertaining which houses existed at the same time are considerably improved (5).

As far as the Late Bronze Age settlement is concerned, it is represented by only one NW-SE oriented long-house, which will not be discussed in the present context (6). No regular culture layers are preserved from this first settlement, which is undoubtedly due to cultivation of the area before the establishment of the Iron Age village at the end of the Pre-Roman Iron Age.

Several of the houses from period IIIa were placed directly on the old topsoil: this applies to houses 3, 4, 5, 7, 14, and 25, which may be regarded as coeval, although some chronological variance is also possible. Stratigraphical observations leave no doubt, at least, that houses 3, 4, 5 and 7 are contemporaneous. None of these houses was, however, directly followed by another house on the same site. It is uncertain where the explanation for this should be sought, but we are possibly dealing with a kind of new establishment phase in the village, at a time when a coherent structure was not yet

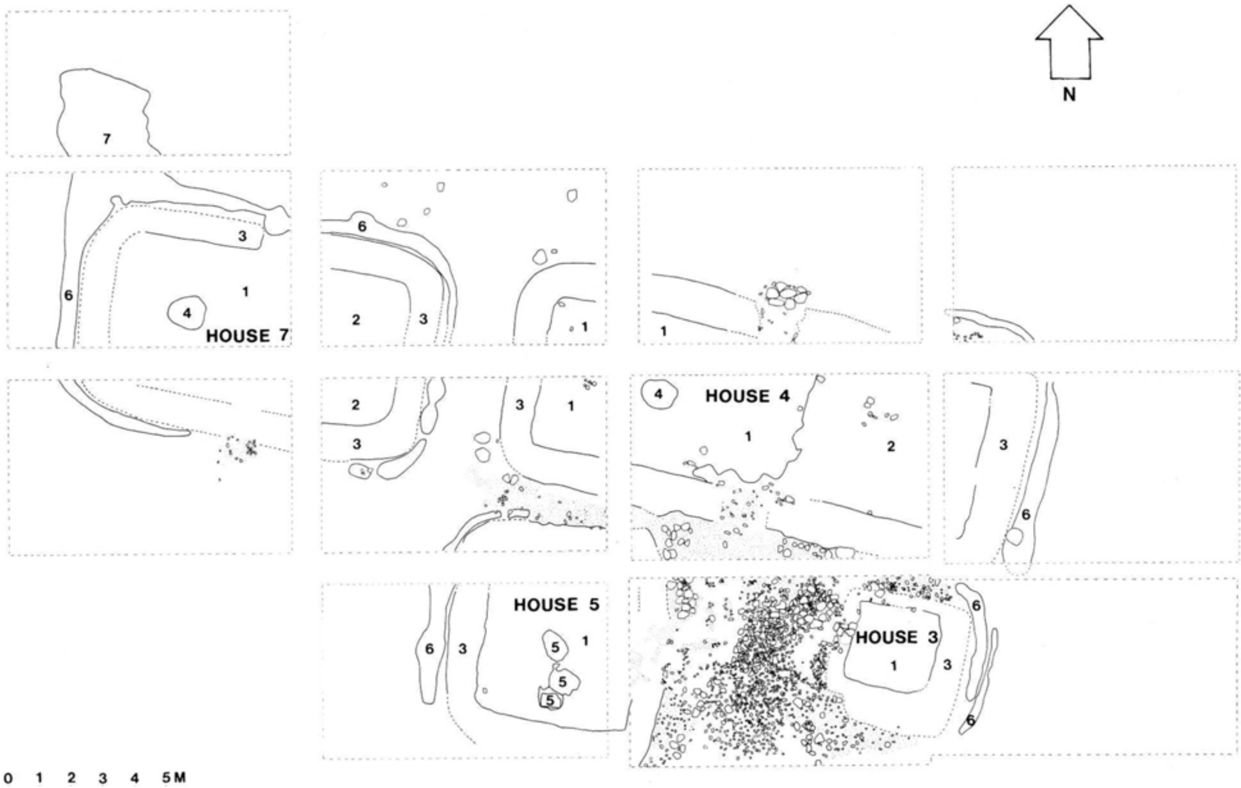


Fig. 6. General outline of house 7 and farmstead consisting of houses 3, 4, and 5 (J.-H. Bech del.). 1: Clay floor. 2: Earth floor. 3: Turf Wall. 4: Clay hearth over a stone bed. 5: Red-burnt patch on the floor (fireplace without a stone bed). 6: Drainage channel. 7: Pit for collecting rainwater.

apparent. If this explanation is correct, these houses will be the oldest on the site. As 5 houses were found in both house group B and house group C, it is likely that a fairly uniform development involved both groups. Each also contains 3 Pre-Roman Iron Age houses, and both groups were probably established at the same time. Group A comprised no fewer than 7 houses, 4 of which must be assigned to the Pre-Roman period, with the oldest, house 25, somewhat displaced in relation to the others. On the basis of fig. 4, a synchronization has been attempted of the houses in groups A, B and C, so that houses 21, 14 and 20 are considered coeval. House 14 rested, as mentioned above, on the ancient topsoil, slightly downslope to the west, while both house 21 and house 20 covered a thin culture layer from the Pre-Roman Iron Age period IIIa. This synchronization means that house 25, and houses 3, 4, 5 and 7, are considered to be the oldest within the investigated part of the village. The oldest houses of the Early Roman Iron Age in the three groups are reckoned to be houses 17, 10 and 23, with house 2 in close stratigraphical association. Stratigraphical observations also suggest that houses 10 and 23 were contemporaneous.

Based on this concatenation of houses from the beginning of the Early Roman period, a contour plan of the terrain at the time may be drawn from the many profile sections (fig. 5,2). If this situation is compared to that obtaining when the village was established (fig. 5,1), the result of the accumulation of culture layers through the Pre-Roman Iron Age is readily apparent. thus apart from illustrating how a village mound is formed, the contour plans and sections A–B through the mound show that a very dissimilar accumulation of culture layers occurred, so that after a mere century of occupation, the terrain was much more uneven than previously. This is naturally a consequence of the localization of the houses in particular areas of the settlement, whereby they gradually came to lie on small eminences comprising culture layers. This circumstance has undoubtedly contributed to a fixation of the existing pattern, since the lower-lying parts of the site must have been less attractive, when a new house was to be erected.

While the Pre-Roman Iron Age and Early Roman Iron Age are well represented in the find material, we are on more uncertain ground with respect to the later structures. Thus only 2 houses may be dated to the Late Roman Iron Age or Early Germanic Iron Age (houses 1 and 27). They were both found at the eastern edge of the investigated area and were poorly preserved, owing to their lying just under the modern surface. Their dating is based among other things on the presence of a piece of a rotary quern in the entrance paving of house 1. Fragments of a pot with horizontal perforated lugs on the shoulder likewise derive from the eastern edge of the site and are possibly synchronous with house 27. The pot should probably be dated to the Early Germanic Iron Age (Jensen 1978, p. 109).

With reservations in the scanty find material, which must be placed after the 2nd century AD, it would seem most likely that the site was continuously occupied up into the Early Germanic Iron Age, and that cultivation over the years has destroyed the most recent layers within the central parts of the settlement.

In addition to relative chronological and stratigraphical information on the various houses, fig. 4 also shows the length of each house. We see here how it may vary considerably from house to house within the individual sequence. This is most obvious in house group C, where the short house 11 is replaced by the somewhat longer house 23, which again is replaced by the short house 18. Development in group B is smoother, the relatively short Pre-Roman houses being replaced by two long-houses proper in the Early Roman period. In group A, house 25 is replaced by the shorter house 21; whether development from this point on followed that of group B can unfortunately not be fully established, since determination of house length in the later sequences is somewhat uncertain.

Thus we can state that in general there is no clear common developmental trend in the individual house groups. Perhaps several of the smaller houses in groups B and C, should not be considered independent economic entities, but were used in conjunction with houses which should be sought outside the excavated area. This topic will be further discussed below, in connection with a more detailed description of the houses.

THE HELTBORG HOUSES

The Iron Age houses at Heltborg are all of the traditional north-west Jutland type with turf walls, which was the only one known from the Pre-Roman Iron Age period III and the Early Roman Iron Age in Thy. In the following, we shall examine some of the most informative houses more closely, and start with the first certain farmstead structure demonstrated so far in village mound context.

This structure consists of houses 3, 4 and 5 and is part of the oldest Iron Age settlement on the site. To the north, oriented WNW-ESE, is long-house 4, while the two smaller houses, 3 and 5, are located immediately south of this on either side of a yard surfaced with stone and gravel (fig. 6).

House 4

House 4 had an inside length of 14 m and a width of $4^{1}/_{2}$–$4^{3}/_{4}$ m, and formed two parts, with a clay floor in the western half and an earth floor in the eastern. The entrances were placed in the centre of the long sides, only the northern one being furnished with a small pavement consisting of 7 large stones flush with the outside of the c. 1.1 m thick turf wall. Like the southern entrance, the actual opening through the wall was surfaced with an irregular layer of small stones and gravel. The fireplace, which had a clay hearth over a stone bed, was found mid-way between the entrances and the west wall. In the west end, an irregular thin covering of clay was found along parts of the southern wall and in the south-western corner – undoubtedly remains of collapsed clay daub, which could with varying definition be observed along the walls in the dwelling part, locally still standing to a height of 3–6 cm above the floor surface. There were, – in common with all the Heltborg houses with clay rendering – no traces of wood or wattle in connection with this daub.

Both at the level of the house floor itself and at subsoil level, a number of post-holes were observed. Most of them can be assigned to house 4, although a few of the subsoil holes, in particular those in the north-western part of the house, may derive from the Early Bronze Age settlement. It seems that house 4 had five pairs of inner posts to support the roof, placed at a distance of 1 m from the long sides. At the east end there was, as in the other long-houses, no clear demarcation of stalls, but a couple of oblong marks must be connected with sub-division of the byre.

Outside house 4 was a 0.5 m wide channel, which had been dug to a depth of 0.5 m into the clay subsoil, and which had surrounded the east end of the house. Similar ditches, which were observed in a number of the Heltborg houses, have not previously been recorded in Thy and must be seen as small drainage channels to hold rainwater and roof-drip. This is most apparent in the ditches which surround the over 9 m long house 7, where the water has been collected in a larger pit north-west of the house (fig. 6).

House 3

The two smaller houses of the farmstead, houses 3 and 5, were, as mentioned above, placed immediately south of house 4 on either side of the farmyard. The smaller of these is house 3, which measured only 2.7 × 2.7 m. It had two phases with greatly worn clay floors directly superimposed. In both phases the house had the same dimensions, with only a small displacement. From the yard, there was in both phases access to the house via a small cobbled passage through the turf wall. The house was not furnished with a fireplace. Two posts in the wall line just inside the entrance supported the roof, with a further two near the rear wall. It was not possible to define the outer edge of the turf walls with certainty at the time of excavation, but judging from the course of the stone and gravel surfacing outside the house, the wall must have varied somewhat in thickness, being widest to the south and east. Corresponding to the two house phases, two small drainage channels were found opposite the east gable.

House 3 is definitely the smallest building at Heltborg and apparently the smallest among the Early Iron Age houses so far investigated in Thy.

House 5

On the other side of the yard was house 5, which with its inside dimensions of 5 × 5 m belongs to the same category of small houses as house 3. From the yard, a gravelled 1 m wide entrance led into the house in the middle of the east side. Just inside the entrance, the clay floor had been locally worn away: elsewhere patches and unevenness were seen in the c. 2 cm thick clay floor. No certain traces of clay rendering were observed in either house 3 or house 5.

On the clay floor of house 5 no fewer than three fireplaces were found, one no doubt replacing the other over the years. All were without a stone bed and lay in a row following the north-south oriented mid-line of the house. The most distinct and regular fireplace lay a mere 0.5 m from the south wall, and appeared as a rectangular, strongly red-burnt clay surface of about 60 × 40 cm, surrounded by an irregular border of red-grey, fire-marked clay. The clay under this fireplace was only 2–3 cm thicker than the surrounding floor. The two other fireplaces in house 5 consisted merely of red-burnt parts of the clay floor itself, with the more northerly placed just opposite the entrance.

Like the other short houses at Heltborg, house 5 had only four posts to support the roof, one at each corner, 0.5–1 m from the inner wall line. The holes in connection with the western posts were unusually large, and there is as yet no explanation for the fact that the clay floor could be followed down into the partially filled holes, so that it here lay 25–30 cm below floor level.

The turf wall around house 5 was mostly well defined, with a width of 90–115 cm. Just outside the west wall, a 50–90 cm wide ditch was observed, which continued with a smaller width around the north-west corner of the house. As the difference of over 50 cm in the level of the bottom of the ditch shows, rainwater could be collected in the broad, southern part of the channel.

Fig. 7. House 2 excavated to floor level. On the left is the cobbled porch and entrance paving. Viewed from the west (phot. J.-H. Bech).

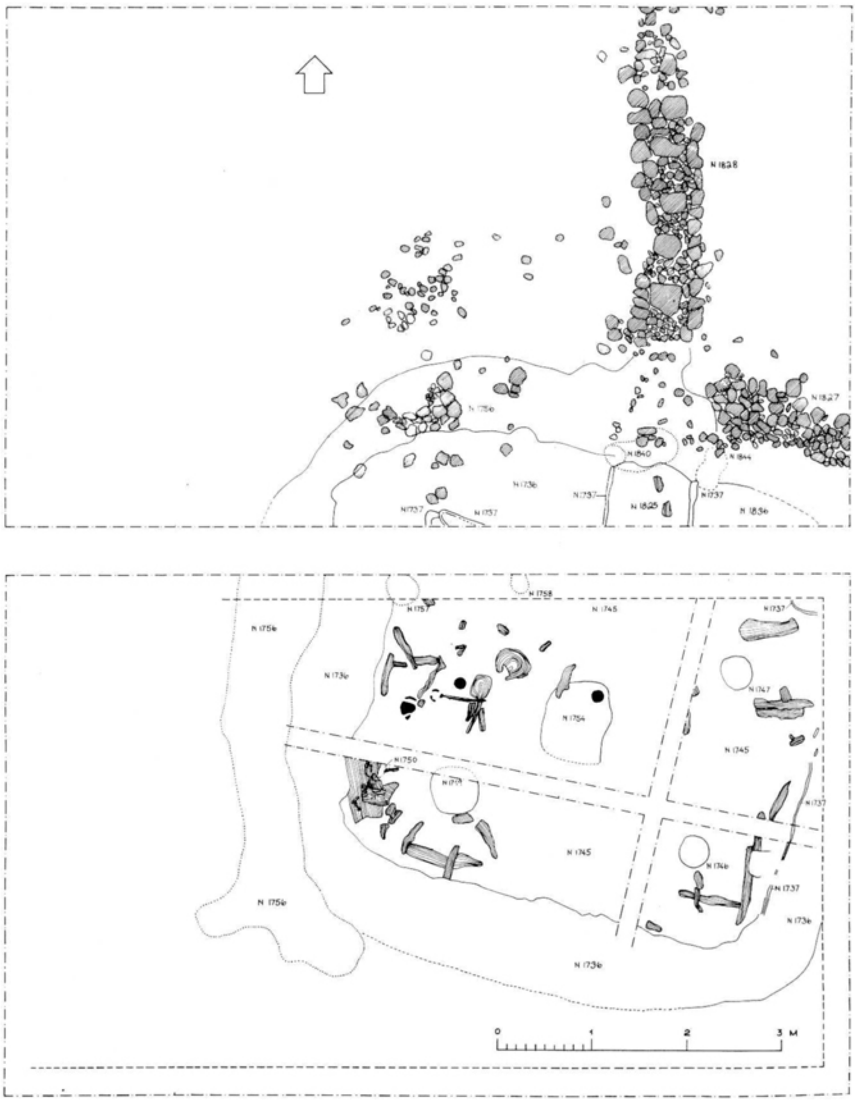


Fig. 8. House 14 (S. Klingenberg, L. Stange *del.*).

The close connection between the long-house and the smaller houses strongly suggests that they served for work, for storing implements and perhaps for storing food, like the small houses at Hodde, south-western Jutland (Hvass 1982a: 132) and the annex houses at Overbygaard, Vendsyssel (Lund 1976: 135ff).

House 2

Other small houses at Heltborg, too, support the view that these houses were not independent economic units. This is most clearly apparent from house 2, which by means of a paving was linked to the north to the 9.4 m long house 23, which presumably had a byre, since it is furnished with an earthen floor at the eastern end. House 2, on the other hand, was 5.2 m long and 2.9 m wide, and thus clearly belongs to the category of small houses. In the western half of the house was a regular up to 10 cm thick clay floor with a very uneven surface and numerous depressions. The clay floor was at the eastern end of the house preserved only in fragments – in some places it was missing entirely, in others smaller patches were seen, especially along the walls, which were clay-rendered. The well-paved porch (fig. 7) formed by the passage through the turf wall had likewise been rendered with clay.

On the best preserved part of the clay floor, the remains of two fireplaces were found, both consisting of red-burnt patches on the floor without a stone bed or strengthening of the floor. A stone-lined roasting-pit filled with fire-fractured stones lay immediately up to the more westerly fireplace.

House 14

The best-preserved house at Heltborg is undoubtedly house 14, the only one to have been razed by fire. The inside dimensions were 4.8 × 3.75 m. Access was from an entrance in the centre of the north side, whence a cobbled path led north into a part of the settlement which has not been investigated (fig. 8). The clay floor in the house was covered by small pieces of charred wood and collapsed clay rendering which was locally preserved intact to a height of 40 cm above floor level. As was also the case with house 2, the daub continued out into the porch which led through the turf wall to the outer door. Judging from the amount present, the wall must have been rendered to at least 1 m from the floor. On house 14's clay floor, which shaded from brownish-yellow to yellow, were several yellow patches, no doubt caused by the conflagration, but in the middle of the house was an area of about 70 × 90 cm with a more reddish, distinctly hard-fired surface, which must be the fireplace itself, although no stone bed was present. Apart from a very small amount of burnt corn and three small pots, there was nothing on the floor of house 14 which in itself could clarify the function of the structure, but like the other small houses, it seems most likely that it was used for work or storage. A complementary long-house must presumably be sought within the unexcavated area to the north, as suggested by the direction of the path outside house 14.

Houses 11 and 18

If the interpretation of the short houses is correct, house 11 and house 18 must also have been part of a larger unit. They were both found in the northern part of the excavated area within house group C.

House 11 measured 3.9 × 3 m and had a compacted clay floor and entrance in the centre of the northern long side (fig. 9). Like house 14, this placement of the entrance would suggest a connection with the area immediately north of the investigated part of the site.

In the centre of house 11, two red-burnt patches on the floor showed that the fireplaces in this house, too, were of the simple type. The partially investigated and poorly preserved house 18, which with its E-W length of 3.2 m clearly belongs to the same group as the other small houses, differed in having a fireplace with a stone bed.

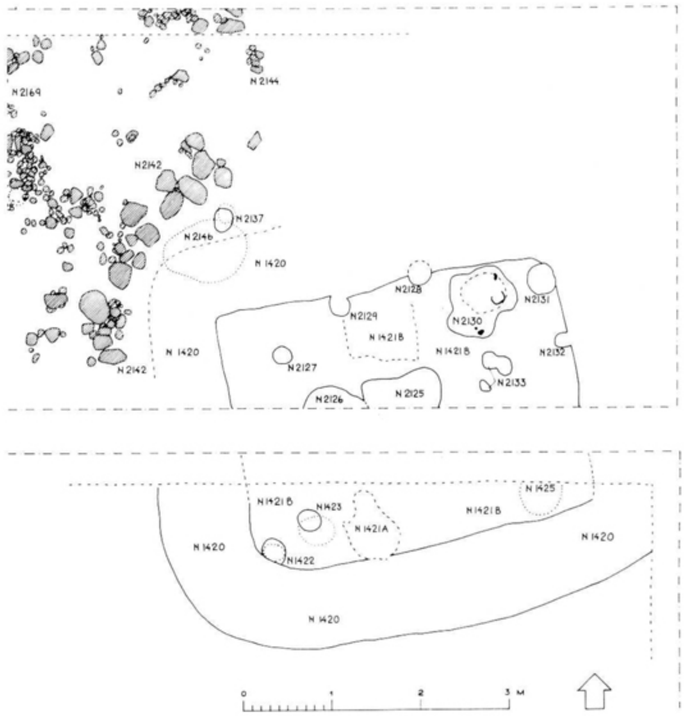
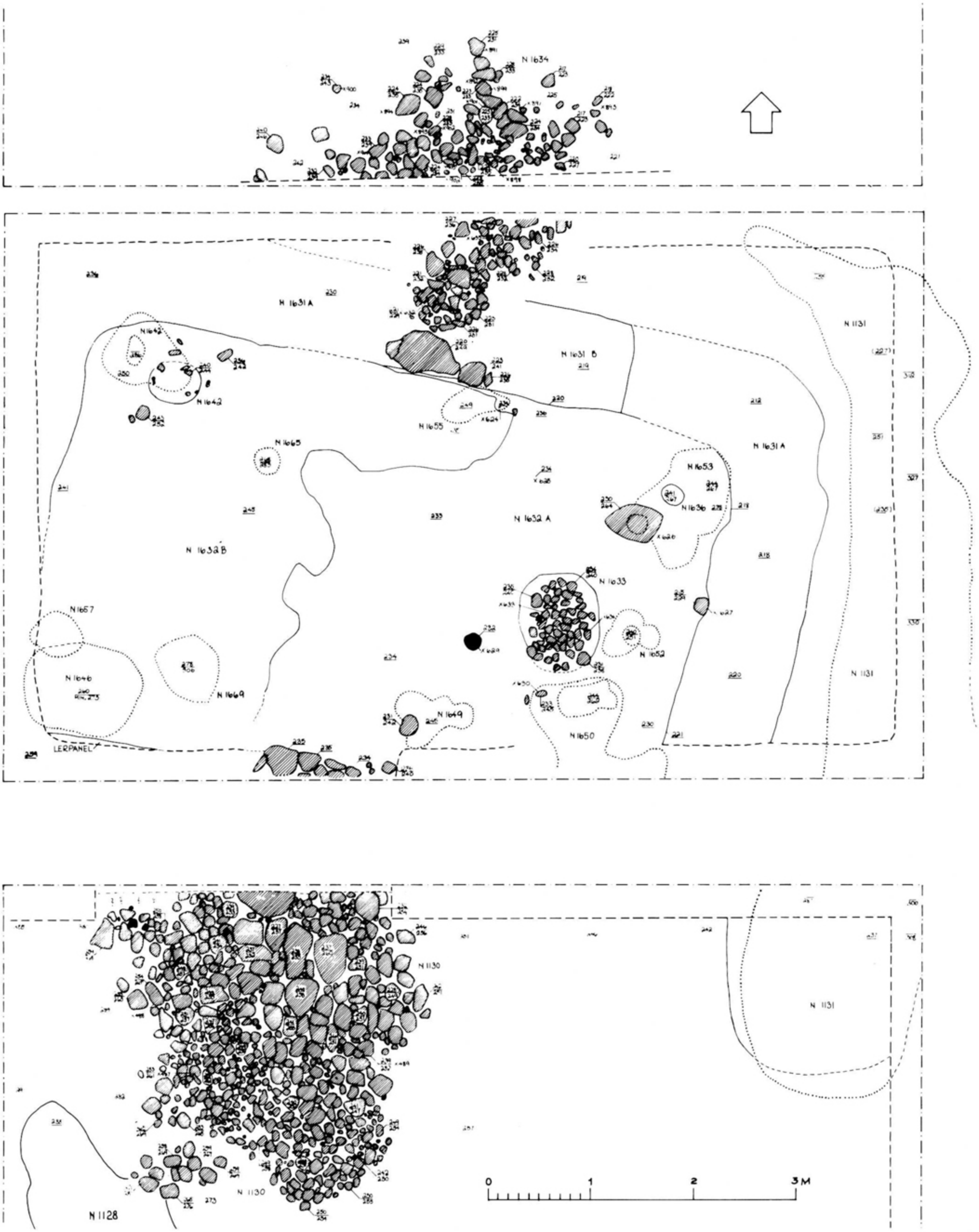


Fig. 9. House 11 (M. Mikkelsen, H. Vandkilde, L. Stange *del.*).

In conclusion to the above, we can conclude that at Heltborg it is definitely possible to point to a group of houses which did not function as independent economic units. This will naturally affect the evaluation of other Thy village mounds (and settlement mounds in general), i.a. Vestervig, where all the buildings, even the small short ones, were regarded as dwellings (Andersen and Voss 1963: 11; Vebæk 1971: 959, and 1976: 60). Important criteria for separating these ancillary houses will, apart from the length, which in the examples described from Heltborg does not exceed 5 m, be that the house have a complete clay floor, be furnished with only one entrance, and have a fireplace without stone bedding or underlying clay foundation. That a few houses such as house 18 have stone-bedded fireplaces naturally does not exclude the possibility that they can have served in the same way as the other small structures.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In the following, a number of houses from Heltborg occupying a place mid-way between the short houses and long-houses will be examined: houses 8, 12, 13 and 21, varying in length from 5.8 to 8.4 m.

Houses 12 and 13

House 12 had inside dimensions of 5.8 × 4.8 m with an entrance in the southern long side, and was in the western part furnished with a clay floor and fireplace with clay hearth and stone bed. But at the eastern end of the house, which was somewhat lower, there was only an earthen floor with small patches of clay.

We encounter the same sub-division in the slightly longer house 13, which had inside measurements of 6.5 × 4 m and, unlike house 12 and the even shorter houses, was furnished with an entrance with associated paving in the centre of each side (fig. 10). The east end of the house had a clay floor and fireplace with clay lining and stone bedding, placed mid-way between the entrances and the east gable. In the north-eastern corner of the houses was the mortar stone, still in place set into the clay floor. Immediately south of this, two depressions were seen in the clay, separated by an elevation. These depressions exactly fit a pair of knees and are undoubtedly due to wear on the floor in connection with the use of the mortar. A largish stone 17 × 11 × 15 cm, with fashioned, strongly worn end, may well have served as a pestle, but it would have needed two hands.

The floor layer at the west end of the house appeared as a heterogeneous, mainly dark brown layer with a high content of charcoal, a few patches of red-burnt clay and patches of yellow-brown clay. The boundary between this earthen floor and the clay floor was irregular and sinuous. Seen in relation to the entrances, it is clear, however, that the earthen floor maintain a single course to the northern entrance, while the southern doorway opens onto a regular clay floor. This difference between the entrances is also manifest in the paving outside the entrances where the southern is a setting of large stones, while the northern is more irregular. On this basis, it is tempting to speak of a front and back door to house 13, despite the absence of any signs inside of a physical separation between the two parts of the house. A similar disposition of clay and earth floors

Fig. 10. House 13 (A.L. Haack Olsen, M. Mikkelsen, S. Klingenberg, L. Stange *del.*).

Fig. 11. House 8 (H. Mikkelsen, J. Dencker, L. Stange *del.*).

with a different relation to entrances has been previously observed by Gudmund Hatt in Østerbølle house A (Hatt 1938: 169) and may, although less distinctly, also be observed in Heltborg house 4.

Corresponding to earlier observations, there was outside the 1 m thick turf wall of the east end of house 13 a nearly 1 m deep ditch, which, judging by its size, must first have served as a source of clay for the house, before being slightly expanded and used for drainage.

With a length of 6.5 m, house 13 still falls within the group of houses which in respect of size have close parallels in a number of small houses at Hodde (Hvass 1975: 147). In contrast to these and the already described short houses from Heltborg, there is no doubt that house 13 functioned independently. In support of this conclusion, there is also the circumstance that the main entrance opened onto an area which at the time was devoid of houses which could be reasonably associated with house 13.

Whether or not the west end of the house served as a small byre cannot be established on the basis of the

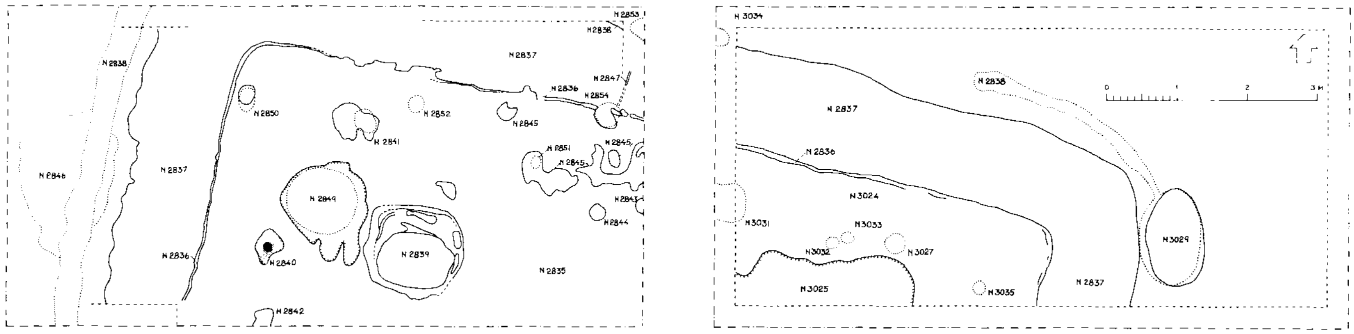

Fig. 12. House 25 (J. Dencker, H. Vandkilde, L. Stange *del.*).

available material, but considering the smooth transition from houses like house 13 to regular long-houses, the possibility cannot be rejcted. How the slightly smaller house 12 should be interpreted is more uncertain, but since its entrance opens to the south onto an area which, as with house 13, was at the time devoid of buildings which could be linked to it, it should presumably also be regarded as an independent unit.

House 8

As mentioned above, the fireplace in house 13 was placed at the east end of the house, close to the wall. A similar placement is encountered in houses 21 and 8, which are also dated to period IIIa.

The east end of house 8 was partially destroyed by the above-mentioned sunken road, which had cut right through the culture layer (fig. 11). The entrance paving, which was on the southern long side of the house, and the fireplace were untouched, however, and if we assume that the entrance was placed in the middle of the south side, the house can hardly have been more than 7 m long. The fireplace must then have been placed a little more than 1 m from the east gable-end. It was furnished with a stone bed and a clay hearth decorated with a rectangular frame in the form of a groove. In the south-western part of the house, an irregular, c. 2 × 2 m area of the clay floor, which otherwise covered the whole house, was missing, perhaps owing to wear.

House 25

As an example of a somewhat longer house at Heltborg, we shall in the following take a closer look at house 25 (fig. 12), which is the oldest house in group A, and which with an inside length of 11.8 m clearly belongs to the same basic type as house 4 – the long-house in the farmstead already described.

House 25 lay in the southernmost part of the excavation area and could be only partially investigated. At the west end was a 4–6 cm thick clay floor, which was locally, especially opposite the entrance in the northern long side, worn away. Mid-way between the west wall and the entrance was the fireplace. In contrast to the usual situation in houses of this size, the oval clay hearth covered a layer of dark brown lumps resembling bog iron ore. Analysis of these lumps revealed that they were manganese concretions, which are formed under similar conditions to bog iron ore (7). These concretions were probably gathered from the nearby Visby river valley.

A bed of the same kind was also found in the earliest phase of the fireplace in the c. 14.5 m long house 20. At the Hurup village mound, similar observations were made in two fireplaces in houses 21 and 35, which based on pottery are dated to the Pre-Roman Iron Age period IIIa, entirely in accordance with houses 20 and 25 at Heltborg (Salewicz 1976: 66).

Likewise deviating from the usual construction of fireplaces, there was in long-houses 9 and 17 at Heltborg no stone bed, but instead a very thick layer of clay, which could absorb heat from the fire. In house 17, there was a pit containing clay under the fireplace.

In situ in the dwelling end of house 25 was a stone mortar. The position mid-way between the fireplace and the west wall accords closely with Gudmund Hatt's earlier observations in Early Iron Age houses at Ginnerup, Mariesminde, Østerbølle, and Nr. Fjand (Hatt 1935: 39, 1938: 171, 1957: 146 f, 1960: 75).

Since house 25 was erected on the merely 10–15 cm thick ancient topsoil, there was, as with house 4, a good possibility of observing any stall separations at the east end of the house. As will also be apparent from the plan fig. 12, there were found apart from a more recent large disturbance only the post-holes for the roof supports and a few other scattered post-holes, but no stall separations. Against all common practice, the floor level was found to slope up to 40 cm from east to west, so that the dwelling end was lower than the rest of the house. In other long-houses, the problem of sloping terrain has been solved either by using an extra thick clay floor at the west end or by locating the dwelling at the east end of the house, as in house 20.

House 25 was oriented WNW-ESE, like the majority of the other houses, where orientation could be determined; only houses 1 and 6 deviated from the norm with a N-S orientation.

Based on the purely functional agreement between the short houses at Heltborg and the small houses at Hodde, we shall in conclusion of this section examine how great the similarities are between the houses of Thy and Hodde. Fig. 13A presents a histogram recording the lengths of all the Hodde houses (8). This may be compared with a corresponding diagram recording inside length for houses with turf walls at different localities in southern Thy: Heltborg, Ginnerup, Hurup, Vestervig, Mariesminde and Tåbel (fig. 13B) (9). By far the majority of the Thy houses are from the Pre-Roman Iron Age period III and Early Roman Iron Age. Although Hodde belongs to the first period, the differences between the two diagrams cannot be ascribed to a difference in chronology, because the house types in the whole of Jutland are the same both in the late Pre-Roman Age and the Early Roman Iron Age (Hvass 1982a: 132). Whereas the difference between the small houses and long-houses at Hodde is readily apparent, the picture from Thy is less distinct, with a whole series of houses falling mid-way between Hodde's two types in respect of dimensions. This intermediate group is represented at Heltborg by houses 8 and 21. As emphasized above, the merely 6.5 m long house 13 also belongs to this group, although its length accords with several of the small Hodde houses. But as we have seen, it differs in essence from these by having served as a dwelling. This intermediate group has in common that it consists of houses which must have been independent economic units, not based on cattle-keeping to any extent.

As far as the Thy houses of 10 m or more are concerned, they have probably had the same function as

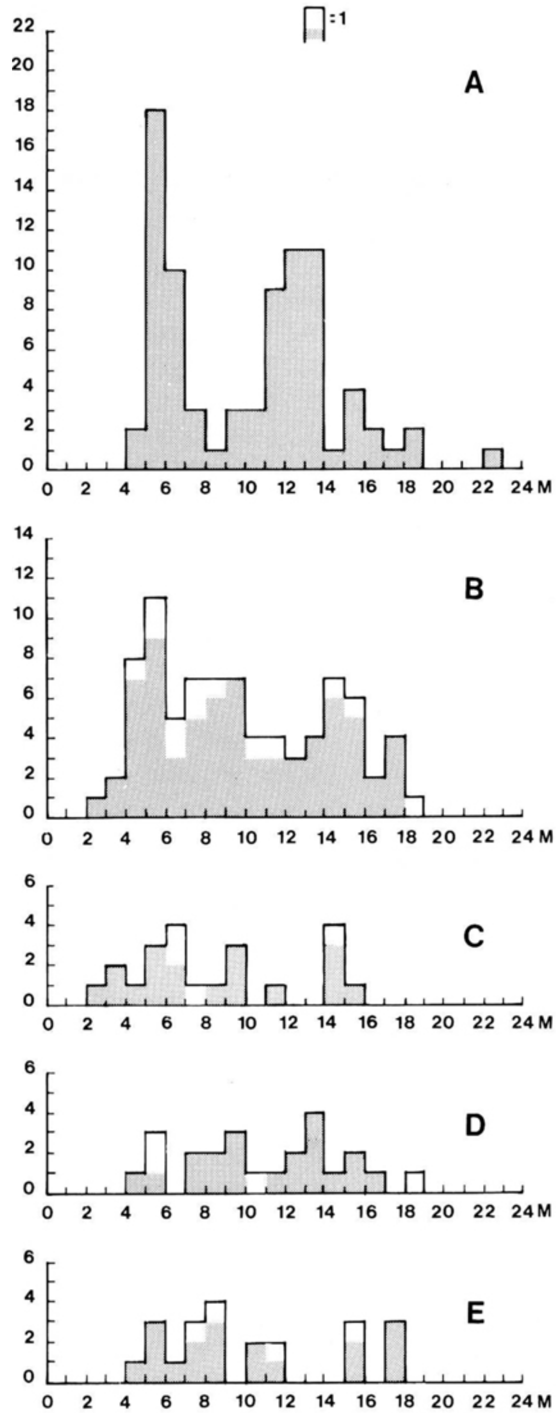

Fig. 13. Histogram to compare the inside length of houses. 1 = length somewhat uncertain, may be greater. A, Hodde. B, Thy (Ginnerup, Heltborg, Hurup, Vestervig, Mariesminde, and Tåbel). C, Heltborg. D, Hurup. E, Vestervig.

the Hodde long-houses. It must be emphasized, however, that as a detailed presentation of the houses from Vestervig and Hurup has yet to be undertaken, it cannot be established with certainty whether the absence of a fully typical byre arrangement with separate stalls in house 4 and other long-houses at Heltborg is a general Thy feature. If this be the case, possible differences in function of the long-houses should also be considered, since long-houses without demonstrated stall divisions at Hodde comprise only a small part of the total number of long-houses (Hvass 1975: Taf. I + II).

The differences we have been able to distinguish between the Hodde village and the Thy settlement mounds are hardly fortuitous and probably reflect differences in economic strategy. Whereas the Hodde villagers have been able to utilize adjacent meadows to keep cattle on a large scale, conditions in Thy have been different, as already pointed out by Stig Jensen and Steen Hvass (Jensen 1979: 29; Hvass 1982b: 191). Considering the high population density in Thy (Jensen 1976, 1979) and the lack of meadows suitable for grazing, arable farming, based on the fertile clay soil, undoubtedly played a greater role there than in the more sandy tracts of south-west Jutland, and part of the explanation for the differences demonstrated in house size should undoubtedly be sought in different subsistence patterns.

SUBSISTENCE PATTERNS

Differentiation within Thy

Can similar differences in subsistence patterns be demonstrated between village mounds within the Thy area, as suggested by Stig Jensen (1976: 67 ff., abridged and revised 1979: 22 ff.)? The main argument supporting Jensen's theory is the distribution of house types: the mounds of south-west Thy – Vestervig, Mariesminde and Tåbel – show according to Jensen a predominance of short houses, while the picture in the eastern part of the area – Hurup and Ginnerup – is dominated by long-houses with byres. Harald Andersen and Olfert Voss suggested already at an early stage of excavation that the Vestervig village mound should primarily be considered a fishing village (1963: 11). Based on this interpretation, Stig Jensen feels able to differentiate between the different settlements of southern Thy, with fishing playing a major role in the western part of the area and agriculture characterizing the more easterly part, at Hurup and Ginnerup.

But this concept is based on the assumption that all houses are independent economic units, and as we have seen at Heltborg, this is not the case. As far as the dimensions of the houses are concerned, there do not seem to be significant differences between the individual settlements. As the histograms fig. 13C–E show, there are only minor differences between the lengths of the houses of Heltborg, Hurup and Vestervig, the average length of the Hurup houses being only slightly greater than that at Vestervig and Heltborg (10).

That fishing should have played an important role in the settlements of the western part of south Thy is not supported by the finds. Thus no net sinkers have been found at Vestervig, Mariesminde or Tåbel, as was the case at the Nr. Fjand settlement on the Nissum Fjord (Hatt 1957). Moreover, the Vestervig village mound is situated 2 km away from both Krik Vig and Ørum Sø, which are the nearest sizeable areas of water where fishing can reasonably be carried on. Fishing from Vestervig can hardly have been a significant element in the economy. We must therefore conclude that there does not at present seem to be any basis for talking of major economic differences between the different settlement mounds of Thy.

Settlement structure in the Heltborg-Ginnerup area

Although major variations in the basic subsistence pattern cannot be demonstrated, the Thy settlements of the late Pre-Roman Iron Age and Early Roman Iron Age nevertheless vary in size and complexity. It must first be remarked that not all settlements are immediately visible in the terrain, as are the mounds. Scattered between the mounds are localities with remains of brief settlement, where no or only a very thin culture layer is preserved (Jensen 1967: 69). The settlement mounds obviously represent a more enduring occupation, and vary both in respect of extent and of thickness of culture layer.

As an example of a typical settlement pattern, we shall in the following examine the area between Heltborg and Ginnerup more closely (fig. 1b). Reconnaissance of Iron Age settlements within this area is not yet complete, and reservations must be made with respect to future discoveries, but it is already clear how the area has been marked by a very dense settlement in the centuries around the birth of Christ. Settlement mounds are found in a straight line following a N-S oriented range of hills, often in small groups, at a distance of 250–600 m between groups. On the basis of excavation results and the collection of stray pottery, it can be established with reasonable certainty that the settlement mounds represent coeval settlement, although minor chronological disparities in establishment and relinquishment occur. Between the mounds, there are also localities with traces of less permanent activity, where querns, pottery or actual house remains without a thick culture layer have been demonstrated.

In connection with the first presentation of the results from the Ginnerup excavations, Hans Kjær emphasized how the settlement layers within an area 400–500 m long and 100 m wide formed smaller, separate eminences (1928: 12). This feature has subsequently proved to be extremely common in Thy and is also found at two other localities within the area investigated – especially fig. 1b:C, but also fig. 1b:D. Most recently, Steen Hvass, with reference to Ginnerup, has remarked that these eminences have contained a single farmstead (1982: 191). Whether this explanation is valid for all localities with similar groups of settlement mounds depends to a great extent on factors such as the extent of the individual mounds and the thickness of their culture layers. As we have seen, the village mound at Heltborg may very schematically be regarded as a group of concentrated and coalescent small units, where the inner structure of the site is no longer visible in the terrain. In those cases where a division into separate eminences is visible today, it is, however, far from certain that each of these contains one farmstead: two or more farmsteads placed close together may gradually, during the life of the settlement have coalesced to the extent that they are now visible as a single mound.

This is undoubtedly the case with the locality fig. 1b:D, where two c. 150 m long and c. 75 m wide eminences with up to 1 m of culture layers together exhibited more than 25 ploughed-up house remains from the Early Roman Iron Age. A considerable part of these must have been in use at the same time, so more than two farmsteads were undoubtedly simultaneously extant. The smaller saliences at the locality fig. 1b:C, however, can easily each contain one or maximally two independent farmsteads. One of these settlement mounds has an extent of about 90 × 70 m and, in the centre, a culture layer at least 1.8 m thick.

In general, it may be stated that the mapped settlement mounds do not differ from the Heltborg village mound, despite the differences in their appearance in the terrain. It is true that Heltborg is larger with a more cohesive structure, but the fact that the smaller settlement mounds as a rule clump together presumably shows that they functioned as hamlets in the same way as Heltborg. This is definitely the case with fig. 1b:C, where the culture layer also links the individual mounds. The situation is more difficult to adjudge, when, as at Ginnerup (fig. 1b:E), there is a distance of over 100 m between the most westerly mound and its nearest counterpart to the east, and no continuous culture layer can be observed. Here it is a question of definition as to how the main elements in the settlement should be separated. The settlement mound fig. 1b:B does not present the same problem, since it may best be considered an independent entiny consisting of a small group of farmsteads or a single large farm.

In addition to demonstrating aspects of the settlement pattern of which the Heltborg village mound is a part, the above brief treatment may serve to illustrate the great possibilities found in Thy for a more detailed mapping and analyss of Iron Age settlement structure. With minor exceptions in recent years (Jensen 1976: 64 ff.), discussion of the Thy settlement mounds has previously concentrated on single localities; information on the individual houses, their construction and internal arrangement is important, but before the individual settlements are seen in wider context, the picture will not be complete, and in this respect much remains to be done.

Translated by Peter Crabb

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NOTES

1. When employing the term "village mounds", which is a rendering with modification of the Danish *byhøj*, one runs into a terminological problem, since the Iron Age settlement at several localities manifests itself as a whole complex of small eminences, which must together have formed a village (see p. 144 f.). I have confined the application of the term to a discrete eminence with the remains of a whole village: thus it cannot be applied without ambiguity either to a complex of small mounds or to the individual mounds making up such a complex, to both of which the general term "settlement

mounds" has been applied. *Settlement mound* is thus the general term and *village mound* more specific, to be employed only when more detailed study has revealed the nature of a settlement mound.

What figure should by way of definition be employed to distinguish between settlements of ordinary character and the settlement mounds in general is to a certain extent a matter of judgment, since we are dealing with a smooth transition. But a culture layer thickness of, for example, 60 cm would, somewhat dependent on terrain, normally be sufficient for the site to be visible as a slight salience.

2. Museet for Thy og Vester Hanherred, file no. 1690. NM *sb.* no. 105, Heltborg *sogn*, Refs *herred*.

   The investigation was in accordance with *Naturfredningsloven*, § 49, financed by *Viborg amtskommune*. In addition, *Arbejdsmarkedsnævnet for Viborg amt* and *Sydthy and Thyholm kommuner* contributed finance for an employment project. Economic support for draughting plans, etc., was provided by *Kreditforeningen Danmark* and *Museumsrådet for Viborg amt*. Alle the individuals and institutions involved are thanked for their willing cooperation and interest.

   A preliminary report on the excavation results has been published in *Hikuin*, vol. 10 (Bech 1984, in press), from which the two first sections of the present article have been taken.

3. It has previously been stated that the investigated area comprised 1/3 of the total area of the mound (*Journal of Danish Archaeology*, vol. 2, p. 218); after the completion of bore probing, this figure has to be revised.
4. For houses 6 and 8 there are difficulties with a closer correlation with the other houses, and their placement in fig. 3 must therefore be trated with caution.
5. A brief description of the Heltborg pottery has been published in *Hikuin*, vol. 10 (Bech 1984).
6. A brief description and a plan of house 26 has been published in *Hikuin*, vol. 10 (Bech 1984).
7. Kindly identified by *lektor* Per Nørnberg, Aarhus Universitet.
8. For information on the length of the Hodde houses I have to thank Steen Hvass. Fig. 13A corresponds to fig. 74 in S. Hvass, *Hodde: Huse, gårde, landsbyer, samfund, økonomi og bebyggelsesstruktur i ældre jernalder* (in press).
9. For information on the length of the houses at Tåbel, Vestervig and Hurup, I have to thank J. Lund, C.L. Vebæk and K. Salewicz. With respect to Ginnerup and Mariesminde, the diagram fig. 13B is based on published material (Kjær 1928, 1930, Hatt 1935, 1936, 1960).
10. In the case of Mariesminde and Tåbel, the number of houses with information on length is too small to be included in this comparison (see further Bech 1984: note 5).

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Bellingegård, a Late Iron Age Settlement Site at Køge, East Zealand

by SVEND ÅGE TORNBJERG

So far there are only few investigations of Iron Age settlement sites in Zealand. The major part of the excavations have been made in the northern and eastern parts of the island, and in the area under Køge Museum three settlement sites (1) have been examined, all with traces of house sites clearly datable to the Iron Age. One of these sites is located at Bellingegård, and so far it is the only thoroughly investigated Iron Age site in Zealand. Prompted by plans for the erection of a large hospital north of Køge, Køge Museum undertook reconnaissance and dug trial pits in the area. On the outskirts of this area an iron comb and a piece of gold had earlier been found (2). The settlement site is situated on a prominent hill-top surrounded by a cultivated bog area intersected by a brook to the north and west, and with bog pools, hillocks, and littoral meadows towards the east and south.

During the eight weeks of investigations in April and May 1983 excavators removed the topsoil from an area of 12000 m^2. The following autumn additional trial investigations were made outside the area in order to ascertain the boundaries of the settlement site. Towards the north and the west four 50 m long ditches were dug, but no further traces of habitation were found. In a 1200 m^2 large area south of the site the topsoil was removed by the builder supervised by the museum. Only a few postholes and five pits were found here.

The Houses

In the excavated area 31 houses of varying shapes and sizes were found along with a large number of pits and traces of stockades. The houses were preserved as traces of the roof-supporting posts. In two instances, a long-house and a smaller house respectively, there were also traces of wall posts. The depths of the roof-supporting postholes varied between 1 m and 35 cm, whereas the other postholes were rarely more than 30 cm deep.

The houses were clustered in seven concentrations (A-G, fig. 2), sometimes enclosed by a stockade. These enclosed clusters must be interpreted as individual farmsteads inside which the houses have occasionally been renewed and rebuilt. The house clusters show up to five replacements of the posts of the central long-house. Several of the farmsteads contain smaller houses that have also been rebuilt at times. The houses, which are all east-west aligned, can be divided into five types according to the shape of the ground plan.

House type 1 (fig. 3) includes 13 long-houses with 4–5 pairs of roof-supporting posts in two parallel rows. The distance between the roof-supporting pairs is with one exception greatest at the west end varying from 5 to 6 m, whereas the distance between the other pairs is 4–5.5 m.

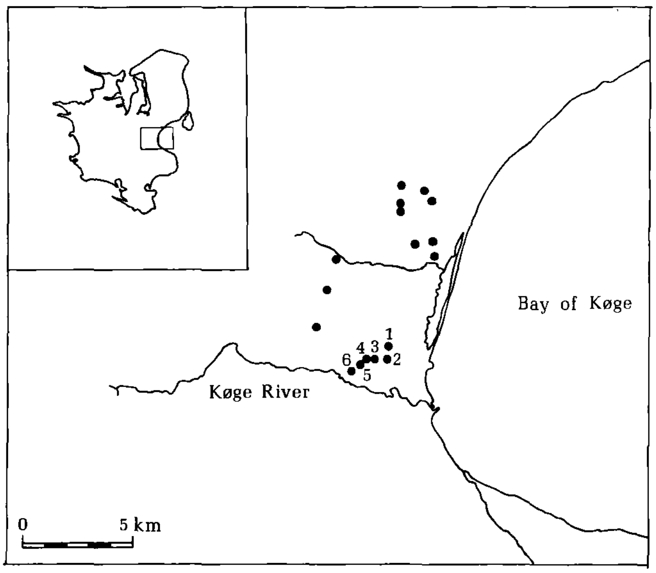

Fig. 1. Map of the Køge area showing registred Iron Age settlement sites. 1. Bellingegård. 2. Settlement site from the late Bronze or early Iron Age. 3. Indeterminate Iron Age settlement site. 4. Early Roman Iron Age settlement site. 5 & 6. Late Roman Iron Age settlement sites.

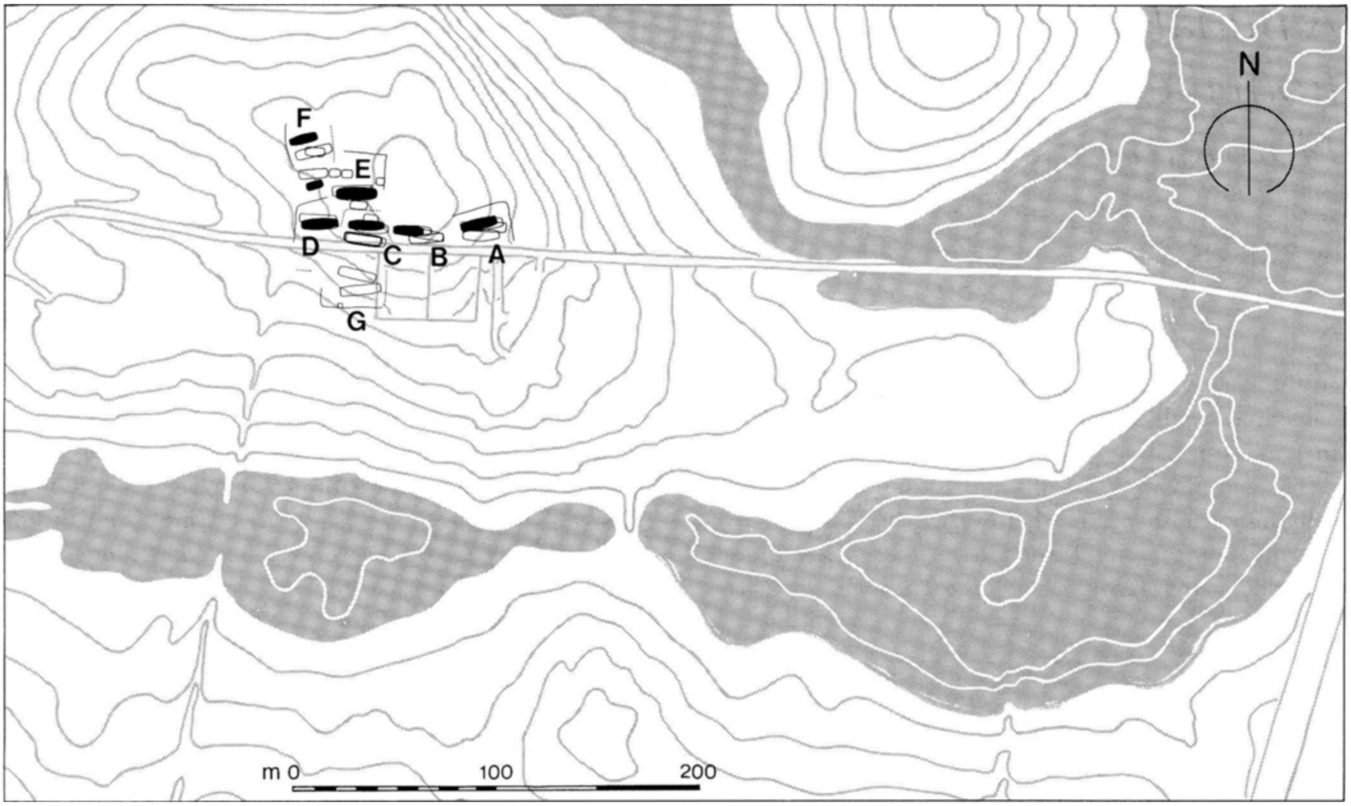

Fig. 2. Map of the settlement site with all houses indicated.

House type 2 (fig. 4) includes 7 long-houses with 4 pairs of roof-supporting posts in two curving lines with the largest transverse measurement at the middle. In this group the distance between the roof-supporting pairs varies a lot more. Thus in three houses the pairs are most widely spaced in the middle, two have the largest distance between the posts in the west end, and two in the east end. In this connection two long-houses should be mentioned that do not fit into either of the two groups, as they have oblique ground plans.

House type 3 (fig. 5) consists of three houses each with 3 pairs of roof-supporting posts in heavily curved lines. The roof-supporting pairs are evenly spaced in each separate house.

House type 4 (fig. 6) includes a total of 7 houses that must be classified as smaller houses. Five of the houses have 2 pairs of roof-supporting posts. The last two have three pairs, but their transverse and longitudinal measurements are somewhat smaller than in house type 3.

House type 5 (fig. 7) includes only one house with no roof-supporting posts. Only a few wall postholes are preserved. This house type may have been more widely used, but under poor conditions of preservation they are hard to find. It may also be interpreted as a small enclosure or a paddock.

A chronological analysis of the house types at Bellingegård can be made either by means of the fill in the postholes or by means of the stratigraphical conditions between the postholes. In the case of *cluster B* both methods can be used. The farmstead consists of four long-houses with partly overlapping ground plans. The fill of the postholes varies a lot from house to house. In one of the houses the fill is almost quite sterile and contains practically no charcoal, burnt clay, or pottery (fig. 8). A post from a later house has been inserted into one of the original postholes (fig. 9), and the postholes of this later house have in turn been disturbed by postholes from an even later house (figs. 9 & 10). The four phases of the farmstead represent two house types. The two oldest houses are of type 1 and the two later houses are of type 3. A similar pattern is repeated in several of the other house clusters. In all cases the oldest houses are of type 1 and have almost sterile postholes, whereas

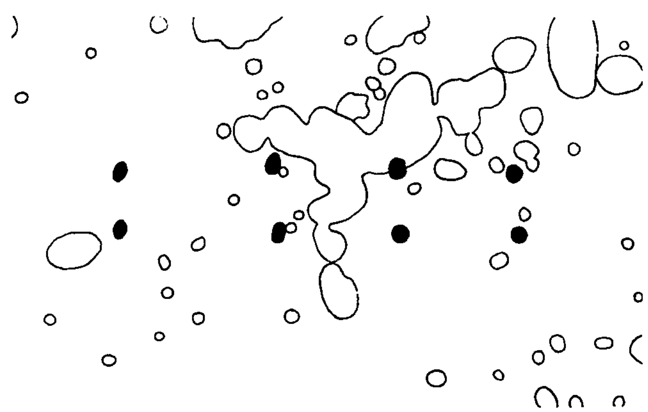

Fig. 3. House with parallel rows of roof-supporting posts. Type 1. 1:250.

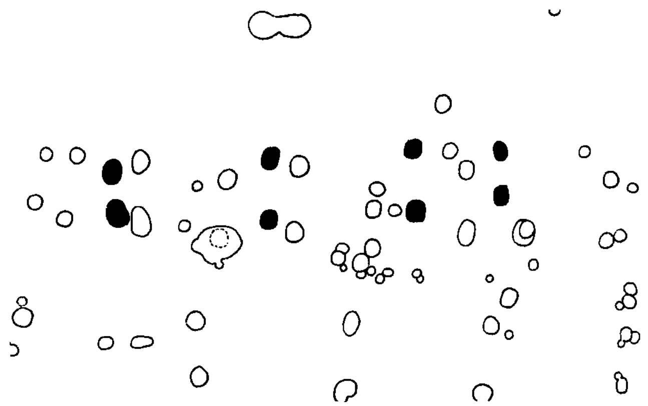

Fig. 4. House with curved rows of roof-supporting posts. Type 2. 1:250.

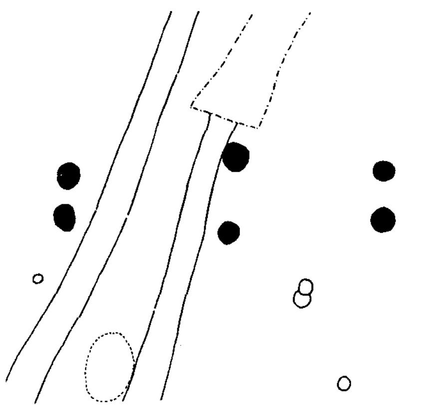

Fig. 5. House with only 3 pairs of roof-supporting posts in heavily curved rows. 1:250.

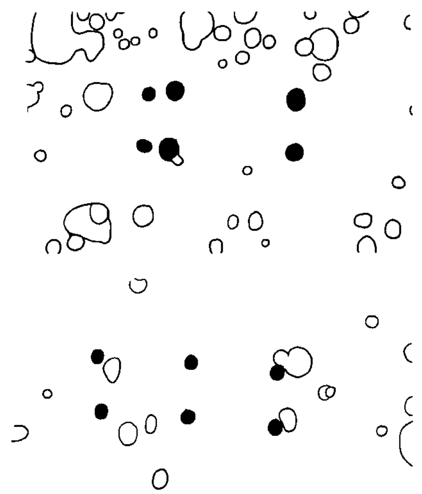

Fig. 6. Small houses with 2 or 3 pairs of roof-supporting posts. Type 4. 1:250.

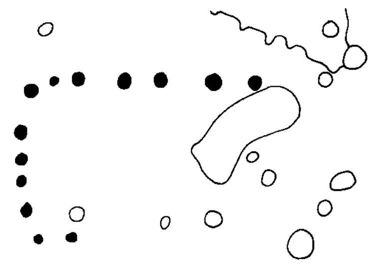

Fig. 7. House with no roof-supporting posts; possibly a paddock. Type 5. 1:250.

the later houses are of types 2 and 3. The distinction between three kinds of long-houses is thus not a functional one, but rather represents a development from the traditional Iron Age house, type 1, to later house types, 2 and 3. These have probably had curving walls like Viking Age houses (Hvass 1981).

The exact dimensions of the houses are difficult to ascertain because of the missing wall postholes. However, farmstead A, where a few wall-postholes are preserved, where among the door postholes located at the middle of the house, suggests a width of approx. 5.5 m (fig. 12). The length, however, is more difficult to determine, but unless the holes from the roof-supporting posts at the east and west ends of the house represent the gables, the house must have been more than 20 m long.

Several of the houses were surrounded by an enclosure preserved as a series of small postholes (fig. 12). Presumably each farmstead has had its own enclosure, as is seen in farmstead A where the stockade is preserved towards the north and east. In the case of farmstead F the stockade is preserved towards the west and partly preserved towards the east, and farmsteads E and G have obvious stockades towards the north and south, respectively.

Along with the renewal of the houses the stockades indicate the changes that have taken place during the life time of the settlement. Farmstead G, where the long-house has only been replaced once, has probably had a shorter life-span than the others and may have been dismantled or moved. Farmsteads D and E have seen two replacements of the long-houses, but contain

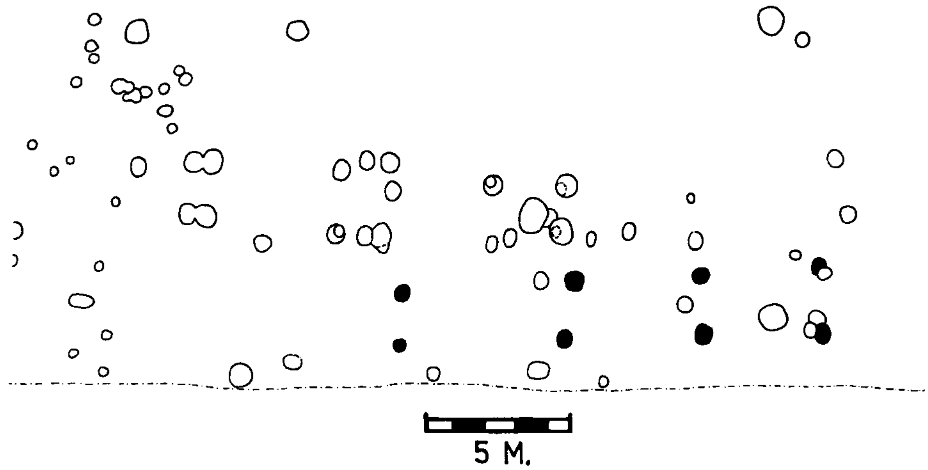

Fig. 8. Farmstead B, the earliest phase with completely sterile fill in the postholes. House type 1.

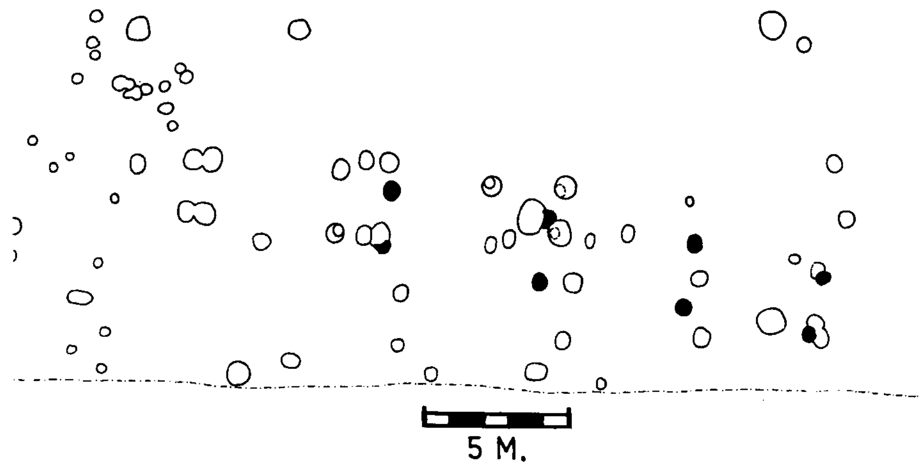

Fig. 9. Farmstead B, second phase. House type 1.

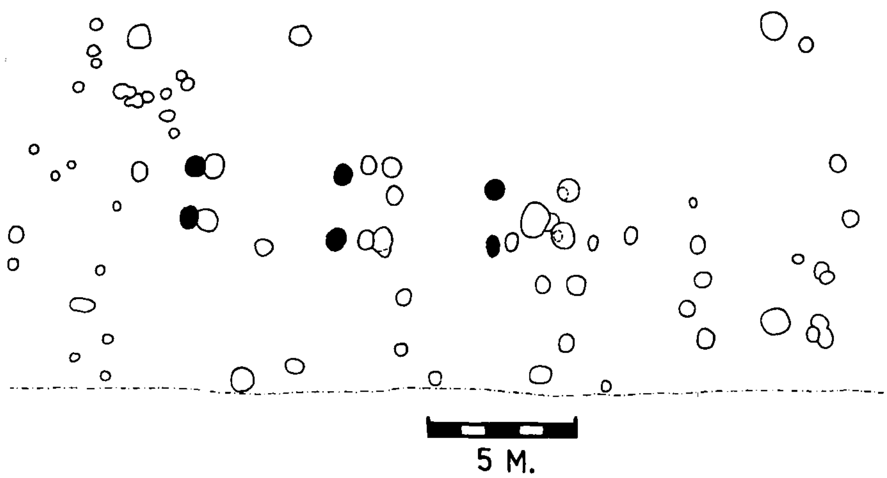

Fig. 10. Farmstead B, third phase. House type 3.

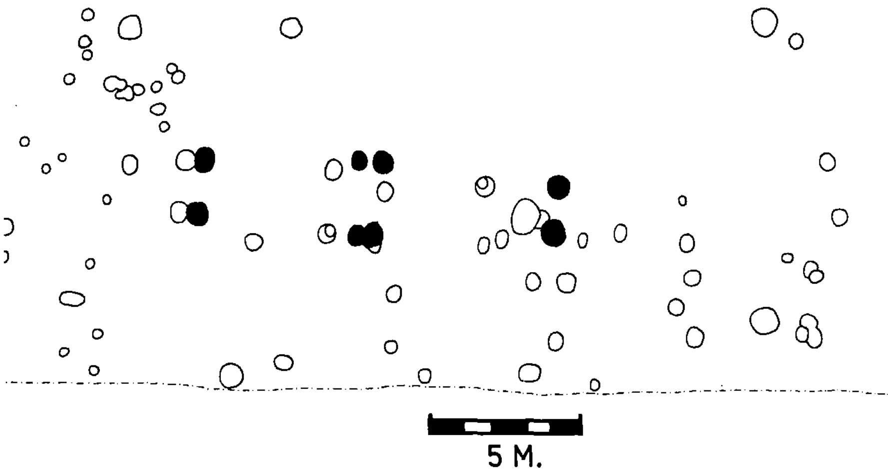

Fig. 11. Farmstead B, final phase. House type 3.

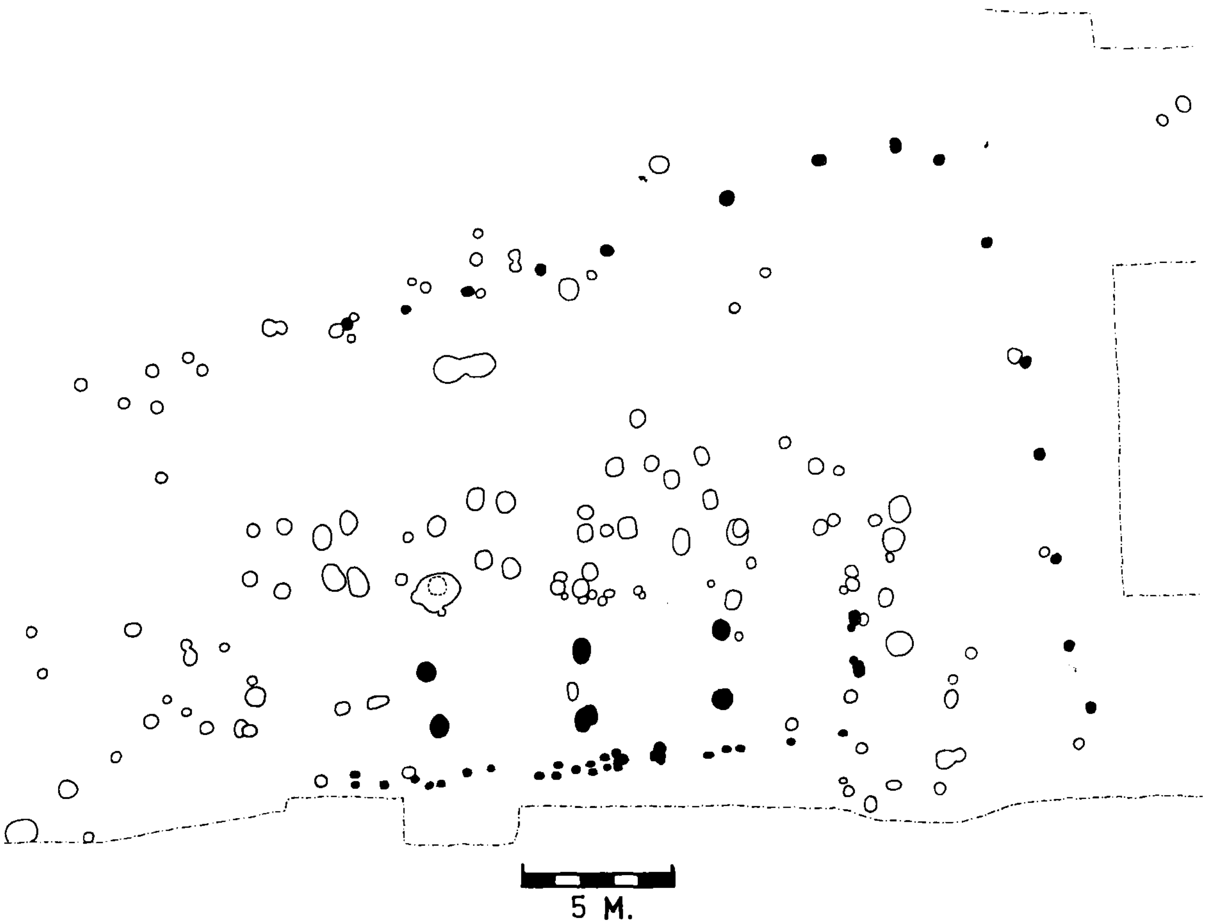

Fig. 12. Farmstead A with remains of the enclosure. The type 2 house has a preserved entrance and remains of the wall along the south side.

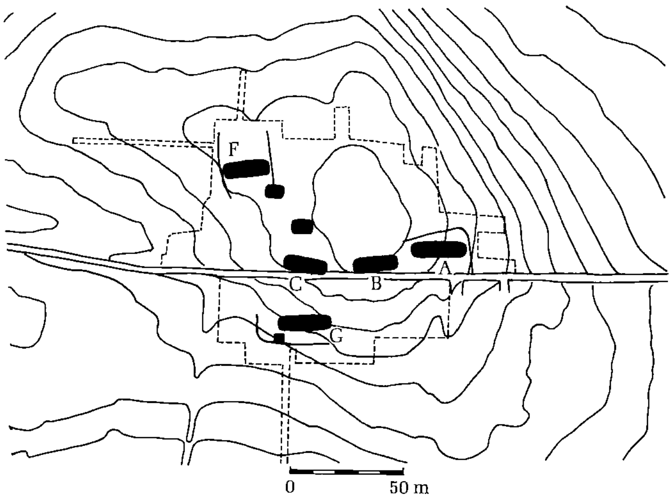

Fig. 13. The earliest phase of the settlement.

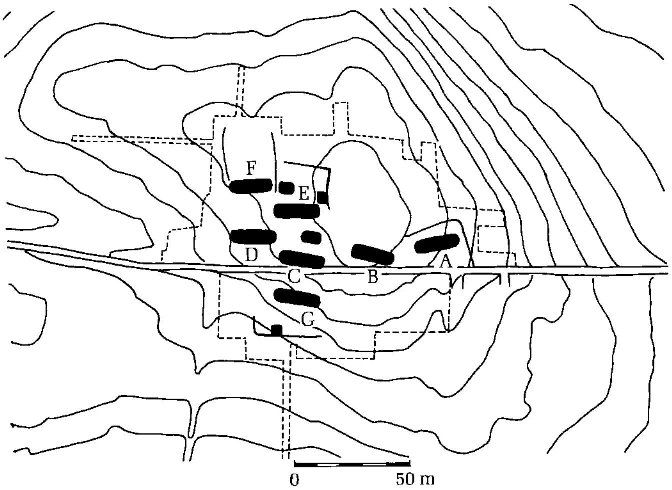

Fig. 14. The middle phase of the settlement.

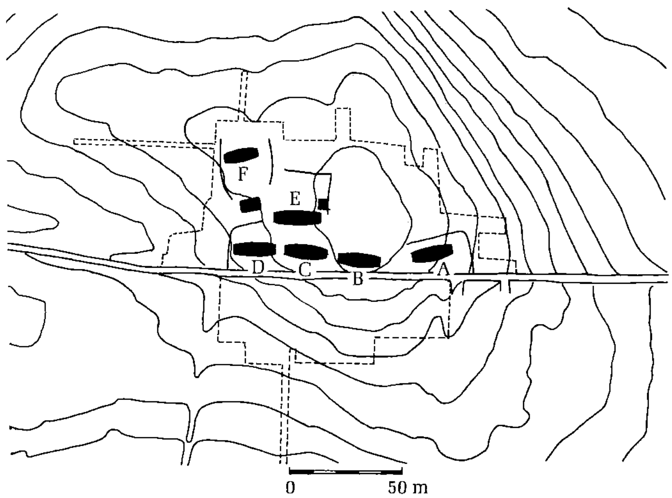

Fig. 15. The final phase of the settlement.

no quite sterile postholes. They have probably been erected at a time when there was much activity in the area. Farmsteads D and E almost appear as additions to the earlier farms C and F, both of which have several replacements of the houses. In both cases one early and two later house types are represented.

So during the earliest period of the settlement there were 5 farmsteads (fig. 13), later the number rose to 6 or 7, and during the final period there were 6 farmsteads (figs. 14 & 15).

Pits

Besides the large number of postholes there were also many pits. The largest ones were probably clay pits whence the Iron Age peasants got the clay for the mud walls of the houses. A few of the pits were fire pits with a layer of charcoal at the bottom covered by fire-shattered stone. Both the clay pits and the fire pits contained pottery in considerable quantities. At the southern end of the excavated area was a large number of pits with a markedly different kind of fill. It often contained flint flakes and in a few cases a little pottery ornamented with needle pricks. These pits should be dated to the Neolithic.

Artefacts

The artefacts found on the settlement site were mainly pottery. The major part was found in the pits, but the holes from the roof-supporting posts also yielded some. Burnt clay from the mud walls appears in considerable quantities especially in the holes from the roof-supporting posts of the late houses.

Farmstead D yielded a large number of warp weights of the well-known type from the Iron Age and Viking Age. Rotating mills of granite appear in the shape of intact underlier and two fragments of 'rubbers'.

In a smallish pit two bluish green cylindrical glass beads were found along with a fragment of an iron bucket handle. Another fragment of an iron bucket handle was found in a posthole from a roof-supporting post in house B. Furthermore there were 9 crushing stones and 3 small whet-stones made of sandstone.

Several of the larger pits contained bones of domestic animals, a.o. cow, sheep, and pig.

The pottery found on the settlement site is best described as rather coarse-grained and at times of

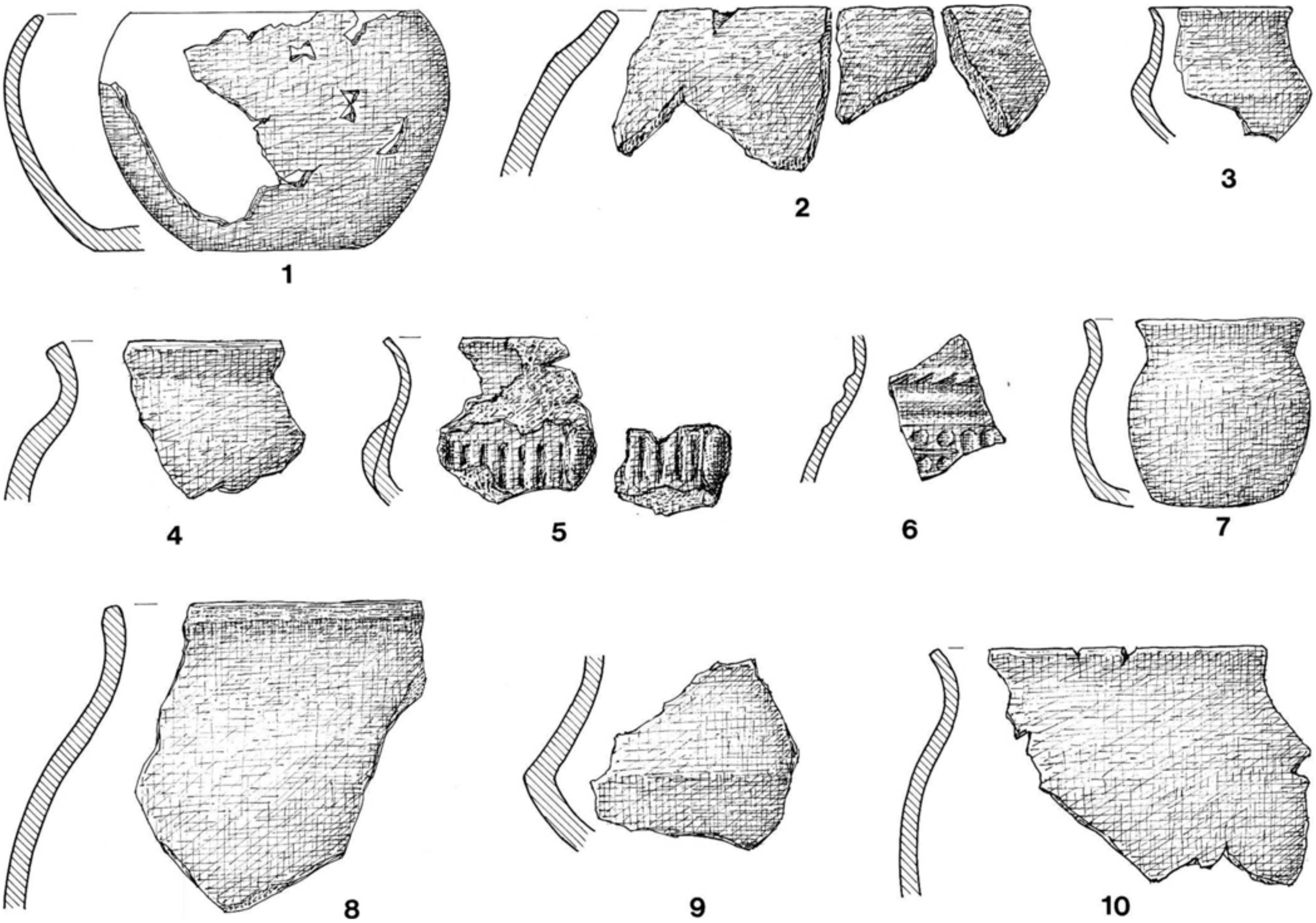

Fig. 16. Pottery. 1 & 2 were found in farmstead F in a stockade posthole and in a pit, respectively. 4 & 5 are sherds found in holes from roof-supporting posts of the later houses of farmstead C. 3 & 10 are from holes from roof-supporting posts in farmstead B. 6 is from a pit with two bluish green glass beads in farmstead A. 7 & 9 were found in holes from roof-supporting posts of an early and a late house in farmstead F. 8 was found in a hole from a roof-supporting post in farmstead D.

rather hap-hazard manufacture. The surface treatment varies, and a few sherds have nicely glazed surfaces. The few ornamented sherds were smoothly glazed, but the ornamentation revealed primitive workmanship.

The rim-sections of the pots were often short with perdendicular or slightly outward-curving lips, though a few had heavily outward-curved lips. Two hemispherical vessels one of which has a preserved base-surface, differ markedly from the others. They show rather coarse surface treatment and recall the hemispherical vessels from the Viking Age (fig. 16, 1 & 2). Both hemispherical vessels were found in farmstead F in a post hole in the stockade and in a pit that is later than one of the type 1 houses, respectively.

The pottery material contained only three fragments of handles. One had a slightly cruciform cross-section (fig. 17:4), and the other two were stout, almost sausage-shaped handles. All three fragments were found in the same pit.

Dating

A precise dating of the Bellingegård settlement site, which has undoubtedly had a long life-span, is not all that simple. The pottery dates the settlement site to the period between the 3rd and 6th centuries. Both the development of the house types and the 4–5 reconstructions of the farms suggest a long life-span.

The pottery material contains no items that can be

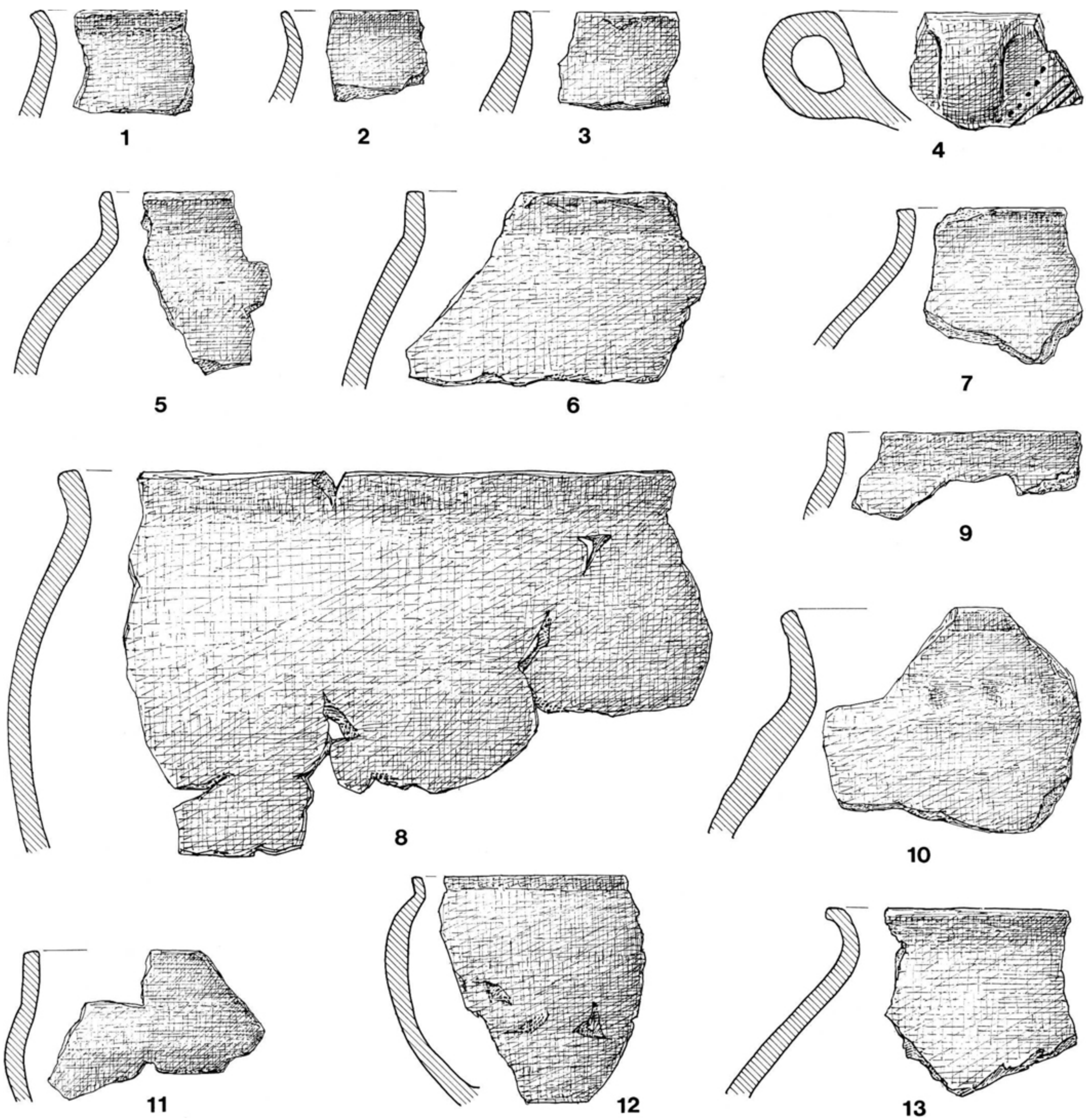

Fig. 17. Pottery found in various pits and postholes. 7 & 8 were found in fire pits. 10 was found in a stockade posthole in farmstead A.

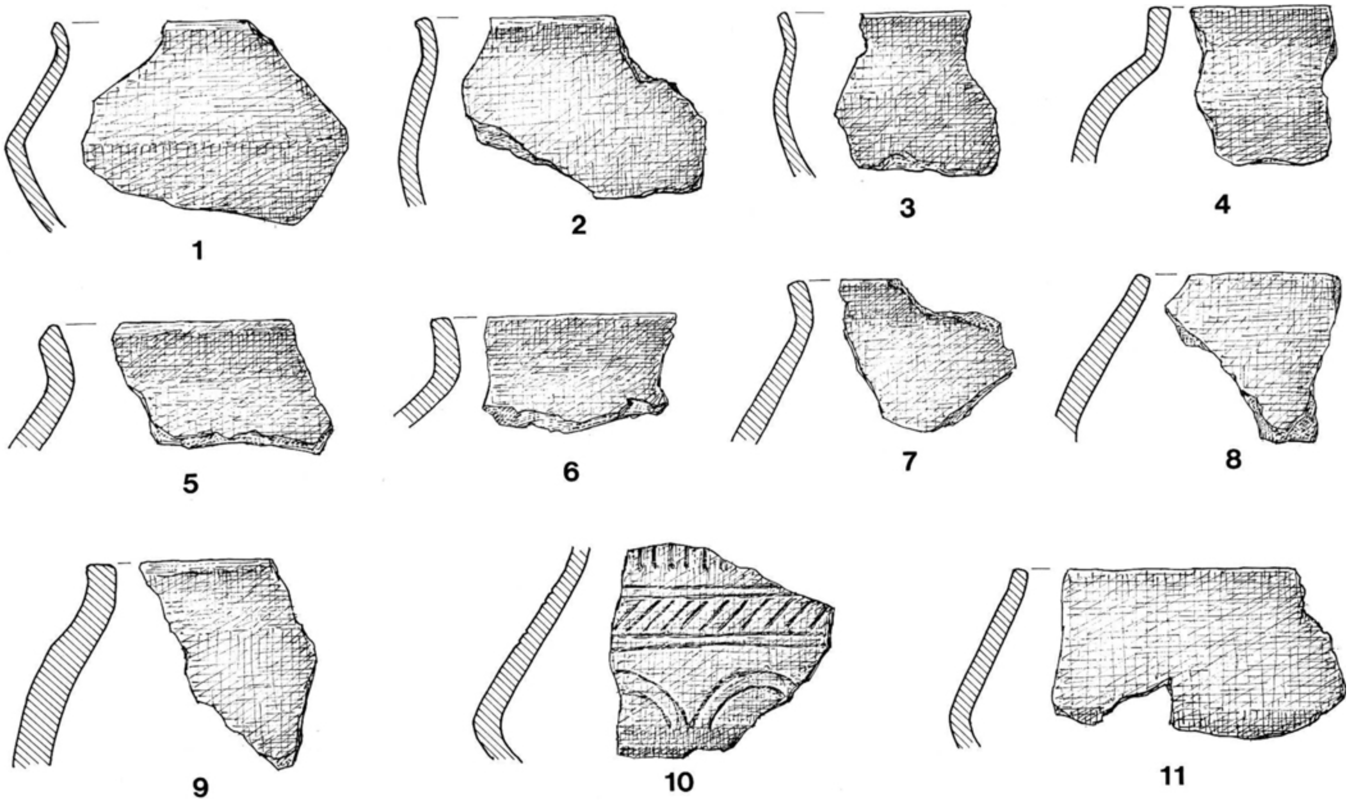

Fig. 18. Pottery from one single pit, which is older than farmstead E.

dated to the early Roman Iron Age. The ornamented sherds should be dated to late Roman or early Germanic Iron Age. The hemispherical vessels should probably be dated to the 6th century.

Some mud-wall fragments from the roof-supporting posts have been dated by means thermoluminescence. So far all results have been between the 2nd and 6th centuries (3).

So in conclusion the settlement site must have been founded during the 3rd or 4th centuries. Originally it consisted of 5 farmsteads, later another two were added only to be dismantled during the 5th or 6th centuries.

The distribution map of Iron Age settlement sites in this area (fig. 1) shows that the Bellingegård site is one out of six settlements inside a limited area. Four of these have been dated on the basis of pottery systematically gathered during reconnaissance. One belongs to the transition period between the Bronze Age and the early Iron Age, and two of them can be dated to early Roman Iron Age. The fourth can be dated to late Roman period and the fifth cannot be dated with any certainty.

Bellingegård may very well represent a period in the life-span of a small Iron Age community that has moved around inside a limited area, a pattern that is known from the extensive village investigations in Jutland (Hvass 1982).

Translated by Ul S. Jørgensen

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NOTES

1. Bellingegård (Højelse s., Ramsø h., Københavns a. *Køge Museum* file no. 1019). – Havbogård (Solrød s., Tune h., Københavns a. *Køge Museum* file no. 1012), settlement from the early Roman Iron Age. – Solvadgård (Solrød s., Tune h., Københavns a. *Køge Museum* file no. 1011), settlement from the late Roman/early Germanic Iron Age.
2. Sb. (Central Register) no. 7, Højelse s., Ramsø h., Københavns a.

3. Risø TL no.	Feature		TL date
832201	II,8	Farm A	250±100 AD
832204	IV,237	Farm F	530±90 AD
832206	VI,93	Farm C	170±120 AD
832207	VIII,3	Farm D	450±110 AD
832208	VIII,36	Farm D	350±350 AD
842201	II,35	Farm A	320±100 AD
842202	IV,164	Farm F	500±80 AD
842203	VI,72	Farm C	420±80 AD
842204	VI,195	Farm C	340±100 AD

Samples nos. 832201–832208 consisted of burnt daub, samples nos. 842201–842204 of pottery. All tests were performed at the *Nordisk Laboratorium for Termoluminescens Datering*, Risø.

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A Settlement Site of the Later Iron Age at Vallensbæk near Copenhagen

by FLEMMING KAUL

In the spring of 1983 a small area about 200m. south-east of the village of Vallensbæk near Copenhagen was investigated because of the laying of a natural gas pipeline. A number of ancient rubbish pits were found. Towards the end of 1983, the Copenhagen District Museum Council learnt that a more extensive area north-west of the pipeline was to be developed for housing, and so trial excavation in this area commenced in March 1984. This trial excavation consisted of a number of strip-trenches about 2m. broad and 20m. long, regularly laid out 20m. apart. So positive were the results of this trial excavation that a wider ranging investigation of the area was considered essential. The systematic trial excavation, which covered the whole area affected, was an important basis for the effective ordering of priorities in the work (1).

The real archaeological investigation lasted about one month in March and April 1984 (2). In all *circa* 7,000 sq.m. were investigated. The area under consideration lies partly on a plateau above the broad river valley through which the Store Vejleå runs and partly on the gentle slope down towards this valley (3).

A few pits on the site produced pottery which is apparently datable to the later Bronze Age. Besides these a greater number of pits of the early Roman Iron Age were found with, amongst other things, a quantity of pottery of which the majority is of the very coarsely tempered and poorly fired material which characterizes the larger pots of this period on Sjælland.

The more interesting finds from the site, however, are from the later part of the Iron Age. These comprise in all 13 buildings of various sizes from just two pairs of roof-bearing post-holes upto seven pairs of these. In addition, several lengths of fencing have been identified, amongst which the most significant are a pair of parallel courses which link the valley of the Vejleå with the settlement up on the plateau.

Two complete farm-complexes and a possible third could be isolated. In such a cluster of buildings, the contemporaneity of individual structures could not be demonstrated perfectly, but the relative placement of the buildings together with their "clear" appearance makes this perfectly possible.

FARM-COMPLEX I

One farm-complex lies on the plateau close by the edge of the slope down towards the valley to the south-west. It comprises three buildings, two orientated NW-SE and one orientated NE-SW. The largest building is composed of seven sets of roof-bearing post-holes, and at 22.5m. long is in fact the largest building on the site. (This, and all other dimensions for the buildings, are measured on the roof-bearing posts.) The posts of this building had almost all been renewed, and with this refurbishment the building has shifted almost a meter. In the north-western end of the house a distinctly-bordered area with charcoal remains was observed, presumably what is left of the fire-place. In the other half of this house, crossing the long axis, an oblong feature was found which may represent an internal partition. A few meters to the south-west, and lying parallel to this building, is another building, composed of four sets of roof-bearing post-holes, 12.25m. long. About 16m. south-east of the large building lies a building orientated the opposite way (NE-SW), again with four sets of roof-bearing post-holes, and with a smaller number of wall-post-holes, 12m. long. The wall-post-holes preserved from this building appear to indicate that it had the roof-bearing posts actually in the gable, and that the walls were slightly bowed. The large building is regarded as the principal one. The building on a cross alignment is interpreted as a stall, because the long double-fence leads to it up from the meadow.

About 14m. beyond the south-western end of this

Fig. 1. General plan of the excavations with the buildings and droveway. A greater part of the area was covered by a system of 20m. long strip-trenches.

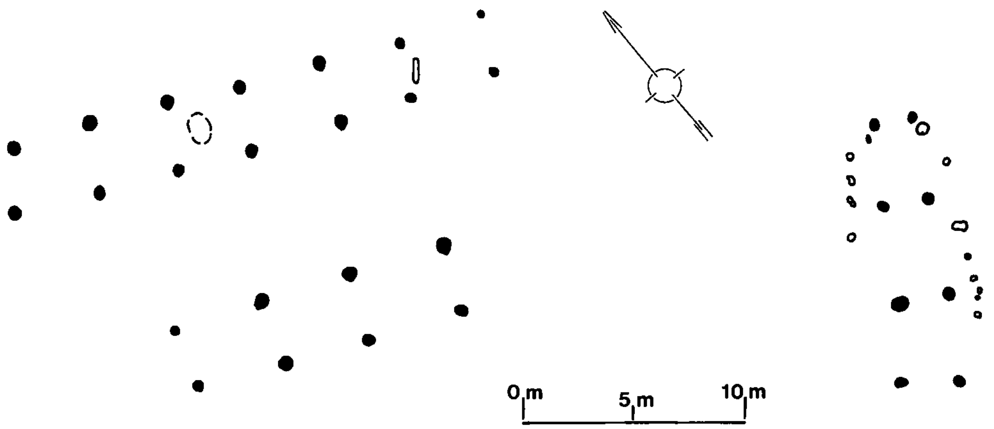

Fig. 2. Farm I. The post-holes of the roof-bearing posts in relief.

building lies one end of a structure composed of two double fences, with supporting posts, running parallel. Both fence-lines run unbroken to a length of 47.5m. The distance between them is 7.25m. The fence-posts proper are fairly evenly spaced, although the intervals may vary from 1 to 2 meters. Most post-holes are double, although some single ones appear. The outer, supporting posts are at more regular intervals of 2.5–3m. They are always found outside a set of fence-posts. In several cases the post-hole of the supporting post slopes, and in one case the traces of a post showed that the support post stood at a marked angle towards the fence so that it would apparently have met it about 1m. above the ground. This structure, with the two parallel and identical fences, runs south-westerly from the occupation area down the slope towards the valley, and ends just where the slope becomes steeper where the meadows begin. The fence-post-holes are especially deep at the end towards the river valley, and on both sides here there is an extra post-hole.

Since there are no other buildings than the farm-complex just described up on the level ground from where this structure runs, and since there are no great discrepancies in the fill of the post-holes, it is reasonable to suppose that these two fences and the farm are contemporary. As the fences thus form a passage-way between the meadowlands of the Vejleå valley (Vallensbæk Mose) and the settlement, their most obvious interpretation is as a droveway, bringing the cattle up to the farm from the meadowlands. The extra set of post-holes by the end of either fence down by the river-valley may have carried some form of gate.

Two further buildings were found to the north-west of this farm-complex up on the plateau, one composed of four sets of roof-bearing post-holes, orientated NW-SE, and the other orientated NE-SW, similarly with four sets of roof-bearing post-holes, but in this case with the middle of the three intervals between the roof-bearing post-holes double the length of those at the ends of the building. A length of fencing, which cannot be contemporary with one of these buildings, was also identified in this area. But it was not possible here to reconstruct a true farm-complex from these buildings and post-holes; the post-holes in this area indicated, however, that settlement here probably continues towards the north-west, under the south-easternmost of Vallensbæk village's farmhouses.

FARM-COMPLEX II

In an excavated area further north, further in on the plateau, another farm-complex was discovered. The individual houses cannot be associated with fences here, but in the relative positioning of the buildings and their "clear" appearance they have all the features of a farm-complex. The principal building of this farm-complex is one with five sets of roof-bearing post-holes. There are also a large number of wall-post-holes here. The building is 17.5m. long. The wall-posts show that the outermost set of roof-bearing posts stood in the gable, and that the long sides of the building were slightly bowed. 5m. north-east of this building lies another one, orientated NE-SW, with three sets of roof-

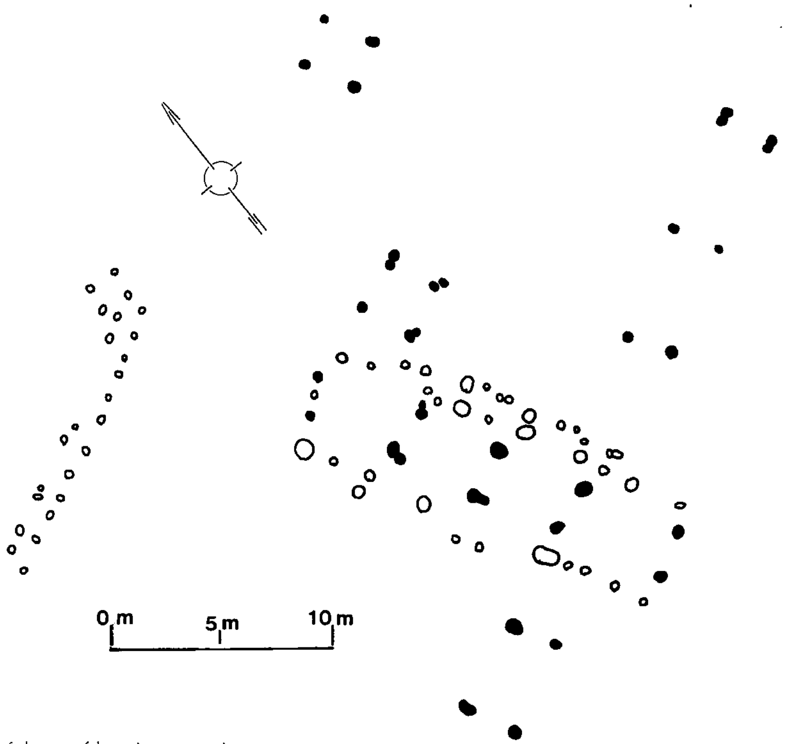

Fig. 3. Farm II. The post-holes of the roof-bearing posts in relief. A segment of fencing can be seen north-west of the largest building, possibly marking the boundary of the farm.

bearing post-holes, 10.25m. long. On the other side of the presumed principal building, in an almost symmetrical configuration, is a third building, also orientated NE-SW. Only two sets of roof-bearing post-holes from this building were found – unfortunately the excavation could not be extended here because of a trackway, and so it is not possible to say if the building was longer. But the fact that the span of one of the pairs of post-holes was lesser than the other indicates that the building was longer, because such narrowings at the gables are found on other larger buildings on the site.

Two smaller buildings are apparently associable with this farm-complex, both of them composed of only two sets of roof-bearing post-holes. One of these lies very close by the farm's principal building, the other further towards the north-west. About 10m. beyond the north-west end of the principal building a line of fencing running NE-SW was found, apparently with single supporting posts. The fence probably makes a substantial turn towards the north-west, and may represent the farm-complex's boundary in this direction. Thus this farm-complex comprises one principal building, orientated NW-SE, with two subsidiary buildings, orientated NE-SW, close by; two smaller buildings can probably also be associated with these.

Further towards the north-west in this area, several lines of fencing were found, running NE-SW, together with three smaller buildings composed of only two sets of roof-bearing post-holes, one of which was connected to one of the fences. In the north-west we have probably hit upon one or more farm-complexes. Parts of these farm-complexes presumably lie underneath the present village of Vallensbæk, which defines the boundary of the site in the north-west.

In the two excavated farm-complexes, the recutting of the roof-bearing post-holes was most consistent in the buildings interpreted as principal buildings. Most of the other buildings also showed signs of a certain amount of renovation.

DATING

Since no sherds yielding clear dating evidence other than being obviously ancient were found in the post-holes of either the buildings or the fences, our dating must be based upon the form of the buildings. A large number of buildings of the Iron Age and Viking Period, forming a basis for comparative study, have been found in Jutland in recent decades (e.g. Hvass 1979, 1980; Nielsen 1980). However it is not yet entirely clear how great regional variation in building construction may be, which, since so few Iron-age buildings have been excavated on Sjælland, renders such comparisons problematic. But the recently investigated settlement site of the Later Iron Age at Bellingegård near Køge demonstrates that observations made on Jutish excavations can be used on Sjælland (Tornbjerg, this volume). A couple of more recent excavations, with buildings dated to the later Roman Iron Age and Viking/early Medieval Period, in mid- and western Sjælland (Siemen 1983; Holm & Nielsen 1983) corroborate this.

On the basis of comparisons with the Bellingegård and the Jutish material it is reasonable to conclude that, at the earliest, the buildings near Vallensbæk village should belong to the Later Iron Age: the Vallensbæk buildings have for instance many examples of a noticeably long distance between the roof-bearing post-holes relative to the width of the building (about 2:1), a feature which begins to appear during the Later Iron Age. Furthermore, the roof-bearing posts in the gables, often however only at one end, have a shorter transverse span than the other pairs of posts, indicating bowed side-walls which appear to be a common phenomenon during the Later Iron Age (cf. Bellingegård). A feature visible in the principal building of the northerly farm-complex, and apparently occuring in one of the subsidiary buildings of the other complex, is that the roof-bearing post-holes are found in the gables, something which first and foremost characterizes Viking-age buildings. The wall-posts in the same buildings show the walls to have been slightly bowed. A building which is not part of either of the two farm-complexes, the building orientated NE-SW with four sets of roof-bearing post-holes and the doubled interval in the middle, also indicates the Viking Period, in which such large intervals in the middle of a building are common.

Thus in sum, the construction of the buildings indicates a dating to the Late Iron Age or Viking Period. Since no great amount of comparable material of the later Iron Age is known, apart perhaps from Bellingegård, a dating to this period can certainly not be ruled out. On the other hand the position of the settlement, hard by and conceivably under the medieval village, indicates that we ought to be in a not particularly early part of the Viking Period, since investigations in our present villages locate the start of subsequently unbroken settlement there in about the second half of the Viking Period (4). A closer dating of the buildings at Vallensbæk will depend upon the future development of a greater grasp of the typological chronology of buildings.

THE DROVEWAY

As has been stated, a 47.5m. long passage formed by two doublefences with supporting posts joins one of the farm-complexes, the one nearest the valley of the Vejleå, to the meadowlands below it. No structure of this form has hitherto been excavated in Denmark, so we must see what the other Scandinavian lands have to offer. From the later Roman and earlier Germanic Iron Ages on Gotland and Öland, for example, passages in the form of stone walls linking a farmhouse with what is interpreted as a more extensively exploited pasture area are known (Stenberger 1933; Stenberger et al. 1955; Hagberg 1976 p. 21; Widgren 1984): such a passage is thus interpreted as a droveway, protecting the intensively cultivated infield against trampling by cattle on the way to the pasture. Several such droveways for leading the cattle to the pasturelands are also known from farm-complexes of Migration-period western Norway (Myhre 1980). A good example is the settlement of Vatland in south-western Norway, where a droveway of broadly the same dimensions as that at Vallensbæk leads from the farm-buildings down to a river (ibid. fig. 140, p. 273).

All of these Swedish and Norwegian droveways are stone-built, but their function may certainly have been the same as the Vallensbæk example. The fences at Vallensbæk, however, seem to be more regularly constructed than the stone walls in Norway and Sweden. Some droveways of stone are also known from historical times in Denmark, some of which still exist.

If the interpretation of the two parallel fences as a droveway is accepted, we have evidence of the exploitation of the ecological resources at Vallensbæk. If we assume that it protects an infield against trampling, the infield must be situated on the approximately 50m.-broad, well-drained slope between the settlement and the meadows where the cattle have been pastured.

Naturally it is not possible to say how great an area on the other sides of the settlement was under cultivation. It is difficult to assess how much the droveway has also been used as a fold at night-time or for milking, but the substantial construction with the supporting-posts could point in this direction (5). Phosphate samples taken both within and outside the droveway are unfortunately not particularly consistent (6), but it does appear that the highest phosphate levels occur some way up the slope outside the droveway (7). One can reasonably imagine that this reflects the throwing of dung out over the fence to manure the field. In connection with the possible use of manure it may be noted that in the later Bronze Age, and pre-Roman and Roman Iron Ages, especially in the early Roman Iron Age, we find many rubbish pits on settlement sites, often with a high pottery content. It is commonly on the basis of these that the settlement sites can be identified. In contrast high pottery yields and find-rich pits are rare in the later Iron Age (cf. Jensen 1982 pp. 121–122). The cause of this may be that settlement refuse begins to be used to a greater extent to manure the fields where sherds and other remains rapidly perish. This hypothetical change in cultivation strategy may be one of the reasons why it has been difficult to locate settlement sites of the later Iron Age. The Vallensbæk site is certainly very poor in finds – actually, it was the pits from the early Roman Iron Age which first drove attention to the site.

CONCLUSION

Two farm-complexes of the later Iron Age or Viking Period, and parts of more, have been excavated at Vallensbæk. The farm-complexes lie upon a plateau above a fertile river valley; a droveway connects one of the farm-complexes with the meadowlands. On the basis of this droveway one may infer that around the buildings, perhaps in a 50m. wide belt, was an intensively cultivated infield; below the infield towards the south-west are the fertile meadowlands where the cattle grazed. The settlement is thus situated so that the ecological resources in the meadowlands, on the slope upto the plateau, and on the plateau itself can be exploited with the maximum convenience. The settlement is centrally placed relative to all three topographical features. The present village of Vallensbæk, beneath which our settlement probably continues, lies in the same topographical situation, as does Vridsløselille further up the valley, both of them villages of antiquity. The same goes for another settlement of the later Iron Age or Viking Period in the neighbourhood of Vridsløselille, a few kilometers north-west of Vallensbæk, Ragnesminde (Mahler, this volume).

The settlement structure at Vallensbæk seems relatively "open": the farms must have been relatively spread out on the level ground above the valley. This corresponds to what has been observed in Jutland, where the individual farm-complexes cover a greater area in the Viking Period than in the later roman Iron Age or earlier Germanic Iron Age. A similar change in the individual farm or farmsteads' size has been observed on Gotland (Carlsson 1979). However the Gotlandic settlements seem to be more dispersed farms. Thus the settlement structure too indicates a later Iron-age or Viking-period date.

Translated by John Hines

Addendum

In the spring of 1985 further excavations were carried out under direction of the author, this time in the village of Vallensbæk itself, appr. 300 m north of the excavation dealt with above. Apart from a number of pits from the late Funnel Beaker Culture (MN V) containing a rich flint and pottery material, the excavations yielded a large building c 20 m long and 7,0–8,5 m broad without traces of roof-carrying posts. The side-walls are slightly curved. Such buildings are known from sites in Jutland and are dated to the later part of the Viking Age (Jørgensen and Skov 1980 fig. 7, Hvass 1980 p. 155 and fig. 17 and 18). Near the house was found a system of ditches, probably for fences, which, together with a couple of pits yielded some few pottery sherds of Baltic ware. The area available for excavation in the village of Vallensbæk was too small to gain a clear overall picture of the settlement pattern. Both the pottery evidence and the type of the large "hall" indicate a date to the later part of the Viking Age or early Medieval.

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NOTES

1. The trial excavation was directed by Ditlev Mahler.

2. The full excavation was directed by the author; Palle Schielderup, Liv Appel, and Lene Husum also took part, whom I thank for their great assistance.
3. Vallensbæk parish, Smørum herred, Copenhagen amt, Søllerød Museum journal no. SØL 180. The excavation was financed by Vallensbæk kommune.
4. The absence of any Baltic pottery could however indicate that the date is no later than 1000.
5. The cattle and calves in summer and autumn could find protection here, close by the people during the night, against predators such as wolves.
6. The phosphate levels from the settlement of Vallhagar on Gotland with droveways in the form of stone walls are not particularly consistent either (Stenberger et al. 1955 fig. 448 p. 1059).
7. The phosphate analyses were carried aut by Jens H. Jönsson.

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Journal of Danish Archaeology vol. 4, 1985, pp 164–167

Ragnesminde

A Germanic – Early Viking Age House – Site in Eastern Sjælland

by DITLEV L. MAHLER

Although archaeologists have often attempted to direct the nature and chronological character of the incoming flow of source material, chance and luck are still the modern archaeologist's best friend. The site of Ragnesminde was discovered as the result of preliminary antiquarian reconnaissance in connection with the natural gas project. Field survey indicated activity typical of the Early Iron Age, and true enough evidence of activity from this period was registered (1). The site's major structures are, however, of a somewhat later date. These would not have been discovered, were it not for traces of Early Iron Age activity in the topsoil and under the preliminary excavations.

The site of Ragnesminde, placed on clay soil with a high agricultural potential, lies on a terrain that slopes evenly down in a south-eastern direction. Some one to two kilometers south/south-west, lie freshwater deposits as well as the old Litorina sea bed. Both entities must, at the time of Ragnesminde, have been large useful compact marshes and meadows. Furthermore to the east, less than five kilometers as the crow flies, lies Køge Bay. The placing of settlements on land well suited to agricultural exploitation, with stretches of marsh and meadowland in the vicinity, as opposed to placement in high terrain or on slopes facing south, is characteristic of several well known Viking – age settlements – for example Sædding (Stoumann 1980: 96).

The actual excavation of the threatened site of Ragnesminde took place over two one-week campaigns in respectively November and December 1982 (2). As there was no sign of preserved culture layer, the topsoil was removed by a caterpillar tractor. The uncovered area totalled 750 sq. meters, plus 350 meters in two meter wide test trenches placed directly in the path of the coming gas pipeline.

Wall and roof-bearing post-holes appeared faintly at first due to the heavy clay subsoil, however subsequent desiccation and oxidation caused these to later stand out fairly clearly. The main excavation area totalled 370 features, mainly post-holes, that almost all converged to produce the remains of three structures. Large and small pits could be dated to the Late Bronze Age or Pre-Roman Iron Age, but it was not possible to establish any further contemporary complexes. Besides potsherds, the pits contained fire-shattered stones, cindered clay, charcoal, and some bone fragments, the condition of which left much to be desired; in other words, the usual material found in these so-called rubbish pits.

The post-holes were reasonably well preserved. Between 40 to 80 cms of the roof-bearing post-holes and ca. 5 to 35 cms of the wall construction post-holes were preserved under the 45 cm. thick topsoil. The degree of attrition seems to have been moderate compared with other Iron Age sites.

House I

House I's groundplan was the most complete, and consisted of a total of 206 post-holes. The c. 24 m long house, orientated east-west, had three partitions and a total of five pairs of roof-bearing post-holes. House I has slightly convex longitudinal wall courses, the gable walls being 5 meters wide while the area between the two entrances in the middle of the house, measures 6.5 meters.

The first set of roof-bearing post-holes are placed immediately inside the west gable and are closer to one another (2.0 m.) than the other pairs, that seem to follow the curvature of the walls. The space between the roof-bearing post-holes and those belonging to the walls, is the same for all five sets: that is between 1.50 and 1.75 m. The actual span between two pairs of roof-bearing post-holes is largest between the two sets that stand symetrically on each side of the two entrances.

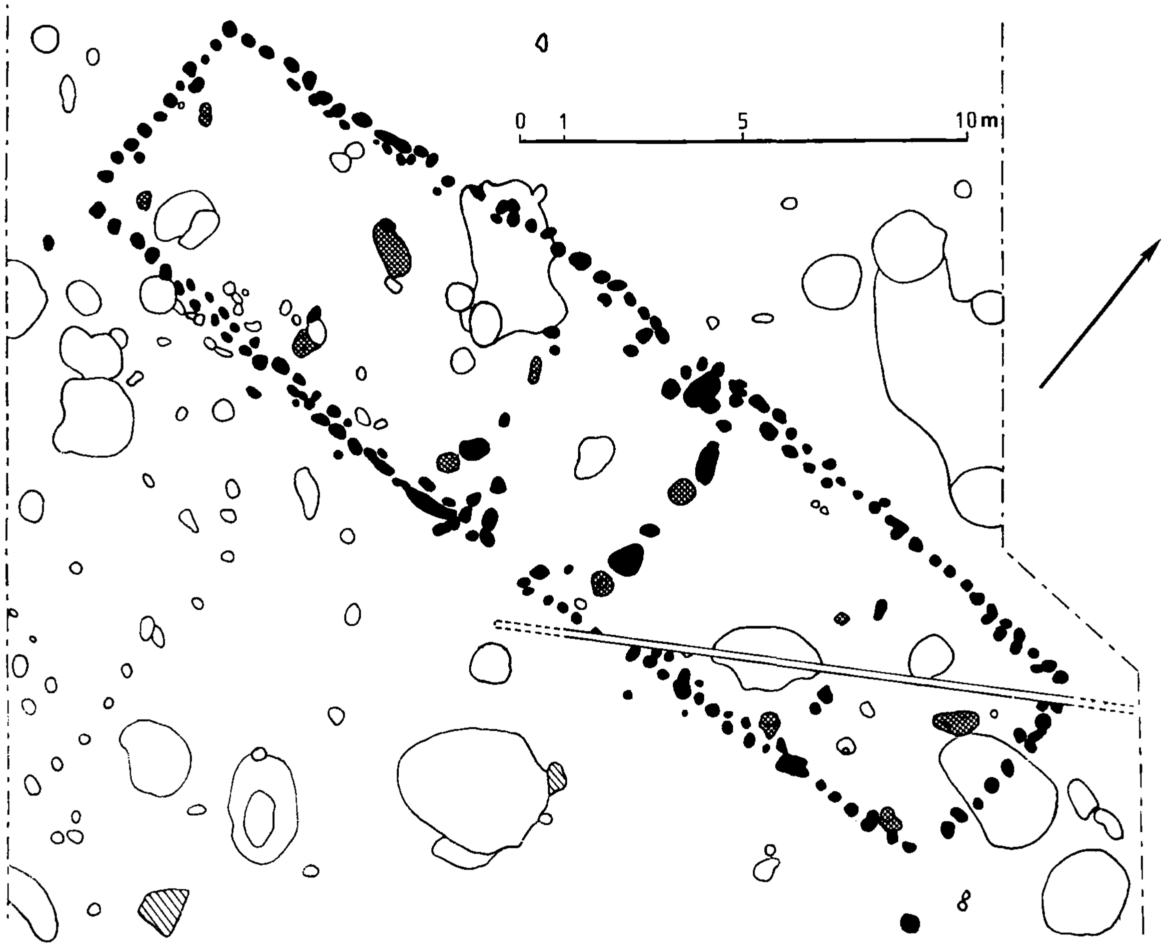

Fig. 1. Ragnesminde. House I (dark) and II (shaded). Only the roof-bearing posts of house II are preserved.

The easternmost set of roof-bearing post-holes seemed to be missing, with the result that House I's supportive structure appears slightly assymetrical. On the whole though the impression is one of symmetry and regularity. The southern post in the easternmost set, and the northern post in the third set from the west end, appear to have been replaced.

Of the wall courses, the northern wall is the most irregular, however this irregularity does not appear to have been caused by reparations or replacements. The southern wall, on the other hand, curves evenly although part of it's west end has been repaired. The walls consist mainly of a double row of post-holes, although traces of a runnel appear for a short length of the southern wall, just west of the entrance area.

The two entrances are placed in the middle of each longitudinal wall course, and thus symetrically opposite one another. Both entrances measured at one time 1.50m, though later reparation reduced the width to 1.00 m. In both cases, seen from the outside, it is the left side that has suffered reparation, presumably because this side was the supportive element in the entrance structure.

Aside from the roof-bearing post-holes, the interior structure consisted of sporadically scattered post-holes following the wall courses, the function of which we cannot reconstrue. However two of the post-holes were placed directly opposite one another, between the two pairs of post-holes at each side of the entrances. These seem to suggest a triple partitioning of the house; so that to the west we have a 10 m. long room including the third pair of roof-bearing posts, hereafter an almost 4 m. long room spanning the area between the above mentioned third set to the next pair of roof-bearing posts, and finally a room consisting of the east end of the house.

A rather singular feature worth mentioning was the presence of a fragmentary layer of charcoal, interpreted as the bottom of a hearth, placed right in the middle of the house, directly between the two entrances. This symetrical placement within House I could be a coincidence, and there is no proof of contemporaneity, however it cannot be excluded that a hearth was placed here by the inhabitants of House I.

House II

Only the roof-bearing post-holes of this east-west orientated house were preserved, in all six pairs. Their depth varies from 40 to 60 cms – the middle set being the deepest. The actual span varies by half a meter, so whilst the eastern and western-most sets have a span of 2.5 m, the rest have a span of 3.0 m. The distance between the pairs of roof-bearing post-holes varies, too, the span separating the westernmost pairs being 5.0 m while being 3.5 m in the east end. This building must have had much the same length as House I, and being stratigraphically older, it would be natural to interpret House II as House I's immediate precursor.

An additional fragmentary structure was uncovered on the site, and consisted of a north-south orientated construction south of House I's western wall. It was not possible to determine the character of this structure, or its chronological relation to the two house complexes, however it seems logical to include it as part of a whole. It is possible that we here have the remains of a fence, eventually equipped with a half-roof, running at right angles to house I or II.

South of House I and east of the north-south orientated "fence" was found an oval pit 2.5 × 3.5 m in diameter, and bearing a certain likeness to the well known Late Iron Age / Early Viking-age pit houses. In spite of the immediate resemblance to these pit houses, we found no sign of a bearing structure within or around the pit. A comparison with material from Skåne, shows that pit houses without any sign of bearing structures do exist, although they are exeedingly unusual (Ohlsson 1976: 78 and Strömberg 1971: 198 Abb. 3). It is important to be aware of this problem while excavating Late Iron Age sites, as indeed is being done in for example, the northwestern Slavonic areas (Donat 1977: 119ff). The pit contained morever, the usual settlement site domestic refuse, within which Early Iron Age potsherds were found. This dating is supported by two TL-dates (3): 40 A.D ± 150 and 220 A.D ± 150, and is thus also consistant with the interpretation of the pits' function as a rubbish pit.

Dating

An absolute dating of Houses I and II is rather difficult as none of the finds were of a datable character. As mentioned above, both Late Bronze Age and Early Iron Age activity could be registered on the site. An analysis of the remaining pottery provided no specimen that could be definitely dated to later than the Early Iron Age (compare with Jensen 1982: 119 ff). This situation mirrors the general picture in relation to the lack of finds on Late Iron Age settlements, and, in the light of the limited area excavated, there is nothing strange in the lack of specimens younger than the Early Iron Age. A dating of Houses I and II and the fence-like structure must thus be based on the typological position of House I.

Convex long-walls are a structural element characteristic of Viking Age houses, but cannot be used as a firm dating criterion. The newly excavated house-sites from Vallensbæk lack archaeologically datable material, too, thus any close chronological comparison to Ragnesminde House I must include certain reservations. There are, however, certain similarities between structures from the two sites. Some of the house-sites from Vallensbæk seem to have had convex long-walls judging from the position of the roof-bearing post-holes, as well as owning a set of roof-bearing post-holes close to the gable wall. The Vallensbæk house sites are tentatively dated to the Germanic Iron Age or the Viking Age (4).

At Bellingegård near Køge (Tornbjerg 1983: 61 ff, and this volume) a recent excavation unearthed major house structures consisting of convex rows of roof-bearing post-holes indicating a house type with convex long-walls. The Bellingegård houses are archaeologically dated to the Early Germanic Iron Age (5). Ragnesminde House I shares certain characteristics with Foulum House VIII (Iversen 1982: 24), which also has slightly convex walls and straight gables. Foulum House VIII is dated to the Early Germanic Iron Age or Late Early Germanic / Early Late Germanic Iron Age. It is precisely the straight gables that dissociate Ragnesminde House I from the Early Germanic Iron Age houses with their characteristic rounded corners, without this being a firm dating criterion either (see Høgsbro house, Jensen 1980: fig. 3 and Nr. Snede, Hansen 1982: 180 ff). The positioning of the first set of roof-bearing posts immediately within the west-gable points to the Viking Age. However there are no structural details that definitely date the house to this period, just as none of the characteristic Viking Age finds turned up on the site.

It would seem thus that on an archaeological basis House I must be placed somewhere in the period between the beginning of the Germanic Iron Age and the end of the Viking Age – and possibly more precisely in the period from the Late Early Germanic Iron Age to sometime in the Early Viking Age.

Sample material was collected for both Carbon – 14 and Thermoluminescence analysis. The ^{14}C sample was collected from a roof-bearing post-hole belonging to House II, and consisted ostensibly of a single cohesive charcoal fragment. The charcoal was dated to 250 B.C. ± 75 yrs. (4), a date that is much older than expected and in no way compatible with the archaeological date based on our knowledge of the evolution of house-types during the Iron Age. It is possible that we here have a case of contamination stemming from much older settlement remains on the site.

The TL-dating of House II (5) points towards some time previous to 400 A.D, and of House I to 340 A.D ± 100. Both dates are from samples extracted from roof-bearing post-holes. The TL-dates point to the Late Roman Iron Age or possibly to the Early Germanic Iron Age for House I, and combined with the archaeological dating place House I within the Early Germanic Iron Age.

However, there is still a clear disrepancy between the archaeological dating and the TL-dates, a disrepancy that may mirror our incomplete and fragmentary knowledge of East Danish house types. If the archaeological dating of House I is correct, Ragnesminde joins a small group of Late Germanic Iron Age house sites, of which there are relatively few in Southern Scandinavia.

However, further speculation must wait until we have a firmer chronological basis. It would be extremely interesting if we knew more about the context in which these houses were placed. Are they the remains of a single farmstead, or do the excavated houses belong to a village settlement – in which case what was the character of the settlement?

Translated by Susan Holten Dall

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NOTES

1. The site of Ragnesminde was discovered by cand.mag Birgit Andersen while reconnoitring for *Fredningsstyrelsens* 5th department, under the Ministery for the Environment. Ragnesminde is registered under *Søllerød Museum*, journal nr. 133 Brøndbyvester Parish, Smørum Herred, Copenhagen Amt.
2. The author was competently assisted by stud.mag Kirsten Hvenegård Lassen and stud.mag Merete Christensen. A special thanks to Kirsten Hvenegård Lassen who, during both excavation periods, and in spite of the difficult and uncomfortable weather, was the perfect assistant.
3. Risø TL nr. 823920 on clay 40 A.D. ± 150
   Risø TL nr. 823922 on stone 220 A.D. ± 150
4. See Kaul in this volume.
5. See Tornbjerg in this volume.
6. K-4134 on charcoal, roof-bearing post-hole House II – 2200 ± 75 pre 1950 equal to 250 b.c. equal to 290 – 350 B.C Cal.
7. Risø TL nr. 823923 on clay from roof-bearing post-hole, House II, pre- 400 A.D
   Risø TL nr. 823932 on stone from roof-bearing post-hole, House I, 340 A.D ± 100.

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Houses from the later Part of the Twelfth Century at Farup near Ribe, South-West Jutland

by PER KRISTIAN MADSEN

In the autumn of 1982 *Den antikvariske Samling i Ribe* undertook a series of trial excavations on various sites in the Ribe area. The excavations were made possible by a grant from Queen Margrethe II's Archaeological Fund, and were founded upon certain problems indicated by a current settlement history research project. This project, which began in the spring of 1981 and is directed by Stig Jensen, has two principal aims (Jensen 1984). The first is to establish a settlement history for the area which is the purlieu of *Den antikvariske Samling* (fig. 1), and the second to indicate which archaeological and antiquarian tasks one should seek to give priority to within this area.

It is not within the scope of the project to undertake new excavations, as it was originally restricted to work on the basis of known finds. It transpired that finds from the transitional point between the Viking Period and the Middle Ages were particularly lacking. The group of archaeologists and historians who are concerned with these periods (1) therefore indicated that it was desirable to extend the project with a series of trial excavations. Accordingly a number of sites were selected which appeared appropriate for various reasons. The excavation of one of these sites, in Nr. Farup, about 4km. north-west of Ribe (fig. 1), covered a considerably larger area than was originally planned. The reason for this was a series of good results, an account of which is given here.

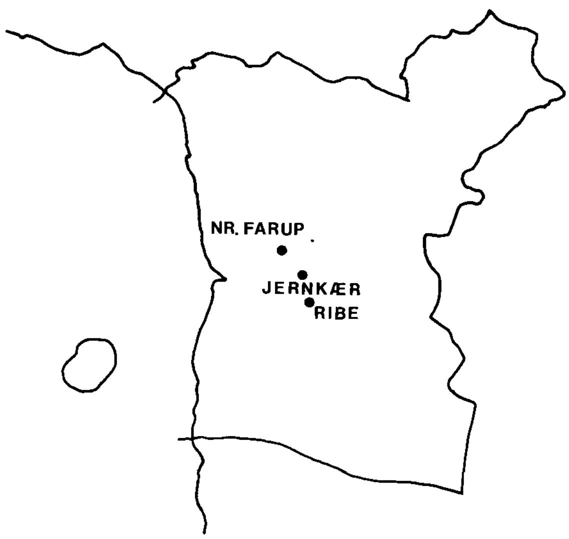

Fig. 1. The map of south-western Jutland with Ribe and *Den antikvariske Samling*'s museum district. Farup and Jernkær marked.

THE EXCAVATION

The site for excavation was chosen from an aerial photograph taken in June 1966 by Hans Stiesdal (fig. 2). The picture shows part of a field in Farup parish (Ribe herred, Ribe amt, ASR 270, sb.no. 13) between the settlements of Farup to the south and Kærbøl in the north (cf. fig. 3). Two house sites show themselves in the centre of the photograph, together with traces of several other features associated with these, including ditches. A dark blotch can be seen towards the east on the photograph which is probably the site of a more recent property which burnt down. The field itself is on the westernmost part of the *geest*, the slightly higher land which borders on the marsh, and on which the settlements in Farup parish just mentioned lie. On the survey map of 1869 (fig. 3) it can be seen that the 10' contour (1 foot = 31.4cm.) delimits the field in question towards the west and south-west almost exactly. The location of the settlements on the 1869 map is also seen on the *Videnskabernes Selskabs* map of the area of 1804. Of more recent developments only the so-called *katastrofe-vej* ("disaster-road"), which runs in a straight line west from Kærbøl to Tanderup, where the westernmost farms in Farup parish lie in a line on the edge of the marsh, and which to-day runs through the field in a cutting in the north, need be mentioned.

The excavation took place in September and October 1982 and lasted just 3 weeks (2). It progressed by stages: the topsoil was removed by machine, after which it was possible to shovel-scrape and to plan the features. Finds of two periods appeared: two house sites, some pits and ditches of the pre-Roman Iron Age (Asingh & Jensen 1983), and four buildings and some courses of fencing which may be dated to the second half of the 12th century. All the features were clearly detectable in the form of grey-black post-holes and features against the yellow sand of the natural. A few more recent disturbances could easily be distinguished. Only in the north-easternmost part of the excavated area were there indications that one or more post-holes may have been obliterated by ploughing.

The general plan (fig. 4) shows the excavated area, 3,000 sq.m. in all, except for a strip-trench excavated east of the east end of Building 1. The following account of the buildings uses the numbers 1 to 4 as they appear on the plan.

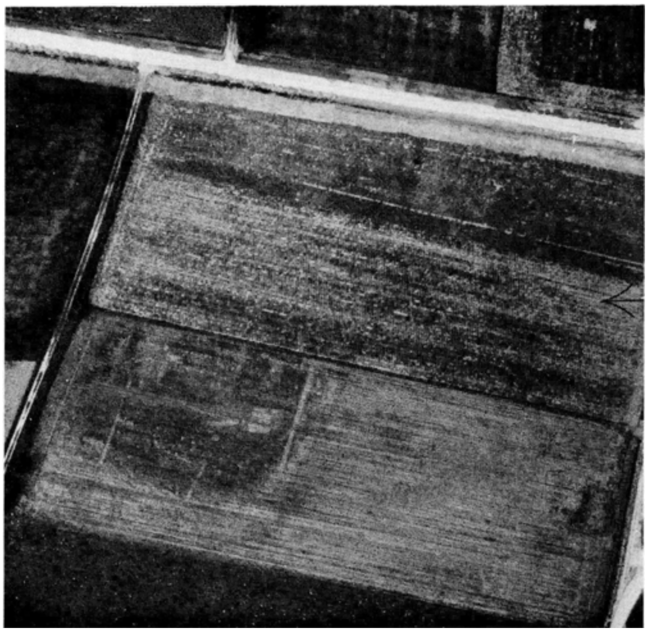

Fig. 2. Air-photograph of the site, 1966. By H. Stiesdal.

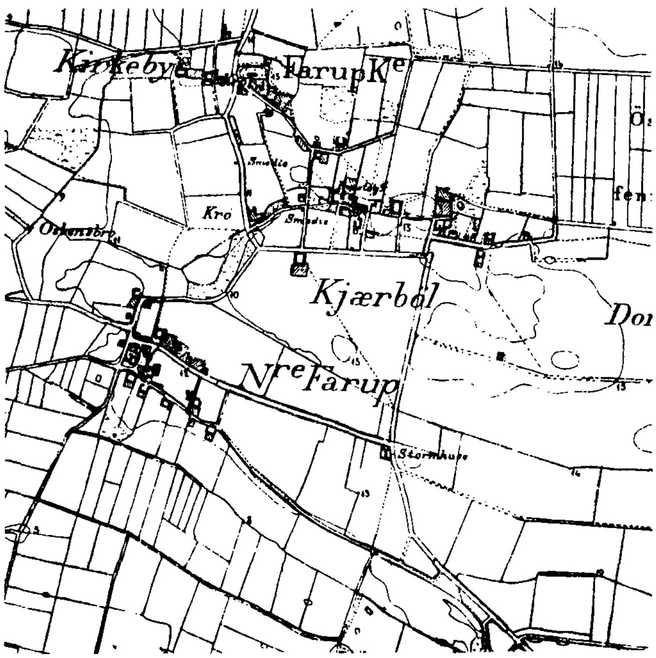

Fig. 3. Section of the Survey Map 1869. By permission A. 386/85 of the *Geodætisk Institut*. 1:25,000.

BUILDING 1 (figs. 5–7)

This building was orientated NW-SE and was about 23m. long. It has a central section, the largest part of the house, joined to which is a smaller section, slightly protruding, in the east, and an outbuilding set at an angle in the west.

The central section measures *circa* 16m. by 5, and like the eastern section was built of posts set into the ground. The three post-holes inside the central section presumably carried a partition wall of a less substantial construction than the exterior walls. The middle part of the building was thus divided into three rooms about 4, 7, and 4 meters long internally respectively. As part of the western room is included a "projection" towards the south, corresponding to the situation towards the north-east in the building.

The post-holes were U-shaped in cross-section. The two holes in the middle of the west gable show that the posts here were more substantial than those in the long walls, but taking into account the length of the house it is not likely that they were to carry a ridge beam (*ås*) running the whole length of the house. If this were the case one or more support posts would have been required, and no sign of such posts was found. None of the post-holes contained stone packing, but, as the plan also shows, in several cases their sections showed signs of recutting.

The post-holes in the side walls are situated opposite each other in pairs, but not at uniform intervals, the

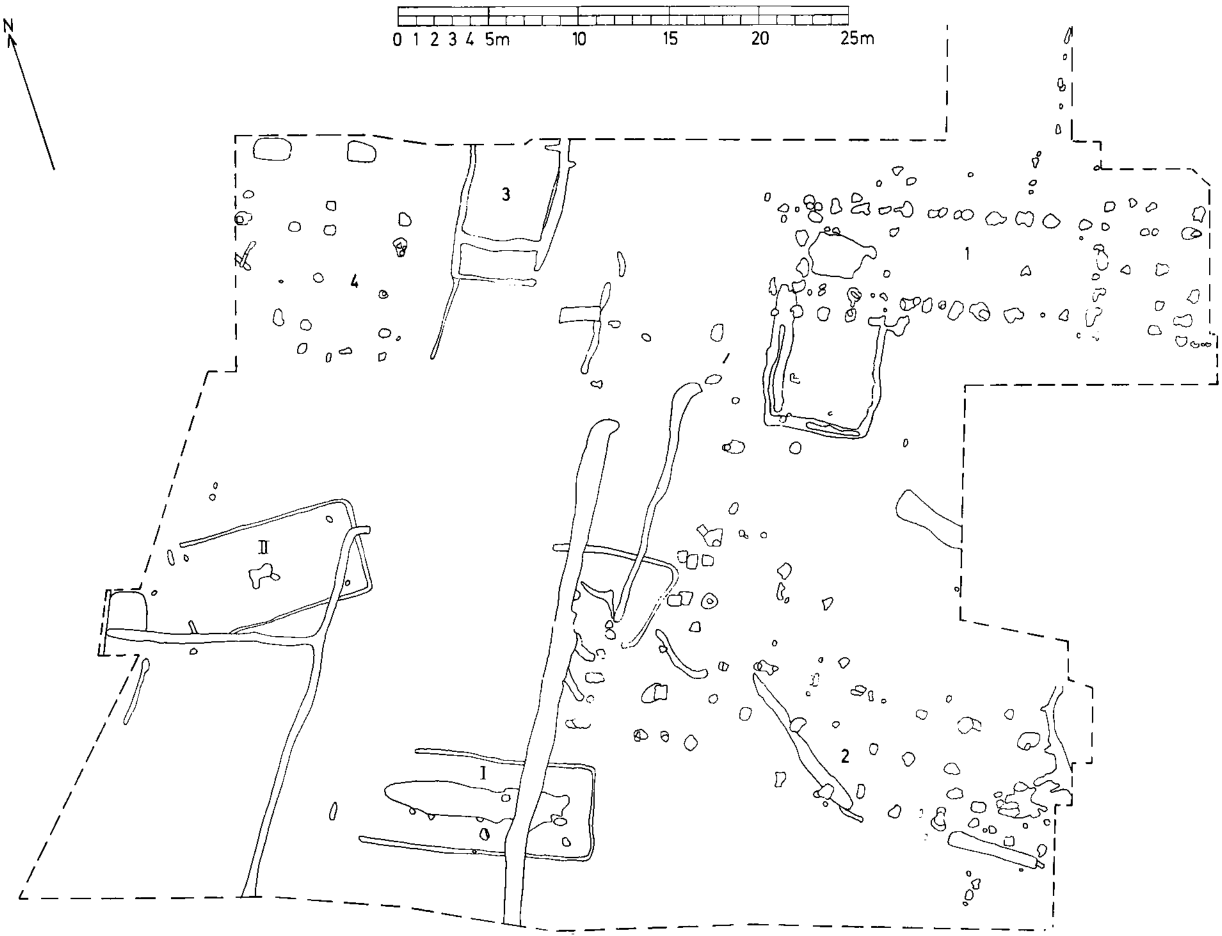

Fig. 4. General plan of the excavation including all registered features; roman numerals I-II mark houses which together with a number of pits and trenches belong to the pre-Roman Iron Age, while the 4 early medieval houses, fences and other postholes from that period are shown as number 1–4. A larger pit in the west end of house 1 is assigned to the 16. or 17. century due to the pottery evidence; it is not the fireplace of the house, as might be suggested by the plan. Pauline Asingh and Børge H. Nielsen del.

intervals varying from 1.5 to 2 meters. The wall-posts were probably joined by tie-beams across the building and one may also assume that they bore a wall-plate (*tagrem*) along the building's length. This wall-plate, besides stabilizing the rather broad bays at the top, would have assisted in carrying the roof. This is probably an example of a type of structure, in which the individual pairs of rafters would not necessarily have been placed directly above the roof-bearing wall-posts (cf. Vensild 1982).

In the eastern part of Building 1, the dimensions of the post-holes indicate that the posts used were mostly more slender than those in the adjacent part of the building. This is clearly visible in the northern row of wall-posts, where the intervals between the posts are also reduced to about 1 meter. This agrees with the idea that there is some sort of "lean-to" (*udskud*) here, as in the south-west part of the building. Thus the wall was lower, as the lean-to would be distinguished by a lower, sloping, one-sided roof connected to the presumably steeper north side of the main roof. The nave-and-side-aisle construction thus seems to be kept to in the eastern end of Building 1 too. The question arises, however, of whether this part of the building has possibly been lower than the adjacent section to the west, and whether this is in fact an extension. In either case the uppermost part of the wall between the two sections could have stood open and visible above the roof of the east end of the house.

In this particular wall in fact, according to the evidence of the post-holes, certain peculiar phenomena are in operation which, on the basis of a possibly

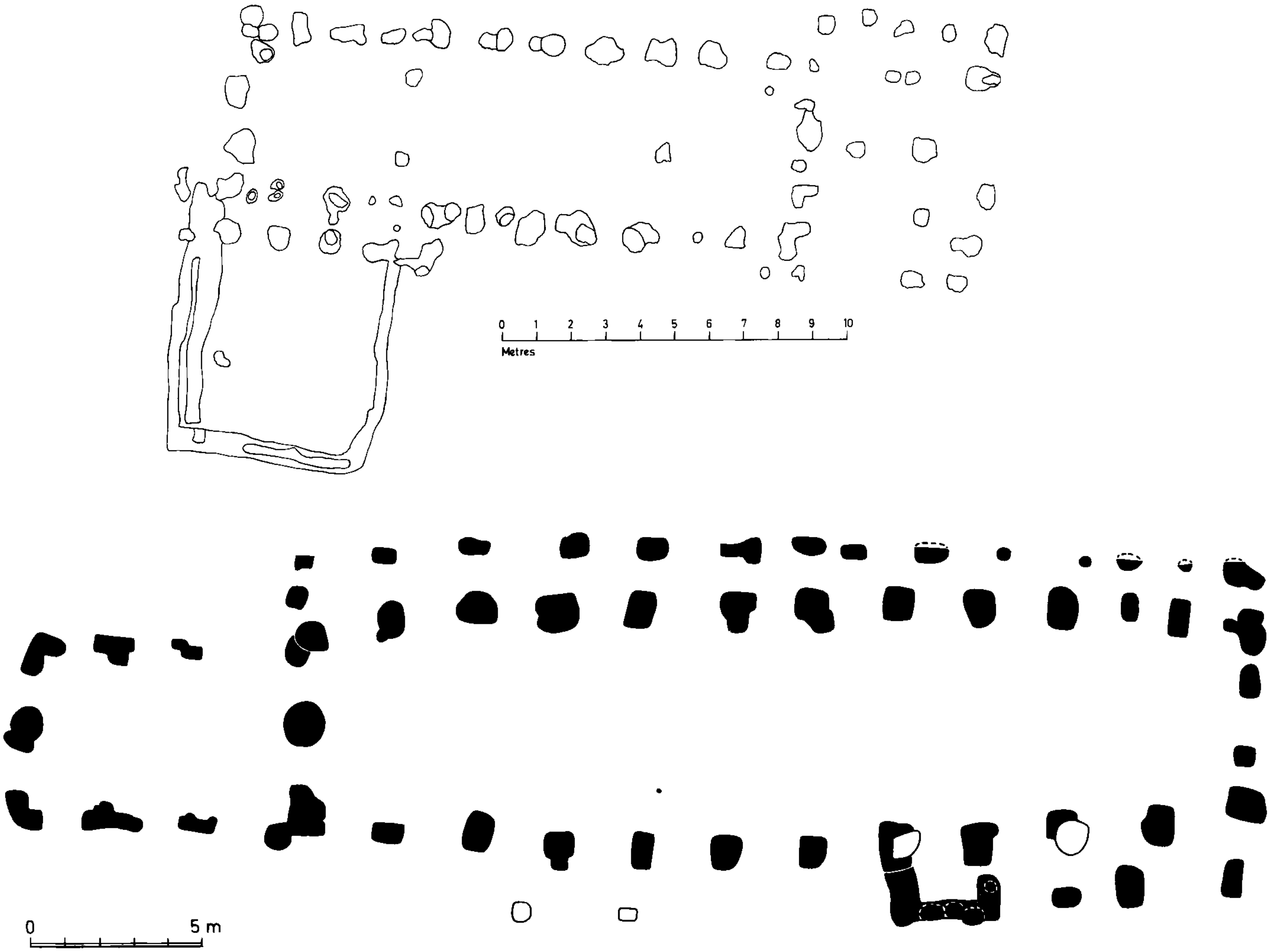

Fig. 5. Building 1: (above) general plan (Børge H. Nielsen del.), and (below) plan of Waterbolk & Harsema 1979, building 87.

slightly risky interpretation, may reveal further features of the building's construction. It appeared that at least three of the posts in this wall had been renewed (fig. 6). This replacement however did not affect the post A5 which is immediately recognizable as the corner-post at the intersection of the north and east walls. This post, however, seems strikingly slender in its size if it were supposed to be a proper corner-post. On the other hand post-hole A37 north of A5 does correspond to the dimensions of the holes of the roof-bearing wall-posts in the central section of the building. If both the side- and gable-walls were topped off by a beam, it is conceivable that these beams were jointed together at the corners of the building, where the post A5 would thus have functioned as a supporting-post for them, and that both beams would further have continued beyond the corner, the beam of the gable-wall on to the more substantial post A37, while the side-wall-beam could have gone on from A5 to the post in post-hole A42 in the east end of the building. This is a span of about 5 meters, and smaller posts in post-holes A49/A50 could have supported the beam along this length. As the corner construction is remarkably slight, it is feasible that it has been built after the nave-and-side-aisle principle with a head-plate (*højrem*), and this could also be taken as evidence that the eastern and the central sections of Building 1 were erected simultaneously.

In the eastern gable of Building 1 only the very bot-

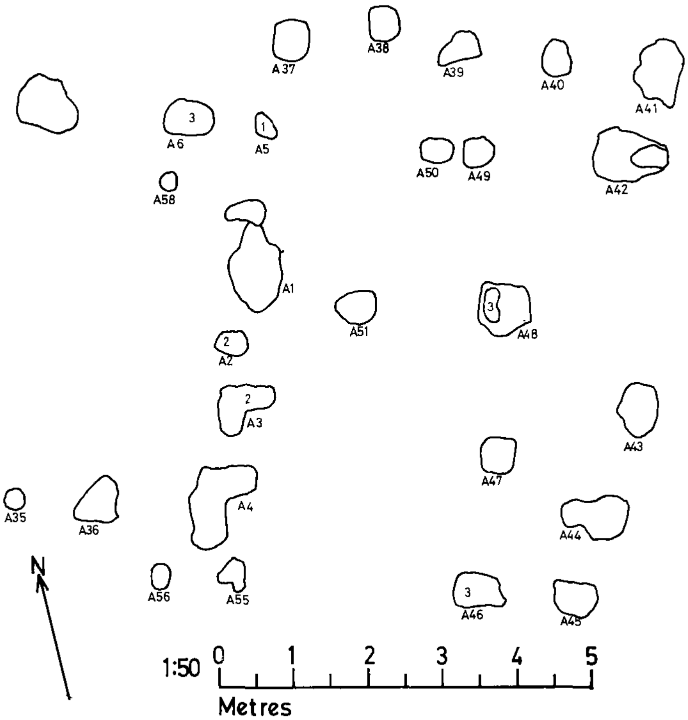

Fig. 6. Plan of the east end of house 1 showing all details, and the excavation numbers as refered to in the text. 1: Pottery, 2: Wattle-and-daub, 3: Stone. Pauline Asingh and Børge H. Nielsen del.

toms of the post-holes found had survived ploughing. It is therefore not impossible that one or more posts stood in the open section of the wall which can be seen on the plan (fig. 5). The southern wall was apparently of lighter construction, and runs about half-a-meter south of the long-wall in the central part of the house. How probable it is that the almost 3m.-broad gap between the two westernmost posts in the south wall show a door-opening is uncertain. Such a feature is, however, visible in the post-holes within the building, which must have carried a partition wall which marked off a room about 3 × 3.5m. large in the south-western corner of the east end of the building. However these posts

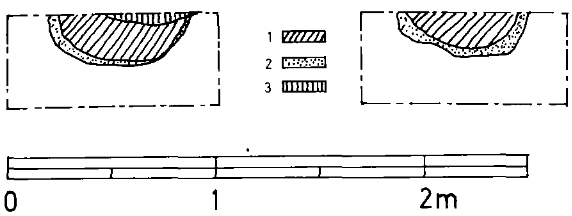

Fig. 7. Two sections in the turf-filled trenches in the south-west part of house 1. 1: blackish-grey sand humus. 2: lightgrey leached sand. 3: layer of turfs, black and greasy. Per Kristian Madsen and Børge H. Nielsen del.

should perhaps be seen as part of a secondary phase, possibly in connection with the replacement of the three posts in the wall between the eastern and central sections. These post-holes were the most productive of finds in the whole building, which may be the result of cutting through a refuse- or floor-layer created during the period of use of the building when secondary construction was underway.

There remains the western wing, which measured about 6m. square. This was represented by a turf- and humus-filled trench of varying breadth and depth in the natural sand (fig. 7). The trench connects with the south-western lean-to and it is difficult to decide whether this is an original part of the building or a later addition. It is certainly not older, amongst other reasons because a northern boundary to the area the trench encloses is totally lacking. The trench corresponds to the structure which is designated Building 3 on the plan. In either case the trench appears too slight to carry a wall entirely made of turf, even though, as far as Building 1 is concerned, this could have been lower than the rest of the building. It is not totally impossible that the trenches are the remains of so-called *træk*: low enclosure- and insulation walls of piled up turf, placed on the outside of a wooden wall. But if this were the case it would be remarkable that anyone should go to the trouble of creating foundations for such walls in ground trenches, even though they were not to bear any of the weight of the roof.

The trenches should probably be regarded as some sort of foundation-trenches for a timber structure which was probably not firmly founded in the ground itself. The surviving turf-fill could be remains of a low "foundation wall" under a now lost base-frame of timber construction (ground plate). Not the slightest trace of posts either in or beside the trenches belonging to Buildings 1 and 3 could be found either by trowelling-down or by sectioning. Similar turf-filled trenches were found on a minor excavation in Darum parish in 1982 (ASR 190) and during the excavation of a late-Medieval/Renaissance-period settlement at Tangen by Tjæreborg, east of Esbjerg, and layers of turf were used as a filling in foundation-trenches under the Cistercian church in Løgum after the year 1225 (Sterum 1976, 1977). The use of grass and mud turves is also well-known in the stone-impoverished west and south-west of Jutland, for instance in the construction of Medieval fortifications (mottes) (Stiesdal 1983).

A find from Bryggen in Bergen, Norway, may possibly indicate what sort of timber structure may in the given case have been built over such turf foundations, even though turf foundations were not used in this example. This is the lower part of a house which was dated by the excavators to after a town-fire of 1332. The house rested upon a framework of lafted logs without a foundation in the ground. The rigidity of the walls, which were built of horizontal planks, was maintained by angled braces between the corner-posts and the base-frame (Reimers 1982 fig. 2). In the case of Building 1 at Farup, junction with the rest of the building would have contributed greatly to stability. This suggested reconstruction is little different in principle from more recent half-timbered houses on foundation-stones. Perhaps we have here a transitional form between earth-fast posts and the use of a filling, which is peculiar to the stone-impoverished south-west of Jutland.

For the parts of Building 1 which are not founded on turves very persuasive parallels can be found in the Dutch village of Gasselte where a whole series of farms with similar buildings have been excavated (cf. fig. 5,2). As at Farup these are probably examples of nave-and-side-aisle construction, with "lean-tos" outside parts of the side walls, lesser stretches of which can also be founded in wall-trenches such as appear in the south-western projection at Farup. The houses in question are dated to the 11th and 12th centuries. The latest finds at Gasselte are from the mid-12th century (Waterbolk & Harsema 1979, type B, p. 255f). Turf-filled trenches are not reported from Gasselte. There are many indications that buildings of this type are essential for the understanding of the development of house plans and construction, not only in the Netherlands and North West Germany, but also in Scandinavia (cf. Näsman 1983) where Building 1 at Farup seems so far to be unique in representing this building-type.

Whether its occurrence in the Ribe area is due to a specific knowledge of the house types of the Low Countries, or whether it is an expression of common traditions of house building along the southern coast of the North Sea, is uncertain. In this connection it is worth noting that buildings with lean-to side-buildings occur at Gasselte somewhat later than houses with the same feature at Telgte in Westphalia from the end of the 10th and the beginning of the 11th centuries, being possibly later than the use of this house type in the area of the Lower Rhine. However, the lean-to on the Westphalian houses runs around almost the whole of the building, prefiguring, it seems, the three-aisled so-called *Hallenhaus* of North West Germany (Reichmann 1982 p. 170 with references). The question is, whether the Gasselte houses, and especially our house at Farup, should also, and exclusively, be seen in this context. If this is so, may we expect to find three-aisled houses of Early Medieval date in southwestern Jutland and possibly also further north, where houses with vall plate construction and lean-to side-buildings are known from more recent times? (cf. Vensild 1982).

BUILDING 2 (figs. 8–9)

Building 2 measures *circa* 26m. × 6, and was recognized in three parallel rows of post-holes. The building, orientated NNW-SSE, lay 10 to 12m. south of Building 1 (figs. 2 & 4). The post-holes were remarkably clear in the sand, and there were no significant disturbances. The gap in the two southern rows may be considered to be original in that there may have been an opening for a gateway in the south side of the building. Across the building the posts stood in rows of three, but the interval is not the same throughout the building. The western gable is more solidly constructed, with five posts set in the ground. Sections in the west gable and several other parts of the building show that the post-holes were upto 1 meter deep below the uncovered surface. Figure 9 shows the section of one of the posts in the western gable. The profile of the decomposed post is clearly visible, and shows that it was 20cm. square in cross-section. The end of the post itself, of oak, was preserved in the bottom of the post-hole, and dendrochronological analysis, undertaken by the Wormianum, determined that the outermost preserved ring of this piece of wood was formed in the year 1141. 20–25 years should be added to this date to compensate for the section of the timber planed away, indicating that 1161–66 are the earliest conceivable felling dates.

It is clear from the section that this is the primary post in the post-hole, the post which was placed there when the building was built and not during a later repair. It can be seen that the trace of the decomposed part of the post is preserved above the remaining fragment of wood to the top of the section: the post therefore has not been uprooted, and similarly there are no signs of recuts by the side of the original posts in any of

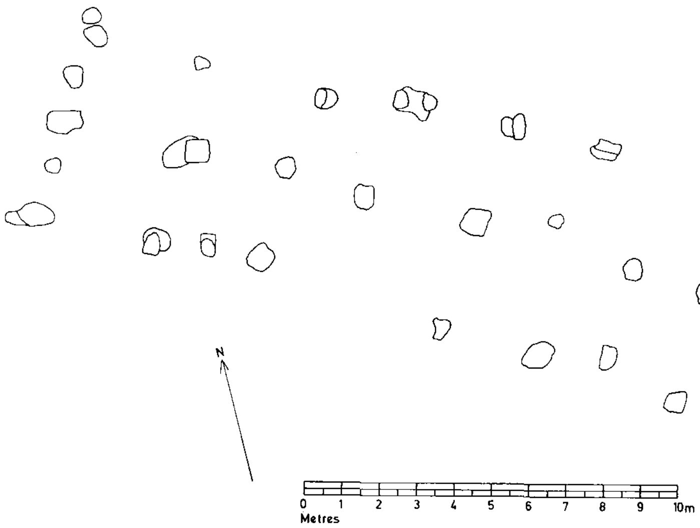

Fig. 8. Building 2: general plan. (Børge H. Nielsen del.)

the post-holes. On the other hand in several places (cf. fig. 2) the original post-hole was cut by a regular four-sided feature cut in towards the centre of the earlier hole, as can be seen to the right on fig. 9. The obvious interpretation is that someone has dug in towards the post from the then ground surface, presumably because the post was rotten and needed replacing. If the cuts were of this kind, the replaced posts must have been placed upon stones or wooden beam pieces, not sunk into the ground like their predecessors which were apparently left to rot *in situ*. An alternative explanation is that the cuts are associated with the demolition of the house, with the timber from it required for re-use, possibly to re-erect the building as a whole on a new sort of foundation.

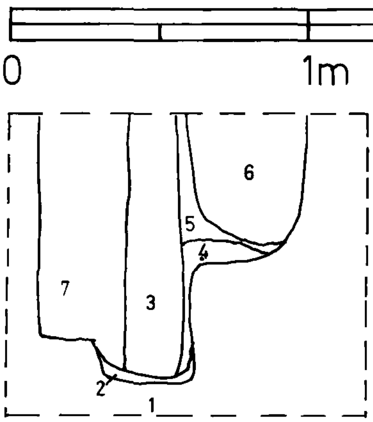

Fig. 9. Building 2: section of post-hole with preserved wood. 1, yellow sandy subsoil. 2, sandy silt. 3, imprint of post with preserved wood. 4, dark brown fill. 5, yellow sand. 6, dark brown fill with a few black patches. 7, Fill with white, black, and dark brown banded layers. Pauline Asingh and Børge H. Nielsen del.

The different fills of the post-hole in fig. 9 and the form of the feature itself give further information on the technique employed in erecting the post. Its end was placed in a narrow hole in the bottom of the 1m.-broad hole, on a thin layer (fig. 9,2) of infallen fill. We can picture to ourselves that as the post was erected a man stood on the ledge to the left in the hole to direct the post into its place. It was held fast in the hole by trodden-in fill of various sorts, nos. 5, 4 and 7 on fig. 9. This procedure is hardly unusual in itself, but with regard to the question of the reconstruction of Building 2 it is worth assessing whether there might be a case for the erection of whole timber sections prefabricated on the ground, not just single posts. It may be added that similar large post-holes have been observed in several places in buildings which like Building 2 must be from the 12th century (Madsen & Petersen 1983, building II; cf. the postulated long-houses at Andersminde, Stummann Hansen 1982, and on Okholm, Bencard 1969).

Building 2 is to be reconstructed either as a 2- or a 4-aisled building. In the former case, the middle row of posts would have borne a central ridge-beam (*midtås*) the length of the building to support the roof, while the outer post-rows would belong to the construction of the walls themselves. The alternative is that each of the three post-rows bore a ridge-beam and that the outer side walls were constructed in such a way as to leave no

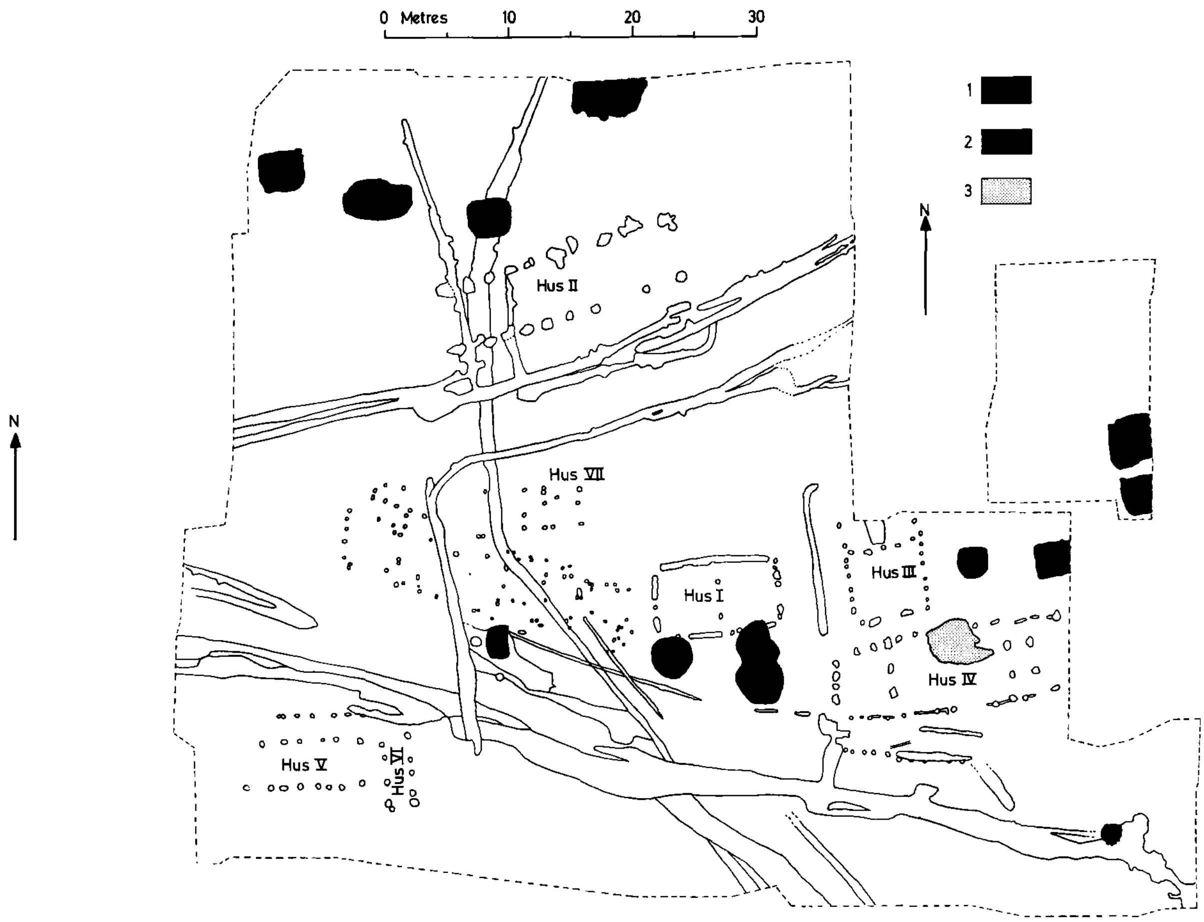

Fig. 10. General plan of the excavation at Jernkær, 1982. 1, well. 2, sunken hut. 3, pit. Jens Erik Petersen and Børge H. Nielsen del.

trace in the ground. The apparent opening in the south may support the 2-aisle theory.

Accordingly, this would well be a ridge-post construction (*sulehus*), related to the nave-and-side-aisle principle of Building 1, although not the same. There is some evidence that Building 2 had a hip-roof, i.e. the markedly much broader outer sections at either end of the building. Furthermore, it appeared from the sectioning of the trench system which runs immediately upto the western end of the building (fig. 4) that the two short trenches which run at an angle out from the east side of the principal trench outside the gable incline away from it. This must indicate that the trenches' purpose was to carry away water which ran down from the hipped end of the roof. This western end was particularly exposed to wind and the elements, and was subject to a great deal of rainwater.

Buildings of the same type and size, and the same date as Building 2 have not hitherto been found in the Ribe area. Amongst the buildings excavated in the deserted medieval village of Jernkær between Farup and Ribe (figs. 1 & 3) are two (fig. 10 buildings I and III) in which the roof must have rested upon a ridge-beam. Both these buildings however, according to the finds, belong to the late Viking Period (Madsen & Petersen 1983). The medieval buildings at Jernkær (fig. 10 nos. II, V and VI) already have roof-bearing wall-posts and rafters; these include the building at Jernkær (no. II) which at *circa* 20m. × 6 approaches the size of Building 2 at Farup. A series of buildings probably from the second half of the 12th century at Bulagergård by Veerst all had roof-bearing wall-posts (Adamsen 1982, 1983). From the excavations of the medieval settlements on Falster, both buildings with roof-bearing posts in the walls and ridge-post buildings are known. These buildings are however significantly later than the Jutish buildings referred to (Hansen 1982). From more recent times ridge-post buildings are known, amongst

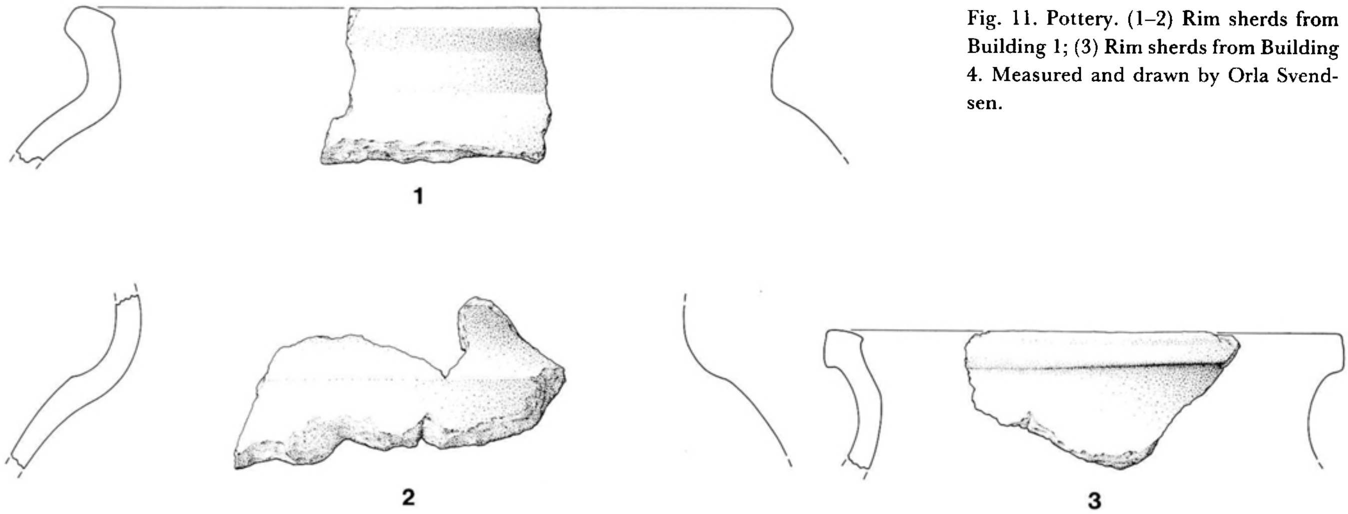

Fig. 11. Pottery. (1–2) Rim sherds from Building 1; (3) Rim sherds from Building 4. Measured and drawn by Orla Svendsen.

other places, from Fyn, where so far two buildings have been excavated of the type with central posts. They are dated by the excavator to the first half of the 14th century and about 1500 respectively (Grøngaard Jeppesen 1981). Finally the buildings discovered in excavations at Pebringe and Store Valby on Sjælland should be mentioned, amongst which there are examples with ground-set ridge-post construction (Steensberg 1952; Steensberg & Østergaard Christensen 1974).

BUILDING 3

The structure designated Building 3 was only partially excavated (fig. 4) and its turf-filled trench has already been discussed in connection with Building 1. Sectioning and area-stripping showed that the southernmost part of the structure with an opening direct into the open area is a later addition, as this part of the trench cuts the south-western corner of the earlier trench. Perhaps what has been uncovered is part of a building comparable to Building 1. The structure cannot be seen on the air-photograph of 1966 (fig. 2), and a possible extension towards the north lies on an area of the field where crops in the year in question did not show marks of house sites.

BUILDING 4

This building was situated to the west of Building 3, but the relationship between the two was not apparent. The building appeared in the form of two parallel rows of five posts each, placed opposite each other in the 5m.-broad building. The length was about 8 meters. The distances of the intervals varies greatly and the small end-intervals might indicate that the building did not have a hip-roof. Like many of the buildings referred to in connection with Building 2, the roof of Building 4 must have been borne by the wall-posts. These may have been connected by tie-beams, and it seems most reasonable to reconstruct the roof as rafter-built.

DATING

The dendrochronological dating of one of the original posts in Building 2 shows that at the earliest it was built in the 1160's. The few, crushed pottery fragments which were found in some of this building's post-holes do not contribute anything more to this dating.

A number of body sherds and two rim sherds of medieval globular pots came from Building 1 (fig. 11,1–2). Most sherds, including the two rim sherds, were found in the post-holes of the eastern part of the building, where the posts have either been replaced or could have been put in later. The pottery could therefore be later than the date of the building's construction, in the suggested case belonging to its period of functioning. In material, firing and rim-form the clay material corresponds to what is dated to the second half of the 12th century or *circa* 1200 in the context of the town of Ribe

(Madsen 1982). The same goes for the body and rim sherds from the south-western cornerpost in Building 4 (fig. 11,3). Reference may further be made to more voluminous finds from the Jernkær excavation, where the same dating is probable (Madsen & Petersen 1983).

There are thus grounds for believing that the excavation has revealed parts of one or more farms in the 12th-century Farup parish. Since several things, amongst others the very few replacements of posts and the possible removal of Building 2 by demolition, suggest a relatively short functioning life for the buildings found, these may have gone out of use around or very shortly after the year 1200. They were used and probably abandoned within the same period as when the great tufa and brick church in Farup was under construction. There is however no necessary case for more comprehensive changes in the parish which could be associated with the building of the church. The placement of a church – of timber – on the relevant site could go further back than the excavated buildings, the removal of which could result from the relocation of buildings within a unit which is much larger than the area uncovered in the excavation. It may alternatively be that an individual farm within a common group was moved, in connection with a redistribution of land (cf. Madsen 1985).

In whatever case, we may assume that in the buildings excavated some of the people lived and worked who saw the building of the church, and perhaps were directly involved in it. A great deal happened in the Danish villages in the period which has been uncovered here at Farup, and the answer to many a question like those outlined above can be pursued through a continuation of the excavations.

Translated by John Hines

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NOTES

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1. Leif Chr. Nielsen, Aage Andersen, Henrik Fangel, Per Kristian Madsen, and Ebbe Nyborg.
2. Pauline Asingh, Stig Jensen, Claus Feveile, Teddy Jessen, and the author participated in the excavation.

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Debate

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The editors

Trends in Norwegian Archaeology

by BJØRN MYHRE

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Kristiansen indicates that Scandinavian archaeologists during the latter century were so oppressed by the burden of tradition and data, that new ideas and theories could not be accepted before the end of the 1960's. The ideology and paradigms of a discipline must, however, be evaluated according to the main scientific theories that are prevailing at the time in question. When Scandinavian archaeologists during the first half of this century gave priority to the study of chronological problems and "archaeological cultures" they operated within the existing theory of all disciplines of culture history; typology, diffusion, "Kulturkreislehre" and migrations were accepted tools, and during some periods were even radical new ideas.

It was only when the theoretical basis for the "new anthropology": social anthropology in England and cultural anthropology in the U.S.A., developed during the 1930's and 1940's, that the new understanding and the new theories were formed, which later also changed archaeology. But even in England and U.S.A. it took a long time before the new anthropological ideas became common archaeological tools. Archaeologists like G. Childe (1951, 1958), G. Clark (1939, 1952, 1953), W.W. Taylor (1948) and Ph. Philips and G. Willey (1958) were pioneers, who not until the late 1950's and early 1960's were followed by a larger group. The advances in philosophy and scientific theory and the development of computers, new dating methods and statistics, that have been of such importance to the new archaeology, were mainly achieved as late as the 1950's and early 1960's.

Scandinavian archaeology has therefore, according to my view, followed an international trend through most of this century, and has even contributed with new aspects and results. When searching for the reason why it lasted so long before Scandinavian archaeologists began orientating themselves towards the new anthropological theories, we must remember that Scandinavian archaeology was in no exceptional position in the world. Even in England and U.S.A. very few archaeologists in the 1940's and 1950's were actively developing in the new direction. To understand the position of Scandinavian

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NORWEGIAN ARCHAEOLOGY IN RETROSPECT

The 1950's

The community of archaeologists was rather small during these years. It consisted of merely 14 persons in permanent positions (Tromsø Museum 1, Trondheim Museum 2, Historisk Museum in Bergen 3, Stavanger Museum 2 and Universitetets Oldsaksamling in Oslo 6 persons). The museums in Bergen and Oslo were part of the Universities, but the two professors were primarily museum directors. The few students there were, spent much time working in the museums and doing field-work, and the setting for theoretical training was not the best.

The Second World War had recently ended, and the rebuilding of the country was given highest priority. Some of the leading archaeologists of the former generation, like A.W. Brøgger and H. Shetelig, had recently retired, while others like G. Gjessing, S. Grieg and E. Engelstad left archaeology to take up leading positions in other institutions. It must have been a difficult but stimulating task for the new generation to start archaeology anew.

The three traditions of archaeological research mentioned by Kristian Kristiansen came to dominate Norwegian archaeology also in the 1950's, but there are also other important aspects and new approaches that ought to be mentioned.

To be able to understand Norwegian archaeology, its tradition of organization and administration needs explanation. When the young State of Norway in 1905, as one of the first countries in the world, got a powerful legislation for the protection of ancient monuments, the still-existing decentralized administration was established. The five archaeological museums in Oslo, Stavanger, Bergen, Trondheim and Tromsø were given the responsibility for prehistoric and medieval antiquities and prehistoric monuments (older than AD 1050) within their region. The revised Ancient Monument Act of 1951 maintained this organization, while a sixth institution, the Central office of Historic Monuments (Riksantikvaren) became the authority for protecting medieval archaeological remains in addition to standing buildings, an authority it had since the Building Heritage Act entered into force in 1920. In 1905 as well as during the 1950's all Norwegian archaeologists were employed by the five regional museums, and both research and legislative administration were in the hands of the same staff. From the start, therefore, the double function of the monuments and the artifacts as both scientific sources and a national heritage was clearly stressed. The tension that is inherent in this organization has always influenced Norwegian archaeology, and has today turned into frustration because of the time- consuming work of administering the Act.

Another important tradition to be aware of is the close connection between archaeology and history. The connection with history has always been strong, and it has been a major aim to use archaeological material as a source of local and national history. The historical approach has also characterized neighbouring disciplines, as also can be seen from their names: art history, culture history, history of religion etc. The study of the society that created the products, and their function within the society, had no strong tradition, and the question "When?" was more often asked than Why and How? (Gjessing 1951, p. 217). This historical approach seems to have been strong also in the 1950's. It was part of the ideology of archaeological research, and it must have been a motivating power behind the revision of the Act for the protection of Ancient Monuments, and of the efforts which so many archaeologists came to invest in monument preservation and rescue archaeology.

Chronological studies with their emphasis on typology and find- combinations have of course been important also in Norway (Gräslund 1976). In addition, the many richly decorated objects from the Migration and Viking Periods created a special interest in animal styles and the history of styles, based on works by B. Salin (1904) and H. Shetelig (1920). Such studies were given priority in the teaching of Bjørn Hougen who was appointed professor in Oslo in 1950. We must also take into consideration that the professorial chair in Bergen was held by H. Shetelig up to 1942 and his excellent works on animal styles and Norwegian prehistory (1925, 1937) considerably influenced Norwegian archaeologists.

It seems, however, that the post-war generation of archaeologists took more interest in the study of settlement history, subsistence and economic adaptation. Interdisciplinary research projects with botanists and zoologists as participants had been a tradition since the early part of the century, when the excavation and publication of the Oseberg Viking grave and the rock shelters from the Stone Age started. The late 1940's and the 1950's were characterized by the many large excavations which were begun with the aim of shedding new light on settlement history and early economy. New detailed excavation techniques developed in Holland and Denmark were introduced, and a cooperation with natural scientists was given high priority. The development of pollen analysis also gave the archaeologist a new tool, and laid the foundation for the close cooperation that exists between the two disciplines today.

Many of the large investigations had young Swedish and Danish archaeologists as participants, and especially the new Danish archaeology was of great inspiration in Norway, namely at the excavation of the deserted Iron Age farm at Sostelid (Hagen 1953), the Iron Age cemetery at Hunn (Hagen 1954) and the Stone Age settlements in Varanger, North Norway (Simonsen 1961). Especially in Oslo where most archaeologists and students were found, there developed an interest in this kind of research, inspired first by Bjørn Hougen (1947) og later by Anders Hagen. The new spirit spread to the regional museums when the students took up positions there. Excavations of New Stone Age sites were started in South and West Norway (Hinsch 1955), Iron Age farms and cemeteries were investigated in Rogaland (Petersen 1954, Møllerop

1957), and the first systematic excavations of Viking and Early Medieval ports and towns opened up a new understanding of these periods (Blindheim 1960, Herteig 1954, 1957 and 1960). By the end of the decade the investigations of the high mountain areas (initiated by the many hydroelectric power projects) were begun and these became of great importance to Norwegian archaeology (Hagen 1959).

Excavations like those mentioned above had never been done in Norway before. The investigations were encouraged by the older generation of archaeologists, like A.W. Brøgger, S. Grieg and B. Hougen (1947, see also Hagen 1953, p. 8–9), but the new inspiration came from Denmark (P.V. Glob, J. Troels Smith and G. Hatt) and England (G.V. Childe and E.C. Curwen). Later it seems that the influence from the "economic approach" of Grahame Clark was strong. A large and complex material for the study of settlement history and economic adaption was collected, and a new basis for a new prehistory of Norway was created. At the same time the new Ancient Monument Act gave the archaeologists of the 1950's a strong tool for rescue archaeology. It seems to have been an optimistic and creative decade between 1945 and 1955 when the historic and economic approach inspired the new and fascinating archaeology. Renfrew's and Kristiansen's phrase of "the long sleep" in no way characterizes this period in Norway. In the last years of the 1950's, however, the pace seems to have slackened. Fewer initiatives were taken and the earlier paradigms guided research and field work. The ground was ready for new ideas and theories.

The 1960's and 1970's

The models and theories of the social sciences found no receptive climate in Norwegian archaeology during the 1950's, but this also applied to most branches of culture history. Even at the Institute of Ethnography in Oslo there was no systematic teaching in social anthropology before 1959, following many years of debate over the ideology of the discipline. At the Institute of Ethnology in Oslo new Anglo-American theories were not taught till 1961. The early 1960's was a time of great expansion for all social sciences at the universities of both Bergen and Oslo, and the new direction of archaeology was a direct result of this development (Klausen 1981, p. 153–159). We may safe conclude that the first phase of a transformation of Norwegian archaeology started around 1960.

Attempts to introduce the ideas of Anglo-American anthropology were made in the 1920's and 1930's by professor A.W. Brøgger (1925, 1937), who was probably inspired by works of Malinowski and Radcliffe Brown (Gjessing 1951, p. 216), and through initiatives taken by the Institute of Comparative Cultural Research founded in Oslo in 1922. It was an interdisciplinary institution that arranged lectures, financed research projects and series of publications. Among the guest lecturers were Malinowski and Frans Boas (Klausen 1981, p. 148). In the late 1940's Guttorm Gjessing was an advocate of American anthropology, especially after he was appointed professor in Ethnography in Oslo in 1947. His article in 1951 "Etnografi og arkeologi" was an attempt to introduce the new American archaeology in Norway, and he also presented the revolutionary book by Walter W. Taylor (1948) which has later meant so much to American archaeology. Strangely enough, Gjessing's activity seems to have had no influence at all.

The new ideas entered into Norwegian archaeology through the next generation of archaeologists who began their studies in the late 1950's and the early 1960's, and to whom social anthropology and ethnology became popular additional subjects to archaeology. When Anders Hagen became professor of archaeology at the University of Bergen in 1961 a new active educational institution was built up. Knut Odner who had studied both archaeology and social anthropology was made a research scholar of archaeology in Bergen in 1963, and his teaching and strong ties to the Institute of Social Anthropology meant much to the attitude held by students of archaeology. It was an atmosphere ready for new ideas and theoretical discussions, and the inspiring publications of C.A. Moberg (1961) and Mats P. Malmer (1962, 1963) had a great influence (see also Johansen 1982). The curriculum for the study of archaeology was changed, and gradually the new methods and theories were presented in Norwegian publications (Odner 1961, 1964, 1969. Myhre 1964, Herteig 1965, 1966, Johansen 1969, Hagen 1970). In 1968 the journal *Norwegian Archaeological Review* was started in Bergen to respond to the need for introducing new ideas into Norwegian archaeology and to start a discussion of methods and theory (editorials of *NAR* 1968, 1969 and 1970).

Therefore, the pioneer phase of the new archaeology in Norway started already about 1960, and its development was under way when the "student revolution" occurred in the late 1960's and the Association of Scandinavian students of archaeology was created in 1969. But I fully agree with Kristiansen that this association and its publication, "Kontaktstensil", had a very stimulating effect on the process.

In Norway the 1970's may be called the second phase in which the new archaeological theories were widely accepted, and when a discussion about the actual value of the different trends and models began. The teaching staff at Oslo University was enlarged, and it gradually lead to a change of the study (Sjøvold 1979). It is symptomatic of the new attitude, that when the new University of Tromsø opened a degree course in archaeology in 1971, it was attached to the Faculty of Social Sciences. Today it is probably in Tromsø that Anglo-American archaeology has its strongest impact on the course of studies.

NORWEGIAN ARCHAEOLOGY IN THE 1980'S

What is then the position of Norwegian archaeology today and in which direction will it develop? It is quite obvious that the image and paradigms of the discipline have changed radically since the 1950's. The training, the excavations and research projects, and the publications show a strong influence from other disciplines and other countries, and an open-mindedness towards the application of new methods and ideas prevails. But we are still at a formative stage, archaeologists still experiment with their new "tools", and the number of practical results are not as many as desired. A constant debate about the future trends of archaeology goes on (f.i. Bertelsen 1975, 1983, Christophersen 1976, 1982, Gjessing 1975, 1979, Hagen 1970, 1980, Håland 1974, Johansen 1974, 1980, 1982, Keller 1978, 1980, Marstrander 1979, Møllerop 1980, Schia 1975, Sognnes 1983, Sørheim 1983), but in spite of great optimism, views tend to differ a good deal, making it difficult to point to an overall trend as the common denominator in the views held by a majority of archaeologists. I will, however, try to sum up some tendencies visible within the discipline.

Organization. Since most Norwegian archaeologists are involved in the administration of the Act to protect ancient monuments, the future organization of this work will influence all other aspects of archaeology. After ten years of discussions a new cultural Heritage Act came into force in 1979. The legislative revision started on the initiative of the five archaeological museums which argued for a common administration of all protection work that needed archaeological expertise. Unhappily this was only partly achieved, as the Central Office of Historic Monuments is still responsible for archaeological monuments in the medieval towns, while other prehistoric and medieval remains are under the authority of the museums. This most unsatisfactory decision has had an unfortunate effect on the study of medieval and post-medieval archaeology in Norway, and is the reason for unnecessary conflicts between institutions.

The proposed organization of the legislative administration was supposed to be an interim solution, but still, five years later, the future organization is under discussion, and it has turned into a disagreement between two Ministries. Will the University museums under the Ministry of Culture keep the authority for the archaeological remains, or will the authority be transfered to the Central office of Historic Monuments and the county-muncipalities under the Ministry of Environment? At the root of the organizational disagreement lies the old double function of the ancient remains: as historic monuments and as objects of scientific research into local and national history. Most archaeologists believe that an administration by the archaeological museums will satisfy both aspects since they are the only institutions with extensive and many-sided archaeological expertise. We fear that if the authority is taken away from the University museums, the monumental and environmental aspects will be given priority, and less attention will be paid to the immense number of sites which are not visible on the surface of the ground, but which are of crucial importance to archaeological research.

The unique position of Norwegian archaeology, where all theoretical and practical sides of the discipline are in the hands of a few institutions, ought to be maintained. The five so-called regional archaeological museums represent a decentralized organization, and being a part of the Universities, they ensure on the one hand a more research orientated rescue archaeology, and on the other hand inspire a more many-sided and practical education based on freshly collected data (see also Fleming 1978, p. 18). The necessary cooperation between the different sections of archaeology advocated by Kristian Kristiansen for Danish archaeology, would then be much easier to obtain.

A decision about the future administration of the Cultural Heritage Act ought to be taken very soon. The amount of work that is needed for rescue archaeology is too time-consuming for the few scholars, and new appointments will not be made as long as the situation is unsettled. According to a calculation made in 1981, 73 years of work were invested in rescue archaeology, and the necessary number of new positions was as large as 57 (NOU 1982: 36, p. 99). The future position of Norwegian archaeology will very much depend on the governmental decision concerning the assigment of authority under the Cultural Heritage Act.

Education. During the 1960's and the 1970's the number of University teachers in archaeology in Norway has risen to nine, and the professors in Oslo and Bergen are no longer museum directors as well. Archaeological studies have been reorganized and systematic education is given at three different levels at three of the four Universities. The teaching is much more influenced by general archaeological methods and theories than earlier, and traditional museum work, and the study of specific Norwegian archaeological material are given less priority both in lectures and in the curricula. Both in Oslo and Bergen there is a tendency to loosen up the organizational bond between the archaeological museums and the teaching institutes, but not in such a drastic way as in Tromsø, where the two institutions belong to two different faculties. The development towards teaching more theoretical archaeology than before, will probably accelerate if the administration of rescue archaeology is taken away from the University museums.

Traditionally the discipline is called Nordic Archaeology, but as non-European material and studies are receiving higher priority, the Nordic part of the name has little significance any more. A renaming of the teaching departments into "Institute of Archaeology" has been discussed at all three Universities. In Bergen one of the lecturers and one research scholar have North-East African archaeology as their main field of research, and give lectures also in Middle Eastern archaeology. In Tromsø circumpolar archaeology is taught, and archaeological scholars from Oslo have taken part in expeditions to the Pacific Islands and the Maldives. The shift of interest from national and Scandinavian prehistory to global archaeology will probably become more distinct in the near future.

In my opinion a certain dissolution of the administrative ties, between the teaching institutes and the museums and their departments of rescue archaeology, will have a favourable effect on the teaching and therefore on the discipline as a whole. But the administrative gap should not be allowed to widen too much, and should always be kept within the Universities.

Research. The frustration felt by Norwegian archaeologists due to the time-consuming administration of rescue archaeology, seems to have led many of them to rethink and re-evaluate their working routines. Even if the number of archaeological positions is considerably enlarged, the amount of work that is needed to protect and investigate all ancient monuments is almost unending, and it has to be guided by a more conscious and thoroughly discussed research policy. Certain monuments and environments have to be given priority both when it comes to protection and investigation, and well defined research projects have to be organized to solve central problems in local, regional and national prehistory. Such a trend within rescue archaeology is clearly evident at all the archaeological institutions. But we are in for complicated decisions, and to find a solution to this administrative and research policy problem will be one of the main tasks for Norwegian archaeology in the 1980's (see also hagen 1980, p. 7).

Settlement history and economic and ecological adaptation in prehistoric and early historic times have been the main interest of the many interdisciplinary research projects that the museums started during the 1970's, thereby continuing the tradition from the 1950's. But it is also clear that much attention is paid to social and political organization (Odner 1972, 1973, Myhre 1978), inspired by works of M. Fried, E. Service and C. Renfrew, and this new trend will certainly be followed also in the 1980's.

The new basis for archaeology has created an optimistic wave as regards the research possibilities of the discipline, and new aspects of prehistoric societies will be challenged. It is obvious, for instance, that prehistoric religion and ethnicity, themes that have been discarded since the frightening developments during the 1930's, nowagain tempt many archaeologists (Håland 1977, Kleppe 1977, Johansen 1979). Because of the research activities in N.E. Africa, and specially because of the strong Lapp liberation movement and a growing interest in Sami prehistory, ethnic archaeology will probably be a major theme in Norway during the next decade. The same can be said about prehistoric demography (Welinder 1979).

We will probably also see a renewed interest in the old concepts of diffusion and migration as important forces behind cultural and social development, after a decade of belief in "internal development" (Sognnes 1981, Håland & Håland 1982). Of course typological and chronological studies will also be important in the future, and the use of computers and sophisticated statistical and mathematical methods will accelerate.

Obviously the archaeology of historic periods will be given more attention. Since the Second World War historians have done most research on the history of Viking Norway, but archaeologists have recently been strongly challenged to take part in the discussion (Blindheim 1982 and *NAR* 1982). The medieval archaeologists have for decades been preoccupied with chronological problems and the handling of the huge material from urban excavations. New publication series are, however, under preparation (Lunde 1977, *Norwegian Antiquarian bulletins, Bryggen Papers, META*). Post-medieval archaeology is also attracting more interest, especially marine archaeology, industrial archaeology and Sami archaeology (*Arkeologiske rapporter 7*). Most probably the millenium between AD 800 and 1800 will be in focus in Norwegian archaeology during the 1980's and 1990's, and it will renew the interdisciplinary cooperation with historians, ethnologists and place-name etymologists, which has been lacking during the last generation.

Museums and Public Information. The staff at the museums is working under hard pressure because of rescue archaeology, and public information has received too little attention. The permanent exhibitions dating from the 1950's and 1960's have not been altered, and most protected monuments are in a sad state. This important aspect of archaeology must get higher priority in the next decade if archaeology is to maintain interest and support. All the museums are now planning new permanent exhibitions, and a national committee has been set up to discuss and coordinate the museums' public relations compaign.

A government commitee on artifact conservation submitted its proposals in 1983, and it will hopefully lead to an improvement in the training of conservation staff and better conditions for the conservation of archaeological objects (NOU 1983: 33). Principles and aims for the preservatin of monuments, however, have never been properly elucidated by Norwegian archaeologists. Most monuments are overgrown with vegetation and bushes, they are seldom accessible to the public, and information plates and pamphlets are usually lacking. Such unfortunate conditions will prevail until a decision on the future legislative administration has been taken. The museums advocate that the preservation of archaeological monuments and their environment ought to be taken in hand by the counties, these have recently established Departments of Environment Protection. The work has to be carried out in collaboration with the museum in question, which also has to take care of the excavations that are needed.

The popularization of archaeology through articles and books has a long tradition in Norway (Hagen 1962, 1982, 1983, Håland & Håland 1983, Magnus and Myhre 1976). Hopefully this is a trend to be continued.

CONCLUSION

Norwegian archaeology has experienced a positive development during this century. From a small group of museum archaeologists in 1900 the discipline is today a University subject of medium size, and due to a powerful Cultural Heritage Act the archaeological institutions are active participants in public environment planning.

The impact of Anglo-American archaeology has also changed Norwegian archaeology considerably, but I am not willing to agree with Kristian Kristiansen when he describes the situation as "awakening from the long sleep". Norwegian archaeology has also earlier experienced periods of expansion, characterized by new ideas and foreign influence, especially the periods 1925–1940 and 1945–1955. The research traditions from these periods still have influence today, not as a burden, but as part of the basis for new trends in archaeological research. The large amount of work that has been invested in recording monuments and in detailed descriptions of museum collections, make exemplary starting points for comparative studies, in addition to the new scientific material collected according to a more complex research policy than before.

Norwegian archaeology is now ready for fresh expansion and progress after a period of reconsolidation and reorganization. A new generation of students with a better theoretical training is coming out of the Universities. Hopefully the new situation will stimulate a many-sided archaeological research so that new aspects of early societies will be investigated, such as demography, religion, ethnicity, and social and political organization. Then "old" concepts like typology, culture, diffusion and migration will be given new dimensions and must be studied anew.

The future of Norwegian archaeology depends very much on how the Cultural Heritage Act will be organized. A central and coordinating institution is needed, e.g. under a reorganized Central office of Historic Monuments in Oslo, but it is to be hoped that the University museums will still be regional authorities under the Act, so that education, research and rescue archaeology will obtain mutual advantages also in the future.

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by ÅKE HYENSTRAND

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Archaeological research to scientific standards reflects common scientific trends, adopting concepts which by the time they are generally accepted in the archaeological context may already be outmoded outside it. Antiquarian activity also reflects society's attitudes, economic conditions, and political ideology. Both sources of influence may be seen distinctly at work in the Swedish archaeological system. The ancient monuments law, after numerous precursors finally codified in 1942, affords prehistoric remains unequivocal protection. It manifests therein a strong state apparatus and centralized organization, represented as far as antiquarian activities are concerned in the Central Board of National Antiquities (*Riksantikvarieämbetet*). With this background, it has been natural since the 1930s to plot all ancient monuments on the official maps (economic maps), a circumstance which led to a nationwide inventorization of ancient monuments to a fixed standard.

The law on ancient monuments and basis for a strong protection of our cultural heritage was passed in Sweden at a time when agrarian society was still intact. It was hardly possible in the nineteen-twenties, -thirties and -forties to envisage the strong expansion which would occur in the -sixties and -seventies. This was not unique to Sweden, but resulted here to a particularly marked degree in an enormous expansion in archaeological activity. Over a period of 25 years, the find material, due to the large number of emergency digs, has been greatly multiplied. The situation may to some degree be compared to that in the USA after the intensive archaeological relief work of the 1930s.

Archaeological research in Sweden follows the same traditions as in Denmark, i.e. it is material and settlement directed, seeking to chart prehistory and cultural history. This circumstance formed the basis of the expansion mentioned above. A large number of young archaeologists with a traditional education found employment. They were to carry out an archaeological documentation to the highest standards, based on the old tradition. That the solution to research problems was to be found in the material was scarcely questioned; NA had as yet no marked influence.

To this was added the conservation of ancient monuments and land utilization planning which during the 1970s was a further manifestation of a strong apparatus of state. A strengthened organization with even more archaeologically trained persons in the system was the result.

Much of the resources of archaeological research have since the 1960s, been expended on a number of projects, mainly of an inductive nature and based on large investigations and material. These, too, have been based primarily on the old tradition, and extremely important results have been obtained. But during recent years, a stronger element of interplay between theory and practice has been in evidence.

NA began to affect archaeological teaching in the years around 1970. In 1969 was published Carl-Axel Moberg's primer *Introduktion till arkeologi*, for which the work of David L. Clarke and Lewis Binford had been the major source of inspiration. From 1970 and on, the Nordic contact seminars proved a source of inspiration for many students of archaeology. At the institutes in Gothenburg and Umeå, NA came to play a major role in teaching, while Marxist ideology periodically dominated the discussion. This situation is known from many places in Europe and from many disciplines.

During the 1970s, there were thus tendencies towards conflict, both between the youngest generation of students and the young generation who had found work during the days of the "gold rush", and between different members of the "establishment". These differences were toned down, however, and did not lead to any real confrontation. The new thinking soon affected all groups (with some exceptions), not least within the ancient monuments service.

Swedish archaeology is dominated today by scholars and practical archaeologists educated in the traditional "paradigm", who have with positive criticism step by step adopted NA and other forms of theories and methodologies. The situation could be compared to that described by Kristiansen for Denmark: 'Tradition is very strong, and most archaeologists belong to it, with only a small group of "pure" New Archaeologists.' The situation could be characterized as a "hybrid tradition". There are several reasons for this, in particular numbers, a quantitative attitude and the developed settlement archaeology.

Archaeology in Sweden is a many-facetted system, both horizontally and vertically. An authoritative direction has long been lacking. The research concept has strongly expanded in step with the expansion of antiquarian archaeology. Different directions have been developed with different degrees of receptiveness for new thinking.

During the 1960s a quantitative view of the source material with concomitant demand for fixed definitions was accepted (cf. Mats P. Malmer). The ancient monument register's structure and accessibility to analysis contributed to this.

At the same time, settlement research was developed, largely as a result of investigations in connection with land development and in conjunction with the comprehensive picture obtainable from the register of ancient monuments. Research pursued this line further during the seventies, inspired by culture-geographical research and parts of NA. System analysis employing models was employed and explanation was a central concept. Increasing interest was displayed in social units and their influence on the environment. This accorded with the needs of the conservation service for information before environmental planning could be effected.

Thus the 1970s were to some extent a time of upheaval. This was reflected in, for instance, Carl-Axel Moberg's criticism of archaeology in 1978. He pointed out that find positivism, among other things, prevented research from developing. The situation was, however, considerably more complex. Several monographs from the late 1970s and early eighties showed that the new thinking was beginning to gain ground. That the need for an analysis of research directions was beginning to be felt is shown by the fact that the Central Board of National Antiquities and other authorities commissioned a report, prepared by Bo Gräslund (1981). Briefer analyses have been presented by Agne Furingsten, Åke Hyenstrand, and others. The volume *Swedish Archaeology 1976–1980* (1983), published by the Swedish Archaeological Society and with important contributions by among others Hans Andersson and K.-G. Selinge, may also be mentioned.

The Swedish archaeological system should thus be well analysed. It is increasingly obvious that its variety is an advantage, not a disadvantage, as was perhaps thought around 1980. This variety is manifest in different ways, in organization with interplay between antiquarian activity and the university institutes, in regional and local variations, and in the subjects of research.

The organization consists of three parts: the antiquarian authority responsible for investigation and inventorization (Central Board of National Antiquities, county councils), the museums (National Museum, regional and municipal museums, etc.) and the university institutes. All these authorities have research responsibilities, and a duty to inform the public and the administration. Although there is co-operation between them, it can be improved. It should be possible to develop circulation of personnel inside the system, and after-training. The system is sluggish, bureaucratic and overburdoned, and an active pursuance of research problems and effective research are therefore necessary.

The university institutes of Stockholm, Lund, Gothenburg, Uppsala and Umeå are located in different regions, each with its own peculiarities and research basis. This leads to a certain differentiation, but an absolute research responsibility within the region in question must be avoided. The size of the country and peripheral location in Europe offer special possibilities, for example the study of regional variations and long periods, study which would be of general importance. This situation has not been fully exploited, however.

In many ways, the Swedish archaeological system appears to be extremely well equipped: with 300 persons employed, a well-documented source material and strong legislative basis, with strong support from the populace for cultural protection and environmental planning, and with a strong but little stimulated public interest. But the situation is not entirely in balance. Apparently good possibilities are counteracted by certain circumstances: the education system, lack of formulation of research aims, and weak internationalization.

The Swedish education system is no longer internationally outstanding. This circumstance must also affect archaeological training, since it is necessary to pay more attention to quantity than to quality. The strong expansion also resulted in a slackening of the requirements for research qualification before employment, otherwise the need for personnel could not be met. This, in conjunction with the traditional training of staff, means that present resources cannot be exploited to the full in theoretical discussion. This has also resulted in a relatively weak international orientation and very sporadic participation in international debate. To all this is added the fact that it has not been possible to assuage the great public interest in Sweden's prehistory through presentation of research results in popular form, although major efforts in this direction have been made during recent years.

All these problems are well known, and there are clear signs of reform, but the situation today is that the archaeological system in Sweden is unwieldy and featureless and plays no active role in public debate. This may well be a superficial picture – it is always difficult to judge the present than see the historical background. It is probably too early to judge the effects of the upheavals of the sixties and seventies. These changes mainly work in a particular direction, towards the creation of a "three-dimensional paradigm". Landscape and environment are kept in the centre and accorded a decisive role in explanation theory. This is undoubtedly a one-sided approach; in today's situation, it is therefore important that alternative research be conducted in a wider context, for example more socialarchaeological and structuralist.

In Sweden, as in the rest of the Nordic countries, archaeology is experiencing an unprecedented generation reshuffle. It is still too early to judge its importance for the future. It should, however, at the least warrant a more intensive Nordic co-operation at all levels, which now seems more necessary than ever.

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The Origin of Agriculture in Denmark: A Review of some Theories

by PETER ROWLEY-CONWY

INTRODUCTION

The purpose of this contribution is to compare some general views of the spread of farming into southern Scandinavia, and to see which of these is most in accord with the archaeological information now available.

The starting point will be the evidence of a long co-existence between farmers in north central Germany and foragers in the west Baltic region. This evidence comes largely from radiocarbon dating. The early neolithic settlement of Eitzum, belonging to the LBK culture, has been dated to 4530 ± 210 bc. 250 km to the north lies Siggeneben-Süd, with the earliest published neolithic date in southern Scandinavia, 3230 ± 65 bc. This may be compared with the distance of about 1000 km from Eitzum to Korlat in Hungary, where the LBK is dated to 4490 ± 100 bc. The LBK apparently spread so rapidly across central Europe that C 14 dates 1000 km apart are indistinguishable. Thereafter, farming took 1300 radiocarbon years to spread a further 250 km (fig. 1).

A reason for this long delay has been sought in the nature of the pre-existing foragers in southern Scandinavia. Coastal foragers are likely to have had greater population density than most central European foragers (Paludan-Müller 1978). There is evidence that the western Ertebølle settlement pattern involved permanently occupied base camps, which may also mean larger group size. It may thus be that forager adaptations were a viable alternative to farming at least for a time (Rowley-Conwy 1983, Zvelebil and Rowley-Conwy 1984). I have argued that a decline in marine resources, particularly the oyster, may have reduced the viability of the forager economy and thus have led to the adoption of farming in the Ertebølle area (Rowley-Conwy 1984a).

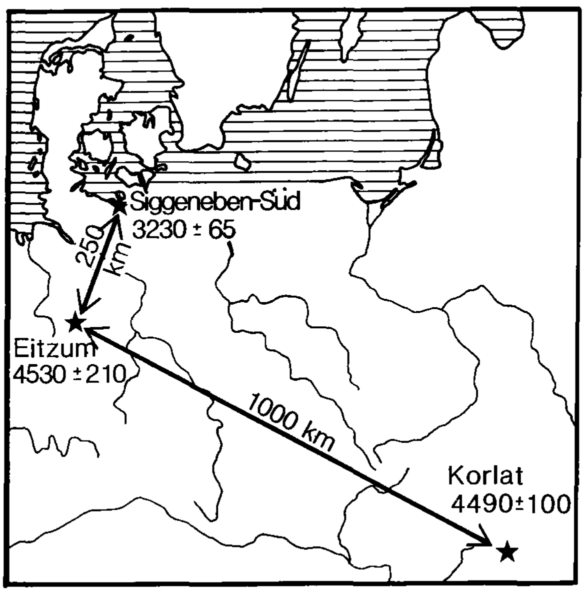

Fig. 1. The delay in the spread of agriculture into southern Scandinavia as revealed by radiocarbon dating.

This is the background against which views of the spread of agriculture will be examined. Any such review involves grouping explanations into categories, and such categorisation is largely a matter of personal choice. The following groupings of explanations are therefore only one possible typology, resulting from the personal viewpoint of the author.

PROGRESS MODELS

These models are based on the assumption that farming is automatically an improvement on foraging, and that farming will therefore be adopted relatively quickly once it becomes available to foragers so long as environmental conditions are suitable.

On the basis of this assumption, questions were asked as to which foragers were most likely to adopt agriculture quickly. As early as 1952, Sauer suggested that the original agriculturalists were derived from foragers of a particular type: "above all, the founders of agriculture were sedentary folk" (1952, 22). The most likely candidates were "well-situated, *progressive* fishing folk" (ibid., 23, added emphasis). This view has subsequently been applied to the spread of agriculture as well as its origins. Sedentary fishers have been seen as "pre-adapted" to adopt agriculture more quickly than nomads (e.g. Waterbolk 1968, 1982).

How well do the expectations of this view fit with the Danish evidence? At first site it would seem – not very well. The long delay in the spread of agriculture into Denmark (an area suggested to have contained sedentary fishers) seems to be a powerful argument against the rapid adoption of farming by such groups. Danish soils are light and easily worked, yet fertile, and farming arrived in the region at the time of the postglacial climatic optimum, so environmental barriers cannot be placed in the way of farming.

Two questions must first be examined, however. Firstly, how rapid an adoption should we envisage? If it is true that the German LBK culture represents immigrant farmers, while the spread of farming into Denmark represents its adoption by indigenous foragers, then perhaps a millennium might be a reasonable time span for foragers to become acquainted with farming techniques and to adopt them. Secondly, what is the evidence for agriculture within the Ertebølle? If claims for Ertebølle agriculture can be supported, then the adoption might have taken place over a much quicker period.

In examining the first question, one point needs to be born in mind. The farmers and the foragers were not isolated from each other. Evidence for exchange across the forager/farmer boundary is available in the form of shaft-hole axes of central

European origin in Ertebølle contexts in Denmark (Fischer 1982). Pots from the neolithic Baalberg and Michelsberg cultures have been found in Ertebølle-Ellerbek levels at Rosenhof (Schwabedissen 1979a). It has recently been suggested that elements of the farming economy could have spread into southern Scandinavia along routes already opened by gift exchange (Jennbert 1984). We therefore have no reason to suppose that the fishing groups were cut off from the potential source of the farming economy.

Ethnographic evidence would not lead to the conclusion that foragers are in any sense too "primitive" or backward to adopt farming if there is a good reason to do so. Limited cultivation by predominantly forager groups is well attested: various north American groups grew tobacco (Forde 1934), and the Ainu of northern Japan grew millet for making beer (Watanabe 1972). Schrire (1980) has questioned the existence of any hard boundary between Bushman foragers and non-Bushman farmers. No sharp physical or cultural boundary exists, and groups and individuals may adopt or give up pastoralism for a variety of reasons (Schrire 1980).

It seems likely, therefore, that agriculture could have been adopted in Denmark very much more quickly than it was, had there been a good reason. Given the flexibility of human behaviour suggested by the ethnographic examples, there seem to be no grounds for assuming a 1000 year incapacity on the part of the foragers to take up farming.

Claims for agriculture in the Ertebølle thus assume a crucial importance. If these claims are supported, then the delay was much less than 1000 years. The progress views could thus still be relevant. I will argue, however, that the evidence does not support Ertebølle farming.

The classic work of Troels-Smith (1953) in the bog Aamosen demonstrated that pollen evidence of farming went back as far as the elm decline and no further. Radiocarbon dating makes it clear that the Ertebølle ends at about the time of the elm decline (Tauber 1972). There is thus little or no pollen evidence for Ertebølle farming, and Ertebølle pottery does not have cereal impressions (S.H. Andersen 1973).

Other claims for Ertebølle agriculture have rested on the presence of bones of "domestic" cattle in some Ertebølle sites. Separation of domestic cattle from native aurochs has always been a problem, particularly with regard to the fragmentary bones recovered from settlement sites. The usual method has been to compare such fragments with complete skeletons of definitely identifiable wild and domestic cattle found in bogs. If the settlement fragments are too small to fit into the aurochs size range, they are classified as domestic animals.

An early example was cattle lower third molars from Dyrholm I. These were so small that they were for a long time regarded as domestic (Degerbøl 1963). The Dyrholm I phase precedes the classic Ertebølle, and so dates before about 3700 bc. This would thus represent a very early date for the introduction of domestic cattle into Denmark. These teeth have recently been reclassified as wild, however: the first domestic animals are now thought to date from around 3100 bc, and are thus compatible with a neolithic TRB origin (Degerbøl and Fredskild 1970).

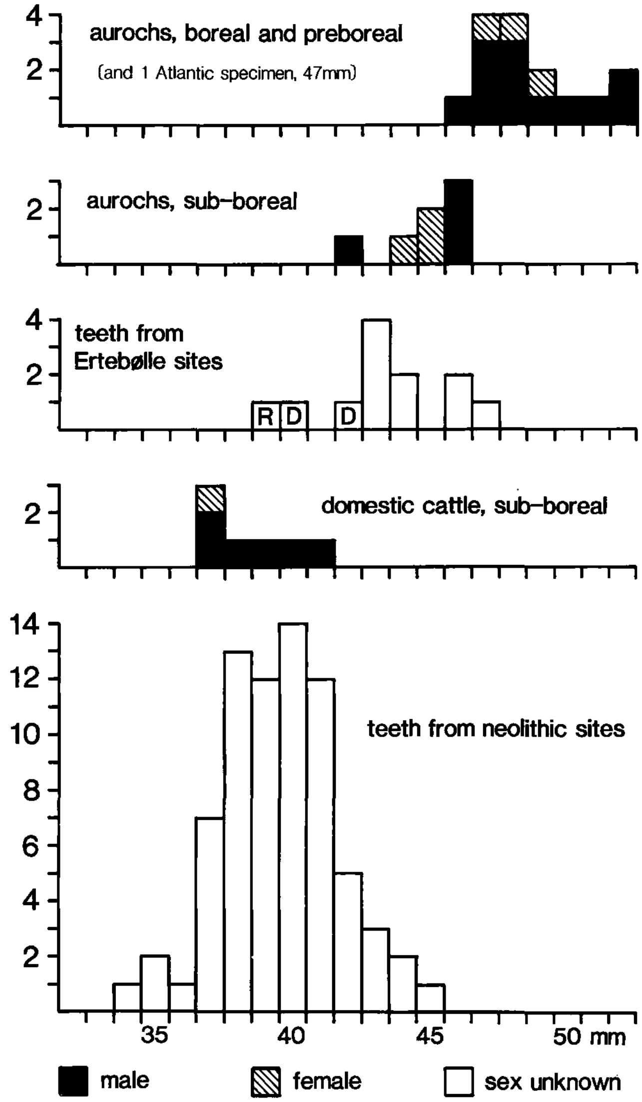

Fig. 2. Maximum lengths of cattle lower third molars, comparing bog finds of sexed skeletons with teeth from settlements. Measurements from Degerbøl and Fredskild 1970, except Rosenhof, from Nobis 1975. D = Dyrholm, R = Rosenhof.

The reason for this reclassification is that until recent years it was not clear just how small female aurochs could be. Early bog finds of complete skeletons were preponderantly of males, as these very large animals aroused more interest when discovered. The smaller females were less often reported. As the size range of females has been extended downwards, it has become clear that neolithic domestic bulls and wild females are in fact of similar sizes (see e.g. fig. 3). The claimed Ertebølle domestics fall within this overlap zone, and may (on size) equally well be wild females as domestic males. Domestic females are on the other hand small enough, and wild males large enough, to be definitely identified. Ertebølle sites

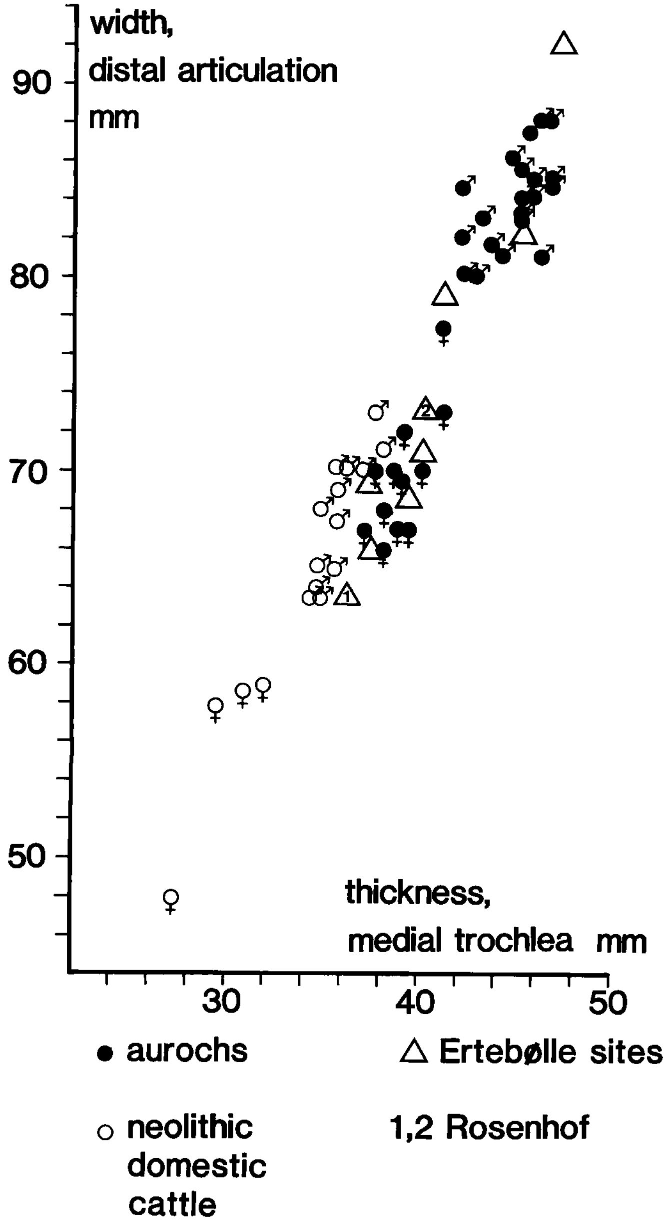

Fig. 3. Metacarpal dimensions of mesolithic and neolithic cattle. Measurements and sexes from Degerbøl and Fredskild 1970 with additions; Rosenhof from Nobis 1975.

contain no domestic females, but have numerous wild males. It is therefore logical to regard the overlap specimens as wild females, not as domestic males (Degerbøl and Fredskild 1970). No good evidence for sheep exists for the Ertebølle (Clark 1975), and claims for domestic pigs have not been advanced.

The few claimed domestic cattle from northern Germany are thus the only remaining candidates for the late mesolithic of south Scandinavia. Of the four bones definitely claimed as domestic, one is a lower third molar of *Bos* from Rosenhof (Nobis 1975). This is very close in size to two teeth from Dyrholm (fig. 2). As the Dyrholm teeth are among those reclassified as wild by Degerbøl (Degerbøl and Fredskild 1970), however, the Rosenhof tooth could equally well be from a wild female. A distal metacarpal from Rosenhof has been claimed as domestic (Nobis 1975). This bone is plotted as no. 1 on fig. 3. If it is domestic, it should clearly be a male. Degerbøl presents an index for this bone for distinguishing males and females (Degerbøl and Fredskild 1970). When this is plotted (fig. 4), the Rosenhof bone does not overlap the male range, however (apart from the exceptional Klarup aurochs bull). If the bone is from a female, then it must, because of its large size, be a *wild* female.

Scapulae from Rosenhof and Bregentwedt-Förstermoor (Nobis 1962, 1975) do fall in the domestic range (fig. 5). Stock rearing in the southern Ertebølle cannot be assumed, however. The bones could perhaps derive from animals acquired from farmers to the south, or indeed from animals that had escaped from these farmers and were then hunted by the mesolithic groups. Individual domestic cattle might conceivably have been acquired from the farmers for prestige reasons, but it does not seem very likely that cattle should be kept if they were only to provide such a minor part of the food intake.

Some bones fall in the overlap zone between wild and domestic (e.g. Rosenhof metacarpal 2 in fig. 3). These are sometimes claimed to be evidence of the local domestication of aurochs (Nobis 1962, 1975, 1978; Schwabedissen 1962, 1979b, 1981). It must be born in mind, however, that a size overlap does not necessarily imply a transitional behavioural type; and the marked size difference between wild and domestic animals of known sex would seem to argue against the local domestication of aurochs. The intermediate sized animals could equally well be wild females.

Traces of cereal pollen have been claimed at Rosenhof (Schütrumpf 1972). The problems of cereal pollen identification have been stressed by S.T. Andersen (1978). One potsherd from Rosenhof had an impression of a cereal grain. In the same level were pots imported from both the Michelsberg and the Baalberg neolithic cultures (Schwabedissen 1979a), so the possibility that the grain impression arrived as an import cannot be dismissed.

There thus seems to be little or no evidence for agriculture in the Ertebølle. This reaffirms the existence of a 1000 year availability phase (Zvelebil and Rowley-Conwy 1984), in which farming was close by but not taken up. This in turn casts doubt on the "progress" view: the adoption of agriculture was evidently not always automatic and inevitable. Other factors are clearly at work.

LONG TERM POPULATION GROWTH MODELS

The long, slow, inexorable process of population increase has often been given the role of motive force behind many of the changes visible in the prehistoric record. This has the advantage of being a universal explanation once population increase is assumed. As population grew (so runs the argument), resources were gradually overexploited more and more, until a new socioeconomic organisation became necessary. The most thorough statement of this approach is that put forward by Cohen (1977); his book, *The Food Crisis in Prehistory* is subtitled "Overpopulation and the origins of agriculture". Cohen reviews a series of estimates of the annual rate of population growth for Pleistocene foragers, varying from 0.0007% to 0.003%, and comments "these estimates for Pleistocene population growth may be slightly low, but they must be of essentially the correct order of magnitude (op. cit., 53).

Applying this to Denmark, there are clearly two alternative ways in which this model could work: (1) *internally*, with forager population rising to a point where the adoption of agriculture by the foragers became necessary; and (2) *externally*, with farming population in Germany rising and forcing colonists to move into Denmark, regardless of the situation of the local Danish foragers.

There are problems with the internal view. The sort of long term population growth usually envisaged is shown in fig. 6. This may very well reflect the situation on a worldwide basis, but ecological considerations suggest very strongly that the local picture in any one area would be very different. In Denmark, postglacial variations in sealevel, vegetation, climate and fauna would surely have caused relatively massive alterations in population through time. A more useful model is probably that put forward by Bronson (1977), emphasising a high degree of short term fluctuation in any one area (fig. 7).

Population fluctuations of this sort, due to variations in resource availability, are documented archaeologically. They may be envisaged as occurring on a timescale of, say, 100 years and upwards. A good example of the variation of a single resource is provided by Meldgaard's (1983) study of caribou. He demonstrates that the West Greenland caribou herd has regularly fluctuated in numbers from 10,000 to 100,000 on approximately a century-long cycle. A good archaeological demonstration of the variation of forager site numbers (and thus, presumably, of population) is provided by Jomon Japan (Oikawa and Koyama 1981). Site numbers vary greatly through time. Of particular importance is the fact that each region of Japan varies independently. Each region thus demonstrates a unique, local history of demographic change.

Changes on the sort of scale discussed here render irrelevant any minor background change in the order of 0.0007 to 0.003% annually. Such a minor increase cannot therefore have any crucial causative influence on the adoption of agriculture in a particular region. Regional, relatively abrupt changes of the sort modelled in fig. 7 must always have a much greater, more immediate effect than the background trend modelled in fig. 6. Whether indeed the fluctuations in any region ever averaged out to approximate the background trend is uncertain. Is there any theoretical basis for assuming that forager density per km^2 in an unchanging environment would necessarily grow? At all events, the difference between 0.0007–0.003% growth and szero population growth is virtually nothing.

The internal application of long term population growth models to the Danish situation does not therefore seem particularly helpful. Their external application to colonising farmers will now be considered.

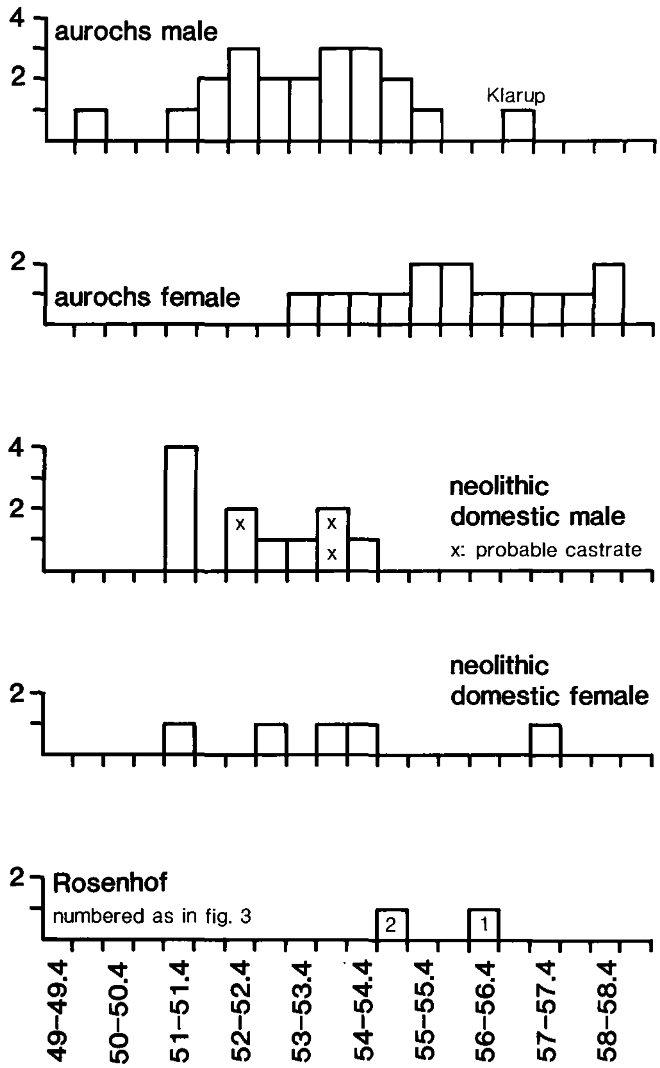

Fig. 4. Degerbøl's index of metapodial distal width, $\frac{\text{trochlea, anterior-posterior, } \times 1000}{\text{distal width}}$ applied to the cattle metacarpals shown in fig. 3. Measurements from Degerbøl and Fredskild 1970, except Rosenhof, from Nobis 1975.

The earliest farmers in a region are often regarded as likely to farm in a most extensive, least intensive manner. This view derives in large measures from the scheme put forward by Boserup (1965, 1981), in which population increase leads to ever greater intensification of agriculture. Boserup's model is based on a series of present-day, mainly tropical, examples. Among these examples, societies with higher population density do indeed farm more intensively (Boserup 1981, tables 3.5, 3.6, 3.10). This scheme is thus a *typology of agricultural intensity* based on modern tropical communities – and not the docu-

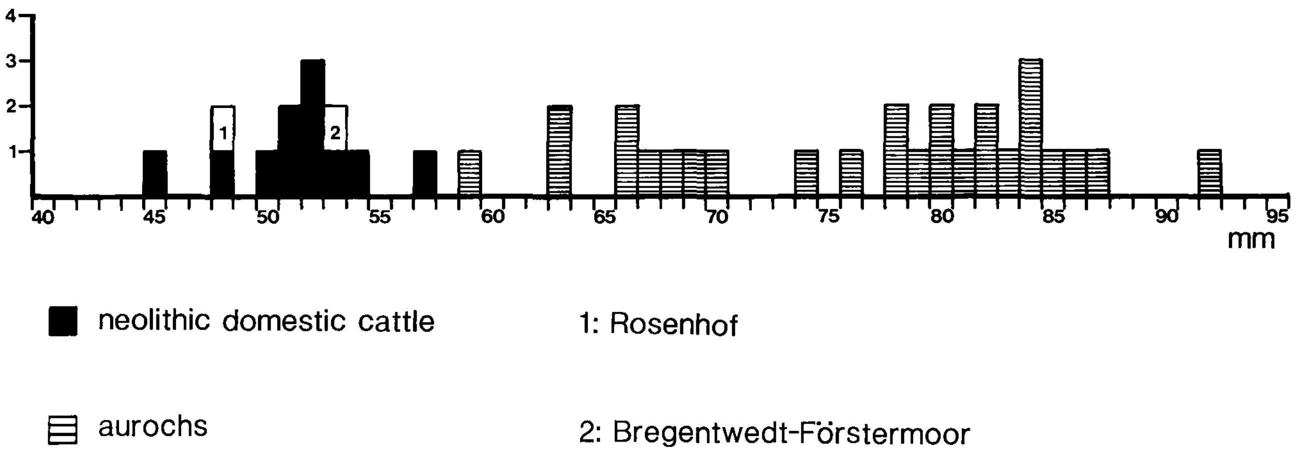

Fig. 5. Histogram of collum widths of cattle scapulae. Measurements from Degerbøl and Fredskild 1970, except the numbered specimens, from Nobis 1962, 1975.

mented history of the stages through which any one group has passed. The basic linking of population density and intensity of agriculture will surely be relevant to prehistory. The over-precise application of the tropical scheme to Europe may not be so justifiable.

The most extensive end of Boserup's scheme comprises shifting cultivation. Application of the scheme to Europe harmonises with Iversen's (1941) argument (based on pollen) that shifting cultivation was the type of agriculture practised by the first farmers in Denmark. The use of shifting cultivation in early neolithic Europe forms the basis for the best and most clear discussion of the colonisation process. D.L. Clarke (1972, 20–24) puts forward a model for central Europe. He points out that the movement of a swidden-based settlement to a new clearance may, all other things being equal, be in any direction at random. He continues:

> "However, this process will be intensified because every two or three moves each Danubian village will have generated enough surplus population both to continue itself and give rise to an additional new village unit... The multiplication of settlement units and their constant mutual readjustments will also ensure that over a long period of time the many derivative village units will become widely dispersed in an expanding mass of hunt-and-seek pathways." (op. cit., 22).

Frequent settlement shifts and population expansion are the essential ingredients of this model. The notion of shifting cultivation in temperate Europe has, however, been criticised (Rowley-Conwy 1981, Sherratt 1980). Anthropological studies suggest that colonisation by swidden farmers may be a more complex process than Clarke's random walk/unit multiplication model envisages. Chagnon (1974) describes the Shamatari group of the Yanomamo, who in about 100 years have multiplied from a single small village to 12 villages, containing about 2000 people. This has been accompanied by a major colonisation of the Venezuelan rain forest (op. cit., fig. 4.1). The enormous area taken up in this colonisation is caused not by the need for new swidden fields, however, but by the ceaseless warfare which causes villages to be very widely spaced – on average 80 km from each other. Consequently, "enormous tracts of land, most of it cultivable and abounding with game, is found between villages... Whatever else might be cited as a "cause" of warfare between villages, *competition for ressources is not a very convincing one* (ibid., 127, original emphasis).

Settlement movement and population growth are clearly not very well understood. As far as neolithic Europe is concerned, a general model of population growth and settlement expansion does not account for the spread of farming as revealed by radiocarbon. Population growth was presumably rapid during the LBK expansion. For the next 1000 years, the frontier of farming spread little further north (fig. 1). Either there was no population increase, or any increase was absorbed by internal intensification. The spread of agriculture in other well-studied areas such as Japan also shows a series of rapid spreads interspersed with pauses (Rowley-Conwy 1984b). The background population increase model does not account for such pauses in the process; nor does it account for the resurgence of colonising dynamism which would have had to occur at c. 3200 bc if farming is to arrive in Denmark with colonising farmers (of course, such a resurgence cannot necessarily be ruled out). The model in both its forms is too vague to be very relevant to the particular case discussed here.

TWO EVOLUTIONARY MODELS

(a) the theories. One of the most common evolutionary theories in archaeology is cultural evolution. This view groups present human societies into a series of types – such as bands, tribes, chiefdoms and states (Service 1971), or egalitarian, ranked, stratified and state (Fried 1967). This is then assumed to represent an evolutionary sequence and applied to the past (e.g. Jensen 1982).

At one level these models come quite close to the progress models discussed above. It has indeed been argued that these

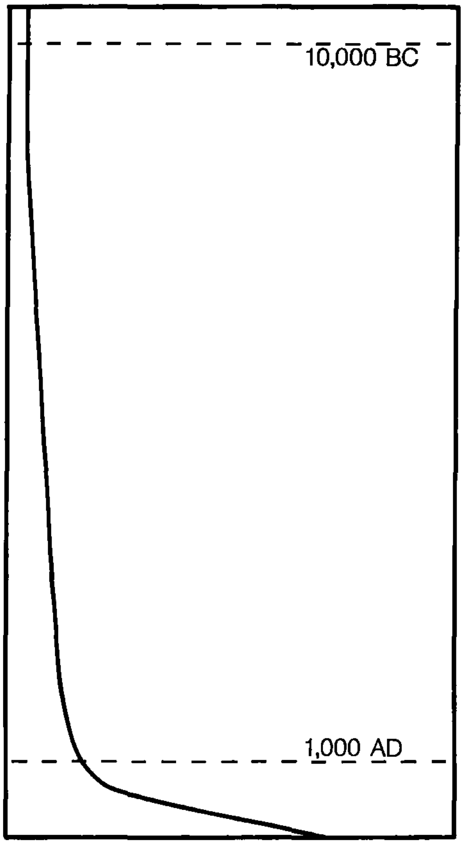

Fig. 6. Model of population increase on a world-wide scale (after Bronson 1977, fig. 1).

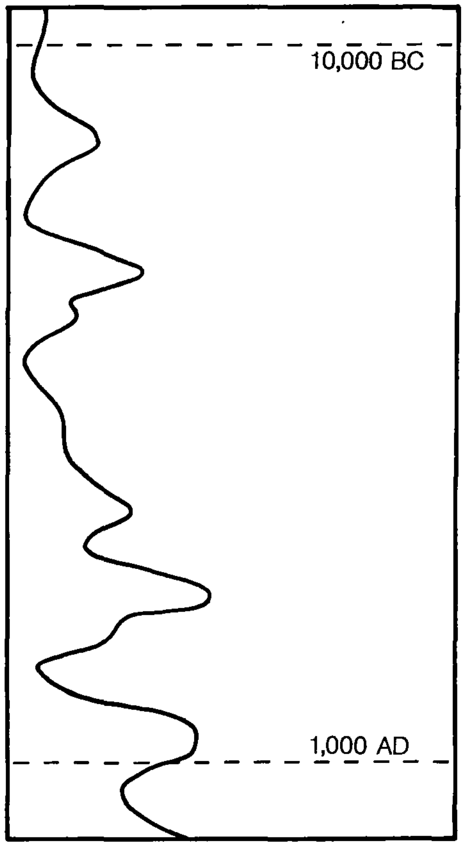

Fig. 7. Model of population increase on a local scale (after Bronson 1977, fig. 2).

models are not actually evolutionary in the strict sense of the word, because they rely too heavily on notions of progress from stage to stage (Blute 1979, Dunnell 1980). "Even if one grants the observational validity of "bands," "tribes," "chiefdoms," etc. in some statistical sense, this reality does not establish their significance in evolutionary or any other explanatory framework" (Dunnell op.cit., 47).

The invocation of causative mechanisms for stadial change such as the resolution of internal contradictions does not alter this. We have no way of seeing "contradictions" in the archaeological record. The imposition of this mechanism on the past as an essential precursor of stadial change is thus an arbitrary device quite similar to the progress models discussed in the first secton. Viewed from this perspective, stadial evolutionary theories seem little different to the obsolete 19th century schemes of Morgan, Marx and Tylor.

The use of such stadial schemes to pigeonhole the past is a logical development of earlier schemes such as the demonstrable division into stone age, bronze age, and iron age. The kind of stadial scheme put forward by cultural evolution involves a particular kind of thinking about the socioeconomic past, which may be called *typological* thinking. An alternative, preferred here, has more in common with biological evolutionary theory and stresses *populational* thinking instead.

These two types of view are really quite different from each other, even though archaeologists have categorised them both as "evolutionary". The typological view creates for itself a problem, by dividing the human past into segments different in kind from one another: by stressing the differences between two segments, an understanding of the change from one segment to another becomes more difficult. The result is a transformational view of change.

This view is analogous to pre-Darwinian biological classification, which can be termed "Aristotelian classification" (Blute 1979). Each taxon in this scheme is regarded as embodying a distinct "essence", different from that of all other taxa. Darwin had to dispose of this notion in order to allow one taxon to develop into another, because otherwise the emergence of new taxa would have to involve a transformational leap from one essence to another (Blute op.cit.).

Populational thinking on the other hand stresses individual variability within any taxon or group; it emphasises diversity, not uniformity. The crucial mechanism is selection. Biological evolution is based on the selection of a limited part of this populational diversity – only a restricted part of a population passes on its genes to the next generation.

The variation in the behaviour of individual humans is a factor arguing that a parallel view can be taken of the human past. Change is seen as a selective pressure altering the behavioural average – not as a transformation of all behaviour. Whether a behavioural trait or activity is genetic or non-genetic in origin, it is subject to selection; it is after all the trait which is selected, not the cause of the trait. Evolution has produced organisms which respond and behave ever more flexibly, genetic control decreasing as flexibility of response increases (Bonner 1980). Non-genetic responses are inevitably quicker than genetic ones. The Arctic provides an example: humans were able to spread into this area by adopting appropriate clothing, shelter, food-getting techniques etc – a non-genetic response. Bears on the other hand had to respond genetically and evolve a completely new species, a very much slower method.

The upshot of this view is that humans may react quickly to altered selective pressures, such as new environmental opportunities or constraints. It might be objected that the adoption or rejection of a behavioural trait by a human group is dependent on the ideology of the group – it is after all the people who have to make the decision. This is, however, to slip back into typological thinking. The counter argument is that the ideology of a group does not have a separate, unitary existence. There will be as many "ideologies" as there are people in the group, each to some extent different from the other. There is thus *variability* in ideology and consequently in the resulting behaviour. Each individual may react differently, for reasons both inaccessible and unimportant. The important thing is the existence of this variability, because then selection between responses can take place.

(b) the evidence. Two major changes are visible in 4th millennium bc Denmark: firstly, the increase in site numbers, many of them shell middens, associated with the Ertebølle; and secondly, the appearance of agriculture.

In examining the first change, it is necessary to refer back to the relatively rapid, local changes in population to be expected among foragers (fig. 7). The rise in Ertebølle site numbers occurred at the same time as sea level in the western Baltic rose towards its postglacial maximum (Christensen 1981). The result of the sea level rise was to introduce many marine resources into eastern Danish seas (Rowley-Conwy 1984a). The response to this was rapid; if it is correct that Ertebølle groups were larger and socially more complex than mobile groups, then these developments demonstrate the flexibility of human settlement and society in the face of a particular environmental opportunity. In the terms used above, this represents a rapid, non-genetic behavioural response. The Ertebølle thus fits with a peak in forager density of the type shown in fig. 7.

The drop in sea level at the end of the 4th millennium bc documented by Christensen (1981) resulted in a deterioration of the resource base (Rowley-Conwy 1984a). Under normal circumstances this would have led to a decline in forager population density, and possibly to a increase in mobility – a trough in the population graph (fig. 7). The availability of farming not far away presented an alternative, however. Behavioural variability (perhaps increased by the advent of more difficult times) must have included the acquisition of elements of the farming economy. As foraging declined in attractiveness farming would become relatively more attractive. The result was the quite rapid spread of farming into the Ertebølle area around 3200–3100 bc.

Both these changes represent rapid responses to new conditions. This is in accord with the evolutionary view, based on populational concepts, put forward above. In this view the two developments are comprehensible as responses to particular, local environmental conditions (including the availability of agriculture). The availability of farming in northern Germany, and the decline in marine productivity, are two unrelated factors crucial to the appearance of agriculture at 3200–3100 bc.

The need for the stadial schemes of cultural evolution therefore recedes. If the various developments can be understood as rapid responses to particular environmental constraints and opportunities, no stadial framework is needed to explain them. If the Ertebølle does indeed represent sedentary foragers with larger possibly more socially complex groups, then the reason for this is to be sought in a particular set of environmental conditions – and not because such a stage is in any way a necessary precursor to farming.

CONCLUDING REMARKS

The foregoing has compared various general views for the appearance of agriculture in Denmark, and selected one particular view as being more in accord with the facts as now known.

For this exercise to be at all worthwhile, it is essential that the facts available to us should bear some approximation to reality. Of crucial importance, therefore, is the generation of improved methods for recovering information from, and testing theories about, the past. Unless our theories are related to facts, they are of little use. Future generations of archaeologists are more likely to thank us for one suitable method to test a theory than they are for a whole series of theories with no test.

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Neolithisation – a Scanian Perspective

by KRISTINA JENNBERT

The division between the Ertebølle, as the last huntergatherer culture, and the Early Neolithic Funnelbeaker Culture, as the first agrarian community, has separated these prehistoric phases rather than presenting them as a sequence. This perception of the division has determined the modes of understanding and explaining neolithisation as reflected in the application of either diffusionist or ecological models.

With respect to the transition, two alternative hypotheses have been formulated. According to one of them, the Ertebølle and the Early Neolithic represent two different cultural and economic phenomena Becker 1947: 126 ff; 1955: 155 ff; Skaarup 1973: 141 ff; Salomonsson 1970: 94; 1973: 24 ff); the other hypothesis supposes that pre-conditions for the development of an agrarian economy were inherent in the late Ertebølle Culture (Troels-Smith 1953: 156 ff; Andersen 1973: 26 ff; Fischer 1982: 10).

A consideration of the different hypotheses should, in my view, be preceded by analysis of environment, subsistence strategies, settlement patterns, and social territories. First, however, we have to discuss shortly the definition of Ertebølle and Early Funnelbeaker Cultures.

Concepts such as culture and period are necessary abstractions for classification. However, the utilisation may constitute an obstruction when it comes to defining a transitional stage, as the neolithisation. This is reflected in the tendency to exclude »mixed« sites (containing both hunting and farming elements) from discussion. Consequently, the period of transition becomes exceedingly hard to grasp. The entire transitional stage can hence be explained away, because the finds from relevant sites are held to be »mixed« – i.e. incongruent with the adopted division, as defined by »pure« finds of either hunting or farming type (Ertebølle and Early Funnelbeaker Cultures respectively).

Therefore I would like to argue that the distinction between the Mesolithic and the Neolithic needs to be »softened«. In the subsequent discussion of the empirical material, the emphasis is on sites containing finds of an Ertebølle as well as an Early Neolithic character. Such sites, it is believed, may open up new perspectives for elucidating the introduction of farming. The basic material is from the Löddesborg site by the Öresund coast in Scania. This site is of »mixed« character, and so are also other sites in southern Sweden (Jennbert 1984).

At Löddesborg several culture layers could be discerned. As the order of the layers is essential, they were subjected to source-critical scrutiny, and it was assessed that the layers are cultural deposits and have not been disturbed.

There are no distinct differences between Ertebølle and Early Neolithic pottery that might be regarded as evidence of dissimilar manufacturing traditions. This is indicated by analyses of tempering material, sherd thickness, vessel-building technique, and firing methods. Nor do the different layers display any major divergences that might suggest abrupt breaks in the settlement history.

Two ceramic traditions are thus found in the same layer and the pottery could have been manufactured by the same population. There is nothing to suggest that the dissimilarity in the designs – that is, the difference between the Ertebølle vessels and the Funnel Beakers – has any functional significance, even if the pointed bases of the Ertebølle vessels imply a special practical function. Clay analysis and tempering materials, as well as analyses of food remains, show no functional differences. Both types have been used in cooking.

Instead, the design of the vessels might symbolise, and constitute an expression of, the peoples' conception of their world. Hence the dissimilarities with regard to shape and decor need not be due to the vessels having been manufactured by different population groups. For if the idea of life is altered in connection with the change in production, the appearance of the material culture will alter, too. Thus, the relationship between changes in material culture and mechanisms of social change is crucial for understanding the conditions for the beginning of agriculture (Jennbert 1984: 134 ff).

By the aid of a C-14 dating, Lu-1842, 3260±80 b.c. (conventional dating), and on the basic of the character of the flint and stone material, the Löddesborg site is dated as belonging to the Late Atlantic time.

A number of settlement sites along the Scanian coastline and in the inland areas, as well as in the westernmost part of the Blekinge coast, are comparable to the Löddesborg site both with respect to stratigraphy and the properties of the finds. They all suggest that previous subdivisions into culture groups, with concepts such as Ertebølle Culture and Early Neolithic Funnelbeaker Culture, should be modified, and that the Löddesborg site is not a unique phenomenon in the later Stone Age of southern Sweden.

These settlement sites are chronologically placed between the »pure« Ertebølle period and the »pure« Early Neolithic period. The special characteristics of the material culture, particularly with respect to the two pottery traditions is thought to reflect a society where change is discernible in material culture. This stage with »mixed« finds can hypothetically have lasted about one hundred years. It indicates local continuity between the Mesolithic and the Neolithic.

The Löddesborg site was located in a favourable ecological setting, where marine as well as mainland-based resources could be utilised. Bone remains throw some light on hunting and fishing. Grains of wheat and barley have been found both in Ertebølle- and Early Neolithic sherds. Also from the Vik settlement, in southeastern Scania, a grain of wheat has been found in an Ertebølle sherd.

The Löddesborg site and other sites from the Late Atlantic period are considered to be permanent settlements. Such settlements have been found from earlier periods, too, although the examples are few (ex. Larsson 1982: 39). The occurence of permanent settlements thus forms one of the prerequisites for the introduction of agrarian production, as it implies a more complex social organization.

After this archaeological definition of a transitional stage between the Late Ertebølle and the Early Funnelbeaker Cultures I will discuss some of the possible explanations of this transformation.

One of the hypotheses concerning the introduction of farming has been that a need for altered living conditions developed as a result of population pressure combined with insufficient natural resources (Fischer 1984: 91; Zwelebil & Rowley-Conwy 1984: 104 ff). The Löddesborg site belongs to a regression phase. So far, however, there is no reason to assume that a regression during the Late Atlantic time had repercussions on the marine resources, at least not in such open coastal settings as the position of the Löddesborg site represents. Nor do current climatological investigations supply any evidence for a climatic change affecting the ecology and the available resources that could be exploited. We should then rather consider the social and economic environment of complex hunter-gatherers and early farmers.

Recent anthropological research suggests that there need not be any major differences with regard to social structure between the Late Ertebølle and the Early Neolithic periods respectively, as both settled hunter-gatherers and the first farmers can be characterised by a delayed-return system (Woodburn 1980: 98 ff). Anthropological studies have also shown that there need not be any major differences in subsistence strategies and land use (Woodburn 1980: 98 ff) or in material culture (Orme 1981: 70 ff) in hunter-gatherers societies and in farming communities respectively.

These general considerations imply that the Late Ertebølle Culture should exhibit some social complexity – e.g. clearly defined social territories – and eventually also some contact with neighbouring farming communities.

The regional variation within the Ertebølle area can be looked upon with regard to distribution of T-shaped red deer antler axes, Limhamn axes, bone combs, bird-bone points, different types af harpoons, scapulae with circular cuts, bone rings, discs made from scapulae (Vang Petersen 1984: 15; Andersen 1973: 33 ff; Becker 1939; Jennbert 1984: 139), flake axes (Vang Petersen 1982: 188, 1984: 17), the Scanian group of Ertebølle pottery (Jennbert 1984: 139), different types of bases of the Ertebølle pottery (Hulthén 1977: 39), and the Early Neolithic pointed butted axes (Becker 1939; Jennbert 1984: 109).

Within the Ertebølle area there are tendencies in the spatial distribution of artefacts to a western and an eastern variety. But there are also local variations (Vang Petersen 1984: 13 ff). Thus, regional and local networks can be defined, just as the material culture in several aspects indicates strong influences from the farming cultures of the Late Linear pottery tradition.

The introduction of farming may thus be a consequence of tradition and innovation in connexion with contact networks and exchange relationships between local Ertebølle groups and the fully Neolithic groups in Continental Europe.

According to this hypothesis agricultural products are regarded as a luxury good. Foodstuffs as well as prestige objects, for example shaft hole axes (Fischer 1982: 10) may have formed part of an exchange pattern between complex hunter-fishing groups and primitive farmers. Marital alliances may also have constituted a vital component in the exchange relationships. Thus, corn and cattle came to Scandinavia in the course of gifts being exchanged, and matrimonial alliances being formed.

Such a hypothesis confirms both with the regional variation in the Late Ertebølle Culture and the archaeological composition of settlement sites of Löddesborg type. According to this there is no hiatus in the settlement history of southern Scandinavia at the transition between the Mesolithic and the Neolithic.

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Reviews

GÖRAN BURENHULT (ed.): *The Archaeology of Carrowmore. Environmental Archaeology and the Megalithic Tradition at Carrowmore, Co. Sligo, Ireland.* Theses and Papers in North-European Archaeology 14. Stockholm 1984. 396 pp.

This volume is the fourth and final volume publishing the results of the Swedish Archaeological Expedition to the Carrowmore megalithic cemetery in western Ireland 1977–1982. Being the final volume, it includes material which has already been published in the earlier ones and thus, by itself, offers a comprehensive presentation of the archaeological and ecological material and results obtained through the period covered by the field work. The most detailed description of the megalithic tombs of Carrowmore is, however, to be found in the volume published in 1980 by the Institute of Archaeology, University of Stockholm.

This – fourth – volume is divided into four parts, the first one being Göran Burenhults own presentation of the Carrowmore project in all its many facets, both archaeological and those concerned with such aspects as cultural ecology, physical environment and paleoenvironment studies. The second contains the environmental and economical analysis, while the third part deals with Neolithic hut sites and the kitchen middens in the area. The final part publishes contributions from the participants of the Carrowmore Seminar held in August 1982. Here many current problems of megalithic and Neolithic research in North-western Europe are presented and discussed by Irish, British and Scandinavian scientists.

In the first part of this Carrowmore publication the introduction shows the reader that the Carrowmore Research Project is indeed a very well-structered one. Three main aims are presented: The first, to establish the cultural and chronological sequence for the megalithic cemetery, to date the main types of tombs and to study the time-span during which they were used; the second was to identify a territory and resource area, mainly for the Stone Age populations, by locating settlements as well as food and raw-material resources in the area around the megalithic cemetery, while the third was to study the ecology of the area in order to understand the cultural adaptations and the shifts in the subsistence-settlement system.

The research-project was focussed on the Knocknarea Peninsula in Co. Sligo (on the west-coast of Ireland) as a whole, the area which surrounds the Carrowmore cemetery, and the thoroughness with which the initial examination was carried out can be judged from the fact that both field, aerial (including infrared photography) and phosphate surveys were performed (the last-mentioned only in selected areas) – it was from the results of these that certain sites were chosen for test-excavations and finally, from these last, certain points worthy of more detailed study were decided upon. Together with this work – concerning the whole area of the Knocknarea Peninsula – four megalithic graves of different types were investigated in the Carrowmore cemetery itself.

A good deal of work has been done to analyze and describe the physical environment of the Knocknarea Peninsula – for instance the project has used radar exposures taken from the space shuttle Colombia to describe the geological surface of the area, while the description of the environment also includes the different ecological resources in the region, which consist of a remarkable variety of ecological zones such as the Atlantic coast, the estuaries, the rivers, the lake district, the lowlands, the mountain slopes, and the high mountains. Perhaps, not too surprisingly, the region offers conditions very favourable to a prehistoric population, which could have utilized the different zones at different times of the year. A short chapter also sums up and discusses the paleoecological results, published in detail in the second part of the book.

Perhaps the most important part of the Carrowmore project is the excavation of four megalithic tombs from the megalithic cemetery which consists of 63 more-or-less well preserved graves, which do not seem to belong to the Irish passage grave tradition, apart from the grouping of the monuments and the finds of certain passage-grave artifacts in some of them. The very thorough excavation technique and the intensive use of C14 dating have revealed interesting facts about the use and construction of megalithic tombs: For instance, grave no. 7, which is a polygonal dolmen, does not seem to have had any covering cairn, there is a posthole in the center of the chamber, which marks the center of the boulder circle around it, while, in corners of it, four intact cremations were found, partly inserted in the dry-walling between the orthostasts in such a way that they must have been deposited during the actual construction of the monument. Grave 4 shows different building phases of the stone-circles around the stone cist. In many of the graves the essential grave-goods seem to be cremated sea-shells, but outside the tombs the survey test holes gave no evidence of this. The many C-14 dates show that the graves have been used both in the Bronze Age and the Iron Age, but the most astonishing C14 dates are related to the construction-phase or the early use of the tombs. Charcoal from the central post in grave 7 has yielded the date 3290 ± 80 b.c., which, considering the statistical weakness of this method, can just fit in with the earliest C14 datings of megalithic tombs in the British Isles. From grave no. 4, however, comes the dating 3800 ± 85 b.c. and this indeed very early date will be further discussed below. From another grave come three datings around 3000 b.c.

Due to the very intensive surveys many settlement sites were found in the area, both kitchen-middens and hut sites, but none can be dated to the late Mesolithic and the earliest Neolithic, which is a pity since it was especially sites from this period which could give us deeper knowledge of the cultural environment of the megalithic tombs. The earliest C14 date from the kitchen middens is 2760 ± 100 b.c., but from a later part of the Neolithic was found some hut sites with dates around 2400 b.c. The bulk of the settlement material is of late Neolithic, Bronze Age, and Iron Age date, though in the early Christian period the kitchen middens were still in use.

The reason why the material before and around 3000 b.c. is missing, seems to be that the sea level in that period was considerably lower than today. At the coast, covered by shallow water, has been found submerged peat which both from the pollen analysis and the C14 evidence can be dated to between appr. 3700 and 3200 b.c. The sea level would thus have been lower at this time, and the kitchen midden material would have been washed away. This does not correspond with the evidence of the Atlantic maximum of eastern Ireland, where this, at different sites, is dated to around 3300–3200 b.c. Göran Burenhult states that "the discovery of a present day submerged peat... has however thrown new light on the local differences of marine submergence limits" (p. 38). In part three of the book (p. 326) Inger and Sven Österholm comment on these circumstances in a diverging way – they seem to reject the evidence from eastern Ireland by referring to the Scandinavian date of the littorina transgressions which, they tell us, culminated 6500 years ago and which will be in accordance with the date of a regression at Knocknarea at around 3500 b.c. – "after all sea levels must be almost the same in Ireland as in Scandinavia". The sea levels must of course be the same, but not the terrestrial uplift. I see no reason to invoke evidence from the very complicated Scandinavian transgressions in this context, since it has been known for long that the transgression maximum does not occur at the same time in the different regions: for instance there are clear differences in such a relatively small geographical area as Denmark. Since the transgression maxima even in Scandinavia do not mark an absolute chronological horizon, we cannot postulate any such horizon including both Scandinavia and Ireland. It can be added, that the Atlantic maximum in northern Ireland seems to be earlier than the maximum in eastern Ireland, which also seems to be the case in western Scotland and Shetland, where it is to be found shortly before 3500 b.c. Thus we must admit that the maximum Atlantic sea level can occur at different times in different regions due to differential terrestrial uplift.

The cultural-historical part ends with a shorter discussion and interpretation of the results obtained, which is also very stimulating, but – since it is an interpretative part – much can be disputed. One feels that perhaps more Irish and British evidence could have been included in this interpretative part – on the other hand, the contributions from the participants of the Carrowmore Seminar and the published discussion of this, remedy the lack. It is indeed not very often, but most praiseworthy, that an archaeological monography ends with reviewing articles and discussios of itself by prominent scholars, as does this book, thus giving the reader much better opportunities to see results and interpretains in a wider context. Some of the arguments expressed below have thus already been mentioned in the Carrowmore-book itself.

G. Burenhult's model based upon the Carrowmore project is that the megalithic tombs started being built as early as in the Mesolithic period by a population which, due to the extremely favourable ecological conditions, had developed a relatively highly structured social system. During what we call the late Mesolithic and the early Neolithic, megalithic tombs were built at Carrowmore, and the economy mostly based on the excellent coastal resources showed little change. The megalithic cemetery is regarded as being the central point of a society (and its territory) which utilized mainly non-agricultural resources within a 5 km radius around it. Since, according to this model, there only seems to be very little economical and social change in the time around the beginning of the Neolithic, Burenhult suggests that we perhaps need to break up the definitions "Mesolithic" and "Neolithic" and find other, less rigid ways of defining the changes.

Even though this model is very fascinating and we can find some parallels in certain hunter-gatherer societies such as the North-West Coast Indians, it is nevertheless built upon the author's own assumptions, whilst others might have been considered. The Mesolithic date of the beginning of the megalith building is based on a single C14 date (3800 ± 85 b.c.). One must look very critically on such a single-standing date and test it on the archaeological evidence available. We must admit that the C14 method is a statistical one, not an absolute one, and even though the charcoal used for the date seems to come from a primary position, we also know that a few datings out of a hundred must be wrong, just because of the statistical weakness of this method. Perhaps this date is such one, since all other dates of megalithic tombs and earthen long barrows in the British isles and Ireland are early Neolithic or later, both seen from the archaeological and the C14 evidence. Burenhult mentions some dates in support of the earlyness of this tomb: At Ballynagilly in northern Ireland we have three dates from 3795–3675 b.c., but in some respect they seem irrelevant to the Mesolithic date of the Carrowmore megaliths, since they are connected with a clear Neolithic material (flint and pottery). If we accept the earlyness of these Ballynagilly-dates they document a Neolithic economy at this time and therefore show that the earliest Carrowmore tombs were built at a time when a Neolithic culture already was present in Ireland; but there are problems with these Ballynagilly dates: From the same site a Neolithic house with the same cultural material has yielded two dates around 3200 b.c. which is in reasonable accordance with the C14 dates of the landnam-horizon in the neighbouring bog. The elm decline starts at 3345 ± 90 b.c. and there are no signs of human interference in the forest before that – no pre-elm decline.

Apart from the C14 date from tomb 4, which has to be treated with reservation, the documentation for a Mesolithic economy or a Mesolithic date for the tomb-builders is very meagre, no more than the crushed sea-shells from the chambers. Apart from the description of the environment and the pollen analyses the project has given no direct clues to the economy of the population in the late Mesolithic and the early Neolithic: settlements and kitchen-middens have been found, but they do not show dates of that period. That the intensive surveys within the 5 km circle around the cemetery have shown no traces of settlement on the low-land areas is taken as evidence for the non-agricultural economy; as mentioned earlier it is reasonable to think that the kitchen-middens from that period have been washed away by the sea.

Another model can as well be proposed: That the megalithic tombs were built by a conventional Neolithic society whose basecamps or agricultural settlements are to be found outside the research area – in fact Burenhult, in the discussion at the Carrowmore Seminar, admits that the areas which will give the best conditions for the base camps are just outside the intensive survey area of the project (p. 390). The megalithic cemetery does not need to lie in the center of the resource area, it may as well lie at the edge of it, or lie in a position which combines different ecological zones; for instance the earthen long barrows of Southern England have been regarded by Colin Renfrew as being the central or focal point of a population of the chalkland, but it can as well be argued, that they lie in a not-so-clear "geometrical" position, to "control" the different resource areas, such as the chalk, the lowlands and the clay-with-flint soil, which is rich in surface flint. Also, distribution maps of Danish dolmens can be interpreted so that these can express territorial behaviour as well at the edge of the territory as at the center.

The Carrowmore cemetery can thus very well lie at the edge of a resource area, while the "Neolithic" part of the way of life was carried out elsewhere; the reason why the megalithic tombs lie near the coastal resources might reflect a territorial behaviour, where the most critical resources are stressed – even though farming and pasture in calories were the most important, it might have been essential for a prehistoric society to have access to the kitchen-midden sites at the coast during the critical winter-period.

In connection with the ecological model for the Carrowmore area Burenhult discusses the definition of the border between Mesolithic and Neolithic. The Carrowmore model shows a very diffuse borderline between the Mesolithic hunter-gatherer population and the Neolithic farmers. In a more general European sense, Burenhult also suggests that the borderline has been overestimated, that the elm decline is more or less a fictive border. I fully agree with Burenhult, that the so-called pre-elm decline found at many places in the British Isles and Ireland in the centuries before the actual elm decline, show some gradual development towards a Neolithic economy, and it is also my personal opinion, that the neolithisation in many places is an indigenous development, of course under some influence from outside, but it is perhaps going too far to state that: "A long time has passed since the idea of migration farmers into southern Scandinavia and other parts of north-western Europe was rejected as a main explanation for the introduction of a Neolithic life-style, ...". It is Burenhult's hypothesis that the Neolithic way of life developed locally, and in some areas (such as the Knocknarea Peninsula) the local conditions were so favourable that a Neolithic economy did not develop until very late in the "Neolithic" – therefore he finds the elm decline too sharp a border line (see also the discussion of the pollen evidence below).

It must be stressed that in the British Isles and Ireland many of the sites do not show any selected elm decline – the elm decline can be seen as an integral part of the fall in the forest curves and the general landnam effects; this landnam horizon can still be seen as a clear border-line; after it we find a culture different from that of before (as in eastern Ireland), a farming culture building megalithic tombs, and there is nothing new or spectacular in the fact that people, also after the landnam horizon, utilized coastal resources – that does not alter the whole concept of the differences between a Mesolithic and Neolithic economy. Both in the British Isles and Ireland, as well as in Scandinavia, neolithic hunting stations are well known. In Britain and Ireland the use of coastal resources seem to culminate in the later part of the Neolithic, and, it is from this period that the shell midden activity at Carrowmore is well-documented.

Even though late Mesolithic hunter-gatherers, such as, for instance, the South-Scandinavian Ertebølle-culture, can have developed a rather sedentary system, perhaps including some very early agriculture, the society had not yet reached a cultural and economical level where megalithic tombs were built. Perhaps there is in this respect nothing very special about the Carrowmore area, which could have generated the building of megalithic tombs in the mesolithic period and (later) with a "Mesolithic" economy. The Carrowmore tombs can as well be a part of a "normal" Neolithic system in which the coastal resources were of importance.

On p. 142–146 Burenhult presents "an alternative view of the megalithic tradition", where megalithic tombs can occur in very different subsistence-settlement systems, from Mesolithic hunter-gatherers to chiefdom-like agricultural systems. I share the opinion that megalithic research can have overestimated the similiarities of megalithic tombs and their underlying societies, but in some way the building of megalithic tombs and earthen long barrows must express some common solutions of the structural problems in the different Neolithic societies. To stress that megalithic tombs can be built under very different ecological conditions Burenhult states (p. 142): "As we have already seen, the elm decline can no longer be used as an indicator of the introduction of the Neolithic, maybe even as an expansion phase, and this can be further demonstrated if we compare Swedish and Danish megaliths with reliable construction dates with the expansion phase diagram (fig. 117). All megalithic construction dates appear before or after the elm decline, not during the elm decline expansion phase itself, and most tombs were actually built during the so-called regeneration phase". Looking at the C14 dates from the tombs mentioned, I see no clear evidence that they should have been built before the elm decline and the landnam horizon. Considering the C14 method as a not totally absolute one, one must expect some overlap between the dates of the elm decline and the earliest dates of the megalithic tombs, and, furthermore, the number of C14 dates from Scandinavia are still too small to make such a statement. From the

British Isles and Ireland, however, we do have quite a number of C14 dates related to megalithic tombs, earthen long barrows and the landnam-horizon. There does not seem to be any documentation for a dating of the beginning of the building of these tombs to a period before the elm decline. The erection of them seem to start shortly after the landnam in the two last centuries of the fourth mill. b.c. and the building continuies in the following centuries. In addition, analyses of sealed soil horizons from underneath earthen long barrows of southern England show clear signs of forest clearance and Neolithic economy in a certain period before the monuments were erected.

The types of graves which can be dated to an early part of the Neolithic are the earthen long barrows of England, the Severn-Cotswolds tombs of western England and Wales, the Clyde tombs and court cairns of western Scotland and Ireland. From the pottery evidence alone, also the portal dolmens of Cornwall, Wales and Ireland can be regarded as belonging to an early part of the Neolithic. Together with, for instance, the Danish dolmens, they are all to be found in an early agricultural society.

Since the Carrowmore megaliths in Burenhult's model have been built in a mesolithic and "early Neolithic" society with very little agriculture, if any, he sees them as the earliest megalithic tombs of Ireland, representing that special "early Neolithic" way of life. Therefore he regards some other megalithic tombs of Ireland, such as the court cairns, as belonging to a later part of the Neolithic – in the first of the Carrowmore volumes he documents this be means of three C14 dates from the court cairns at Annaghmare, Ballyutag and Ballymacdermot (2445 ± 55 b.c., 1710 ± 300 b.c. and 2170 ± 300 b.c.) All three are, in the way in which the author uses them, invalid, since none of them can be related to the building phases or the early use of the three tombs. They all seem to belong to a late phase in the use of the tombs, probably not too long before their final blocking. All three dates come from the forecourt area. In fact, we do have C14 dates related to court cairns (and in more primary positions) which are much earlier than the three used by Burenhult. From Dooey's Cairn, Co. Antrim, we have three dates, which tell us that the megalithic part of the structure has been erected in the first half of the 3rd mill. b.c. perhaps early in this period and from the court cairn Tully, Co. Fermanagh three C14 dates tell us that the monument was built early in that millennium (around 3000-2900 b.c.). Also, from the Scottish counterparts of the Irish court cairns, the Clyde Tombs, come dates, which indicate that this group was erected in the first centuries of the 3rd mill. b.c. The C14 evidence is in accordance with that of the pottery. The court cairns must belong to an early part of the Neolithic, and perhaps that is also the case with the Carrowmore megalithic tombs (which are not court cairns), since the other early dates (apart from the one from grave no. 4) are from this period.

The environmental and palynological studies of the Carrowmore project are presented by Hans Göransson in part II, p. 154–193. The most detailed pollen diagrams comes from the Carrowkeel Mountains showing a normal elm decline, which in one of them clearly is accompanied by the fall of other forest trees. In the centuries before the elm decline two pre-elm decline events are seen, marked by microscopic charcoal particles and an increase in pollen of grasses and bracken spores. Some very big grass pollen are recorded just before the elm decline – perhaps cereal pollen. From Ballygawley Lough *plantago* L and three very big grass pollens occur before the elm decline.

What dominates, however, is a general working hypothesis of the development of the Neolithic economy – an indeed very interesting hypothesis – but it does not seem to have been developed as a consequence of the Carrowmore field work – it is a general hypothesis dealing with northern Europe, to some degree based upon Swedish evidence.

According to this hypothesis a very important element in the early farming economy was the coppice forest, which created pollen in such a way that it is difficult to see any difference from the normal forest in the pollen spectrum. An early farming system based on such a forest is supposed to have yielded a relatively hich surplus, and a very great advantage is that the standing trees nourish the soil and prevent soil erosion. Such a system should have developed before the elm decline which is seen as being non-anthropogenous. The elm decline causes the breaking down of that very stable system and more open areas are created. What is normally seen later in the Neolithic as a regeneration phase is interpreted as a reestablishment of that older, very efficient ecological system. So, according to Hans Göransson the elm decline does not mark any introduction or culmination of the Neolithic economy. This theory is indeed very interesting, and future research will perhaps tell how general it is, but it might be dangerous to use a hypothesis partly based on Swedish evidence in western Ireland. At any rate the pollen diagrams from the Carrowmore area are not very different from other diagrams from the British Isles and Ireland, and in the following paragraphs the hypothesis will be reviewed upon that evidence.

The use of coppice forest was discussed in England as early as 1972 by Andrew Fleming, who regards it as giving very low yields – to him, it seems profitable only if combined with a wider system including open fields, grassland and regenerating forest. Göransson stresses that the forest is not to be seen as the enemy of man, but the same can be said of Fleming's system – the forest can be used in several ways (e.g. winter-fodder) and it can, in a very long shifting cycle, be used to improve the soil. Part of this (regenerating) forest may have been coppiced.

That the pre-elm decline, which is found all over the British Isles and Ireland can be the results of the very first farming was already in 1973 proposed by the British palynologist Sims working on pollen-material from East Anglia: The pre-elm decline marks the first agriculture, which was performed on a very limited scale, but later, the elm decline/landnam horizon marks a certain culmination of population, so that now a more profitable system was needed. According to Göransson the pre-elm decline does not reflect an actual opening of the forest, but coppicing, which he sees as being much more efficient. In support of this, we are told that even though we find *plantago* L and probable cereal pollen there was no great interference with the forest: "It is very interesting to observe that the pollen curves of elm, and in NW Europe outside Ireland, lime are very smooth and undisturbed from ca. 7000 B.P. up to the elm decline level" (p. 171). This, however, does not seem to be the case. Actually, the pre-elm decline in the British Isles and Ireland is characterized by the same elements as the elm decline proper, though in a more limited form – the presence of *plantago* L, bracken, and for instance nettle, is accompanied by the fall in the curves of the mixed forest including oak, elm, and (if present) lime. Examples are Hockham mere and Seamere in East Anglia, Blea Tarn in Cumberland and Ballyscullion in Northern Ireland. So, from the British and Irish evidence the pre-elm decline shows an opening of the forest of the same sort as the elm decline/landnam and not a particular coppice forest in the sense proposed by Hans Göransson.

The most detailed paleo-ecological study in Britain has been made in the Somerset Levels, where many wooden trackways are found. Pollen analyses has given a lot of information about the utilization of the environment in and around the big swampy basin. Shortly after and during the elm decline, which is a part of the general fall for the forest trees, the first trackway was constructed and the wooden material (together with the ecological analyses) shows that the hills around the basin carried controlled stands of coppice forest. Many wooden parts show the characteristic elbow where the twig has grown out from the stool and one stool with remains of the twigs has even been found. The species coppiced are e.g. hazel, oak, lime, and elm. In the beginning of the 3rd mill. b.c. more clearings were made and the material in the trackways then came from species growing near the shore, such as birch and alder. In other words, the coppiced stands higher up on the surrounding hills had then been cleared. In the Somerset Levels there is no pronounced regeneration of the forest during the Neolithic, but in the centuries just before 2000 b.c. there is again some evidence of coppicing. The conclusion from the Somerset evidence must be, that we find the coppice forest shortly after the elm decline in a period when the forest was opened by man and not in a later regeneration phase.

That the regeneration phase seen in so many other areas does not reflect an economical set-back but a stable coppice system is a very interesting point, and it will probably hold true in some parts of Britain, but there is evidence which supports the idea of some sort of ecological set-back. For instance the south English chalk plateau, in the early Neolithic, seems to have been covered with a very productive loessic soil which had been blown and washed away during the Neolithic and now we find these loessic components washed down into the river beds. Also in other parts of the British isles there is evidence of soil erosion.

The evidence from sealed soils underneath monuments in southern England shows a tendency during the Neolithic towards larger areas of open grassland, best fitted for extensive pasture. Under some of the earthen long barrows from the earlier part of the Neolithic we sometimes find a background of tree pollen, which might reflect a coppice forest system, but on the other hand the landsnail analyses mostly show open country species – so perhaps the tree-pollens just reflect some forest areas around a barrow.

The many field boundaries found in western Ireland, which seem to have been in use in the middle and later neolithic, do not fit very well with a landscape of coppice forest.

Even though the hypothesis can hold true in some areas of the British Isles and Ireland (perhaps best in more "marginal areas") it is an open question how general it is. By looking at the spores of ferns of the dryopteris type, which is shade loving, in connection with the so-called forest regeneration, one might get some impression of how much light reached the forest floor, thus perhaps solving the problem of whether the forest regeneration reflects an actual set-back for agriculture or not in a given area.

As will appear from the foregoing, many new and unconventional ideas have been proposed in order to understand the Neolithic way of life and megalithic tombs and, of course, new hypotheses and models will always stimulate discussion. Not only has this book by its interpretative sections given us some alternative models for neolithic society and economy, but it is also a very comprehensive publicatin of the Carrowmore research project, which has given us a lot of new valuable information.

Flemming Kaul

Jutta Meurers-Balke: *Siggeneben-Süd. Ein Fundplatz der frühen Trichterbecherkultur an der holsteinischen Ostseeküste.* Mit Beiträgen von Peter Breunig, Jürgen Freundlich, Dirk Heinrich, Birgitta Hulthén, Dietrich König, Günter Nobis und Burghart Schmidt. *Offa-Bücher* Band 50, Karl Wachholtz Verlag, Neumünster 1983. 136 pp, 96 plates.

Due to isostatic movements in the postglacial period the coastal settlements of the Ertebölle and Funnel-Beaker (TRB) Cultures in Schleswig-Holstein now lie below the present sea level. Only in low-lying areas that have become blocked off from the sea by coastal ridges is it possible to investigate sites of this kind using 'dry land' excavation procedure. Such is the situation in the former Dahmer Bucht in eastern Holstein where archaeologists of the University of Cologne have been carrying out excavations since 1969 under the leadership of Professor H. Schwabedissen.

Although only briefly presented in literature the site at Rosenhof has taken a central place in the discussion about the formation of the early TRB Culture in North Germany and its relation with the Ertebölle Culture. At this settlement there is a C 14-dated sequence with Ertebölle-Ellerbek as the oldest (c. 4200–3500 bc) followed by material of the 'Rosenhof Gruppe' (c. 3500–3000 bc) characterized by the survival of Ertebölle 'blubber lamps' alongside with funnel-beaker pottery and evidence of farming and husbandry. Pottery with both Michelsberg and Baalberge affinities is found with the short-necked funnel-beakers of the Rosenhof Group.

In her dissertation Jutta Meurers-Balke presents the results from the excavation of the site of Siggeneben-Süd situated some 500 m north of Rosenhof. The find material belongs to the later part of the Rosenhof sequence (Rosenhof b by Schwabedissen) being for the main part younger than the material from the Rosenhof site, i.e. c. 3300/3200 – 3000 bc, and it is attributed to the TRB Culture alone. Like at Rosenhof, the finds come from gyttja and sand layers and were deposited during a time with low water level in a small lagoon adjacent to a (not located) habitation area. The conditions of preservation for all kinds of organic material including pollen were optimal. Jutta Meurers-Balke herself reports on the sedimentation and pollen analysis as well as on the analysis of the archaeological find material, thus placing the site in relation to the geological process, to changes in the land – sea constellation, and to the vegetation history of the environment. Birgitta Hulthén has contributed with a technical analysis of the ceramics, Jürgen Freundlich and Peter Breunig comment on the C 14 dates, Burghart Schmidt presents a year-ring analysis of wood not directly connected with the time of occupation, Günter Nobis deals with the faunal remains, Dirk Heinrich with the fish bones, and Dietrich König has made the diatom analysis.

By the pollen evidence the cultural deposit at Siggeneben-Süd is dated to the transition from the Atlantic to the Subboreal, coinciding with the elm-decline. It is noteworthy that in one of the diagrams pollen from cereals and from *plantago lanceolata* occur before the end of the Atlantic period.

The analysis of the find material is making the most of the formal properties of both the ceramics and the rich lithic inventory. The analysis forms a good basis for comparison with South Scandinavian material from Ertebölle and Early Neolithic sites. On the other hand the taxonomy is affected by the fact that there is a deplorable lack of analysis of comparable find complexes in North Germany. The composition of the lithic tool kit is within the variation of the Early Neolithic assemblages of the West Baltic area where strong traditions from the Ertebölle technology are detectable. At Siggeneben-Süd there is also a certain amount of genuine Ertebölle types.

Like at Rosenhof, Ertebölle 'Lampen' (blubber lamps) – but no other Ertebölle pottery – occur together with the Early Neolithic ceramics. We shall no more be surprised when this combination is seen once more in a similar context, though the case has not yet been demonstrated north of the Baltic. From the author's treatment of the Early Neolithic pottery from the site, and from the technical analysis, too, there appears to be no differentiation as to technique and to pottery style. Having enjoyed the opportunity of seeing some of the pottery from Siggeneben-Süd recently, I feel inclined, however, to distinguish between two main components of the pottery material, one in the form of funnel-beakers with a short neck and simple, stamped ornamentation below the rim, and another consisting of mostly undecorated funnel-beakers with a tall neck. The former element seems to be related to the Rosenhof pottery, while the latter comes closer to the Satrup style, although it is mostly without the fringed decoration characteristic of this. The author denies the presence of collared flasks at Siggeneben-Süd. When looking at the sherds of small flasks (Taf. 37:7,9 and Taf. 38:1) one gains the impression, though, that they can hardly belong to any other shape of vessel. In case this observation is right, the collared flasks are to be included in the later part of the pottery development at the site. The above suggestion is, of course, an arbitrary one and is biased by the view that the TRB A and B schemes are applicable to the North German Early Neolithic pottery, identifying the Rosenhof short-necked vessels as A-beakers.

In reality, the nature of the deposit at Siggeneben-Süd does not allow a separation of settlement phases. Although the author's conclusion is that the find material represents a simultaneous deposition, the possibility of a longer duration of settlement including separate phases: Ertebölle, Rosenhof (stage a and b), and the Satrup phase, cannot be rejected. Seen in this way, we may look upon Siggeneben-Süd as an accumulated find complex of which the main part is dated within the period c. 3300–3000 bc.

If we compare with coastal sites in Denmark and South Sweden it is a rule rather than an exception that the hunting and fishing stations were repeatedly used, often through greater parts of the late Mesolithic and the Early Neolithic. There is a predominantly wild fauna to be found at such stations. On this background it is remarkable that there is a slight dominance of domestic species at Siggeneben-Süd over wild species, notwithstanding the fish remains. In the upper levels at Rosenhof bones of domestic animals did not reach 10% of the total bone material. Inland settlements of a distinct agricultural character contemporary with the Rosenhof and Siggeneben stages in Schleswig-Holstein still await discovery and investigation.

The Dahmer Bucht and the Schleswig-Holstein region as a whole has become of primary importance for the study of the neolithisation of the West Baltic area, and we feel that the stage has just been set for future research. The next step will be to find smaller units of occupation in order to work out a finer chronology. In connection with a survey to determine the settlement pattern of the Early Neolithic groups this might give us a more thorough understanding of the processes through which hunter-gatherers became farmers in the borderland between the Continent and the North.

P.O. Nielsen

BOZENA WYSZOMIRSKA: *Figurplastik och gravskick hos Nord- och Nordösteuropas neolitiska fångstkulturer* (Figure Sculpture and burial Customs of North and North-East Europe's Neolithic Hunter-Gatherer Cultures). Acta Archaeologica Lundensia, Series in 4°. N° 18. Lund 1984. 303 pp., table I – XXXV.

The book, which is a doctoral dissertation, is written in Swedish, but the English summaries following each chapter are rather comprehensive.

As the title of the book suggests, one might get the impression that the theme was a rather limited one. This, however, is not the case, and the title turns out to be very modest, when looking at all the phenomena which are considered. Thus one is here faced with an archaeological material within a huge geographical area, covering most of Fennoscandia, northwestern Russia, the Baltic Republics and Poland; but even material outside this area is treated, a.o. within the "Circumpolar Stone Age". This means that one has here an opportunity to be acquainted with most interesting finds in "marginal" areas.

Most of the cultures in question have been studied rather intensively for generations but not least a considerable amount of ^{14}C datings from the last decades have made it possible to establish a reasonable chronological sequence. Many of these datings, especially within the Comb Ware Culture have been surprisingly "early" – a good example of what Renfrew might have termed "collapse of the traditional framework and of a diffusionistic point of view". On the other hand, the Finnish datings using shore line displacement have turned out to be nicely in accordance with the ^{14}C datings. On the whole the ^{14}C datings play a large role in the argumentation in this book, but the student is recommended to look most carefully at the background of each dating, since there are many things to consider before it is possible to compare the datings with each other. It is confusing f.i. that the half-life of 5568 is not always used, and it is inadequate in a chronological discussion to use designations which are valid only within the South Scandinavian Neolithic.

If some confusion is prevailing when talking about chronology, this is still worse with the terminology used throughout the book. Wyszomirska cannot, however, be blamed for this alone since she has inherited a long row of hopelessly inadequate conceptions used by Scandinavian scholars for generations. The discussion of the terminology and the new proposals put forward are not convincing, and the words of Mats P. Malmer that the Pitted Ware Culture of Scandinavia is the most difficult to define of all the Fennoscandian Neolithic cultures is still valid. With regard to the Comb Ware culture Wyszomirska calls it Neolithic or Neolithic Hunter-Gatherer culture despite of the fact that it is a Mesolithic culture exclusively.

Most of the book is a comprehensive examination of the figure sculptures and the burial customs, and this part of the book is valuable because one here gets a picture of an archaeological material, which has so far not been dealt with in detail. The reader is looking in vain, however, for a classification of the many sculptures made especially of clay but also those made of flint, bone, wood and amber. In the opinion of the present reviewer such a classification ought to have been the most important – and first thing – to do, but Wyszomirska declares that a "typological analysis falls outside the scope of the dissertation". Furthermore, the illustrations are of little help because most of them are simple drawings only giving a rough impression of the material. Thus one is not at all convinced when she compares figure sculptures from far and near, and the reader is constantly reminded of the fact that the study of convergence is a sadly neglected field within archaeology.

When such a large archaeological material is discussed, it is inevitable that many of the statements made are to be questioned, especially since Wyszomirska is often rather categorical in her mode of expression. Thus the present reviewer is quoted completely superficially or even for points of views that he has never put forward. To enter into details on these and several other highly disputable subjects lies outside the scope of this review, but it ought to be stressed that several works which could have given a more balanced understanding of the subject are not quoted.

In the conclusion Wyszomirska stresses the similarities between the Pitted Ware Culture and the Comb Ware Culture with regard to the figure sculptures and the burial customs. Also the Mesolithic heritage in general as well as the similar ecological conditions prevailing east and west of the Baltic are emphasized. These things, of course, have also been observed by other scholars, though it is the first time that such a comprehensive material is put forward. Yet, it should never be forgotten that there are several phenomena in the Pitted Ware Culture and the Comb Ware Culture which are different, and these must be considered when the two cultures are discussed.

Svend Nielsen

AXEL HARTMANN: *Prähistorische Goldfunde aus Europa II. Spektralanalytische Untersuchungen und deren Auswertung.* Studien zu den Anfängen der Metallurgie Bd. 5, Gebr. Mann Verlag, Berlin 1982, 155 pp, 9 diagrams 115 plates.

This volume presents 2400 analyses including a number from the Iberian peninsula which will be illustrated in SAM 6 (not yet published). The other finds are all illustrated photographically together with 107 drawings from other publications. According to the author the Iberian finds are the most important, apparently because of their number. As they form the author's starting point it is regrettable that these finds are not illustrated. For Danish readers it is important to know that 713 analyses of Danish gold objects are presented.

Six pages are devoted to Professor Junghans, one of the main forces behind SAM. 41 text pages supplement the 69 pages of analyses, 7 distribution maps, 9 diagrams and 115 plates, ordered geographically and chronologically.

The author uses the preface to counter some of the objections to the preceeding volume, SAM 3, which he regards as misunderstandings. The problem of the relationship between the natural occurrences of gold and the gold finds was not the main subject of this programme of analyses, that relationship only rarely being observable. The main goal was to establish trade routes, trade connections and cultural connections, their durability and changes plus information on the history of technology.

No mention is made of the planning, execution, timing or collaboration with museums or other institutions. It may therefore be relevant to insert some remarks on the development of the collaboration between the Danish authorities and SAM. They will also explain the somewhat scathing remarks p. 1.

It began with a letter from Stuttgart in 1967 declaring the intention to analyse the Danish gold finds. The National Museum replied that similar ideas existed locally and proposed a collaboration over future publications. In 1970 it was proposed that Klavs Randsborg and the reviewer should undertake the examination of the Danish archives while Dr. Hartmann should take the samples from the gold objects themselves. During October he took about 900 samples from the objects in the National Museum. The plan was to execute the analyses in the following two years and a rather intensive archaeological commentary was wanted from the Danish side, while Dr. Hartmann did not like the idea of a possible delay of the printing for this reason. In 1971 he wrote that no application had been sent to the Deutsche Forschungsgemeinschaft. In October 1971 the lists of the Danish finds were finally sent to Stuttgart and it was agreed that a complete catalogue of the analyses should be presented to the National Museum before October 1972. In June 1972 this work was half completed, but since Dr. Hartmann could not obtain a satisfactory solution of the problems concerning the production of photographs for the publication and the nature of the collaborationship, further work was halted. This was partly due to the reviewer leaving the National Museum and thus being unable to produce his part of the archaeological commentary while Randsborg concentrated on other research. In October 1974 the National Museum proposed that the catalogue should be published without Danish authorship. Klavs Randsborg had withdrawn because he had been unable to obtain information from Stuttgart wanted for other studies. In 1976 Poul Otto Nielsen produced the references included in the present volume and since then no correspondence between Stuttgart and Copenhagen seems to have followed.

This is a story of frustrations, misunderstandings, and false reactions to omissions and prolonged silences, which is a poor example of international collaboration. It is quite clear that faults occurred on both sides.

This rather sad story is very relevant to the usefulness of the present volume. What we have now is a corpus of scientific information needlessly separated from the archaeological context. This becomes immediately apparent if we compare the present volume with the French and British works. Spectra like Eluère 1982 fig. 1 and fig. 179 illustrating the find-groups and the weight distribution of the gold finds present overall statistics in a nicely informative way. There is no indication of weight or contexts given in the present volume and I sorely miss both. Someone will have to produce a new volume combining scientific and archaeological information if the Danish Bronze Age gold is to be wholly exploited in studies of the distribution of wealth, regional changes in gold depositing, socio-economic structures or external relations.

What, then, have we got in the present volume? The analyses follow the usual Stuttgart scheme and are sorted into material groups according to the norms already established in volume one (Hartmann 1970). 19 pages are devoted to the Iberian peninsula compared to Central Europe and the British Isles, 8 pages treat the Danish material groups, 5½ pages describe the Aegean area, while the remaining 6½ pages are devoted to Bulgaria and the Balcans during the Aeneolithic (Varna etc). Each chapter is a closed entity, there is no final conclusion or discussion. Just as the geographical range is wide, so is the chronological range, starting with the Aeneolithic and ending in the Pre-Roman Iron Age.

From each gold object a sample was taken and given a sequential number preceded by Au. This sequence is used within the geographical and chronological subdivisions of the lists. For each sample the find spot, parish and county or similar administrative divisions plus an extremely short description, museum code and inventory number are given followed by the actual analyses concentrating on Ag, Cu, Cn with Bi, Ni, Pt, Pb, Sn, As, Sb, Hg, An as additional elements. Finally a reference to a previous publication is given, for Denmark mainly the catalogue of H.C. Broholm (1943–49).

The reader of the present volume will need to have the first gold analysis volume at his side to see which methods have been used. There has been no change in the analytic procedure described in SAM 3, 16 ff. (Hartmann 1970).

Hartmann obviously regrets the geographical disparity (p. 1), but sets the problem aside without further comments. This is, however, directly relevant to the conclusions of this study which are only possible "in grossen Zügen" (p. 1). It would have been a better service to the readers to account for the difficulties of access etc., e.g. preventing analyses of the Swedish finds, or the absence of analyses from the British Museum (Taylor 1980, 2).

Nowhere are we told when the manuscript was finished, but references later than 1977 are only given in two cases (not including Aner & Kersten 1977 & ff). This would seem to indicate a manuscript date around 1978, which would explain the absence of references to Taylor 1980 (written 1973) with its 188 Hartmann analyses. Miss Taylor has 45 Hartmann analyses which do not appear in his own volume and 143 analyses which are also published by him in the present volume. It is a bit curious that apart from the actual analyses no information seems to have been exchanged between Taylor and Hartmann. For anyone without a scientific background a discussion of other methods of gold analysis would have been interesting (e.g. Taylor 1980, 4 ff; Parish 1981; this discussion is only given in SAM 3, 16 ff).

Of the Danish analyses Au 1117 and 1119 are repeated from SAM 3, while Au 1139, 1132, 1133, 1118, 1129, 1131, 1158, 1159, 1162, 1187, 1189, 1196, 1221, 1421 and 1434 are only found in the first volume.

Outside the National Museum only Haderslev Museum seems to have been visited, a number of gold objects exist, however, in other local museums.

Joan Taylor (1980, 8, 10, 21, 71) regards the Stuttgart analyses as reliable but not so their statistical evaluation. She illustrates the groupings in another way which has been adapted by Christiane Eluère (1982). This makes comparisons much easier, (cp. Wessex gold Taylor 1980 fig. 16 with Eluère 1982 fig. 180). I do not intend to go into this problem, but for readers of the SAM volumes it would have been nice to have had the Taylor method illustrated too.

For me the crucial question is how the traditional typological grouping accords with the analysis groups and with the trend towards higher copper and tin contents in the later BA (Taylor 1980, 71; Eluère 1982, 203 f).

The lunulae are typical of this problem. Taylor (1980, 38 ff map 1) suggests that the Nordic specimens are not lunulae proper but in some way related. Hartmann places the lunulae in his groups B (*Tabelle* 2), S (*Tabelle* 4) L 1–2, Q 1–2 (*Tabelle* 6). The nordic "lunulae" are: Au 1118 now placed in group S – *Tabelle* 4 – (in SAM 3 it was put in group L, *Tabelle* 10), Au 1117 and 1119 (*Tabelle* 35 – in SAM 3, 37, *Tabelle* 14 put in *Restgruppe* in Mitteleuropa and interpreted as intentionally alloyed with high silver content), now grouped with diverse lunulae, Wessex bronzes and East European early bronzes with added silver and higher copper contents. The Fredensborg fragments Au 1118 (Aner & Kersten 1973 no 198) are thus the only case still with some sort of internal relationship with the West European lunulae (cf. *Tabelle* 4 in the present vol.). In this case there is an acceptable accordance between the archaeological grouping and the scientific.

The gold vessels present another case: For many years the accepted truth has been that the vessels were imported, while the handles with horse head terminals were added in Denmark. Hartmann has analyzed both vessels and handles or handle attachements in 13 cases (*Tabelle* 25 covering per. IV, while some of the vessels may be per. V or even III). Some vessels differ from their handles e.g. in the presence of Ni og Sb, but the differences are insignificant. In some cases the handles have the additional elements, in other cases the vessels have them. The Ag content is larger on some handles, but not consistently so. There does not seem to have been any intentional alloying of the wire or of the stiffer handles (cp. p. 27). This does not get us much further than previously. The analyses leave open the possibility of vessel and handles having been made in separate workshops, even though Hartmann rejects it.

The decoration of the gold vessels is so elaborate, that pairs may be separated, pairs which must have been intended to be used as such. The goblets Au 3727–28, the bottles Au 3619–20 are the most obvious pairs but Au 3613–14; Au 3617/18 and 3624; Au 4317–18; 3621–22; 3634/3968 and 3862/3967; 3626 and 3629, are equally good examples. The composition of elements varies from one cup to its partner, but radically so only in one case. Cup no Au 3622 from Avernakø is quite normal, but its twin Au 3621 is placed apart in *Tabelle* 25 because of its platinum content (p. 27f). The gold for this vessel must have had another provenance than any other gold vessel.

Even if we include the other European gold vessels the Danish group conforms well (apart from Au 3621). There is no great difference from Rillaton to Gönnebek except that the French vessels from Avanton and Painpour (Eluère 1982 fig. 182 a and 184) have a much lower Ag content that any other gold vessel.

The Mycenaean connection remains ambiguous, some of the gold vessels from Greece have much larger Ag content, while others are rather similar to the Central and North European ones. (*Tabelle* 30–34).

The Danish gold finds are treated chronologically according to the Montelian system. Period I and II are put together, which is natural because of the paucity of period I gold finds. Period II gold belongs to Hartmann's groups L, Q 1–2, and M (p. 23f). These groups correspond with the contemporary Central and West European gold, while Hartmann leaves the possibility open that the M-group moved from Scandinavia to the British Isles and even as far as Portugal. This rather intriguing proposal had deserved a closer archaeological scrutiny.

A number of finds deviate from this picture of normality by containing platinum or an unusually large content of silver. One of the Late-Neolithic "Noppenringe" belongs to this group (Au 4968). It is interesting that the very early fibula prototype from Buddinge (Au 3257) is one of the deviating finds which Hartmann (p. 24) compares with gold group A3 from the Danubian region. Here the analyses correspond well with the archaeological interpretations. The four objects with platinum do not have much in common. Apart from the object from Hagendrup (Au 4236) they appear perfectly normal. The Hagendrup object is unique, its use never determined, but the decoration is within the variation-spectre of Scandinavian decoration. Again a further archaeological scrutiny is now needed if Hartmann's suggestion of a connection with the Mediteranean, read Mycenaean, area is to be corroborated.

A few gold objects apparently had copper added, (Hartmann's group N). They belong to periods II and III, and Hartmann connects them with the Urnfield Culture Area in Central Europe (p. 25). One of the objects with more copper than usual is the famous Trundholm sun-chariot (Au 3596) which marks the apogee of Nordic artistic independance, albeit with a strong southern inspiration. Are we to take Hartmann's interpretation as indicating a late date of the sun-chariot to a period contemporary with the urnfields? Again a more detailed study of chronological and cultural interrelationships is needed (Randsborg 1968; Hawkes 1981). During period III gold M and L are less in evidence than groups Q1/Q2.

Hartmann has placed the arm torques of period III in a special list (*Tab.* 24) characterized mainly as group Q2, but I don't quite see the point in listing them separately. Hartmann interprets these rings as manufactured in certain workshops which did not have a access to the total range of gold otherwise used in periods II–III, but I am not entirely convinced.

In period IV groups Q1/Q2 and M disappear while group N with the added copper takes over (p. 26 ff.). This gold apparently had scrap bronze with tin added (diagr. 8, p. 27), a process apparently more extensively used in central than in northern Europe.

The gold vessels which comprise more than half of the analyses from period IV do not separate themselves from the other material, but are equally varied; they will be mentioned later in this review. Hartmann suggests that the gold came from several different areas.

The oathrings traditionally dated to periods IV–VI have been listed separately (*Tab.* 27, p. 29). This was done because archaeologists have not agreed upon their datings of these rings. Hartmann compares the whole group to period V-gold thus giving an independant dating frame to the oathrings. It is true that the oathrings have a narrower range than the period IV-gold, but it is also narrower than period V-gold (cp. diagram VII) and as the range of the oathrings is contained in both periods IV and V, their composition is not alone sufficient to allow this interpretation. The oathrings repeat the pattern from period III, where the torsioned armrings had a narrower spectre than the contemporary gold finds. The interpretation of the manufacturing in specialized workshops with a more limited access to gold than the average goldworking workshops given for the period III-rings is however not repeated for the oathrings.

As both ring groups are male accessories and must be interpreted as eminent prestigeobjects it could be suggested that special conditions ruled the access to gold. I have in mind that there may have been a special network used by the chiefs to obtain gold for precisely these objects.

Period V is characterized by the addition of more copper to the gold than previously (p. 28 f). This trend might be interpreted as an expression of a decline in the availability of good gold, adding more and more foreign material to the gold. It is therefore strange that the trend reverses in period VI (p. 29 f). It should be noted that it is not the Thraco-Cimmerian objects (Au 3597–3603) which affect the distribution (diagram 7). Hartmann compares the trend in Scandinavian period VI with the trend in Hallstatt D thus adding a new element to the international relations in the Late Bronze Age/Early Iron Age.

The period VI group – *Tabelle* 28 – is too large. It includes objects not belonging to this period. The group of wire rings with oar shaped, flat hammered ends makes 20 of the 41 analyses. There is little to go by, but what we have, points to an Early Bronze Age date. The Birchland fragment from Kent (Taylor 1980, 24, pl. 60) is given a Beaker date by reference to the Bennekom find from Holland (Au 2479 *Tabelle* 6) and is reminiscent of the basket shaped earrings too (Taylor 1980 pl. 3). Shorter and broader ends are found in the Armorican hoards of Kerivoa (Eluère 1982 132, fig. 194) (Au 2195 (photo reversed)) and St. Pere-en-Retz (Eluère fig. 145) with lunulae and copper axes – cp the Danish "lunulae" SAM 3 Au 1117 K& 1119 (Taylor 1980 pl 21–22) (The Søndersø rings have 4 Au numbers but Au 3737 and 3738 are not illustrated). I see no evidence for a LBA date and would prefer the early date. This does not amend the curious fact that the 20 analyses fall into two different groups, which Hartmann clearly points out in *Tabelle* 28. Au 3745 was found with Au 3742 and Au 3724 was found with Au 3737. In each case there is one ring from each composition group. This shows widely differing metal compositions used contemporarily and presumably even by the same goldsmith (cp. p. 146). If this is the case already in the earlier Bronze Age, the situation must have been pretty composite and confusing for us poor archaeologists. The four Søndersø analyses belong to the deviating group, but also exhibit internal differences e.g. regarding the presence of Sn and Bi.

The subtraction of the 20 rings from the per. VI spectrum (diagr. 7d) leaves it much more like the other LBA spectra (diagr. 7a–c). The 20 subtracted analyses on the other hand fit well into per. II (diagr. 6a).

The fragments Au 3899 were found in a grave, whose context is not beyond doubt, but with a likely per. V or VI-date. These ring fragments belong to a group with Au 3567, 3446, 3840, 3466, 3448 and in a slightly wider context the bands with constricted End Au 4112, 4078, 4351, 3449, 3445, 3447 and SAM 3 Au 1381–82. These rings are Per. II and in my opinion of Tumulus Culture origin or affinity. There are no significant deviations within this group, except Au 3899 which has a much higher Cu and Sn content plus Ni and Sp. The Sn content is only equalled in Au 3273 with platinum otherwise a comparison with per. V objects (*Tabelle* 26–27) seems quite reasonable.

This leaves a group of gold objects from the Råddenkjær bog area in Central Jutland described by Jørgen Jensen (1970): The button ended earrings Au3599–3602, the neck ring Au 3615, and the disc Au 3597 as well as the pin Au 3598 have been interpreted as Southeastern and would be expected to deviate from more western objects. They do not. Their composition resembles the Per V-objects, really a disappointment.

The solid armlets Au 3763–4, 3769, 3762, and 3770 are so simple that proper comparisons are none too easy. Au 3767 could however be compared with French LBA (Eluère fig. 173) Au 3769 with MBA (Eluère fig. 150, 153, 100) and with Au 2231, 2236, 2298, 2349–50 etc. pl. 22–23.

The 127 objects of *Tabelle* 29 are of very heterogeneous age. The grouping of finds of uncertain date with finds from the Iron Age is slightly curious. Most of the finds given an uncertain date are certainly Bronze Age, most likely per. II–III including most of the spiral wire rings. Several objects are closer datable. The important gold fingerrings from the Iron Age Langågraves (Albrectsen 1960, no. 57–58) have not been analysed. Three further analyses are found on page 150.

I have not been able to check all the finds of *Tab.* 29, but certain amendments may, however, be made: Au 3318–19 may be given a period I/II date (Aner & Kersten 1973 no. 451 I); Au 3372 was found with a period II dagger, Au 3503 was found with other objects in a container datable to period III; Au 3708 + 3710 were found with the oathring Au 3709 which looks period V to me; Au 4151 is dated to period III (Thrane 1967); Au 4237 belongs to a hoard from period III (Broholm 1943, M92; Aner & Kersten 1977 no. 2069); Au 4239–40 come from a period III hoard (Aner & Kersten 1977, no. 1745); Au 4310–11, 4320, 4323–25 come from period II graves (Aner & Kersten 1984, no. 3526, 3601, and 3389).

The ear rings Au 3572, 3574–76 pl. 98 still await dating, are they Iron Age? The fingerrings Au 3570–71 wouldn't surprise if they were found in Late Roman graves. – Au 4289 comes from an Early IA cemetery. – Au 4258 is of course Early IA.

The chronological distribution of the gold samples is rather uneven. Hartmann lists the analyses as shown in table 1. Also included in the table are the corrections suggested above. It is still open to further corrections.

Late Neolithic	I	II	III	IV	V	Oath-rings	VI	undated or Iron Age
3		75	208	113	50	52	31	127
+20	+2	+7	+6			+2	÷20	÷17
Nett:23	2	82	214	113	50	54	11	110

Table 1. The chronological distribution of gold samples by A. Hartmann (top) with the corrections suggested in the review.

It is interesting to look at the closed finds with several gold objects. There is no coherent pattern, some finds contain objects of very similar composition e.g. Au 3706–07, Au 3792–93, Au 3683 + 3701, Au 3795–98, Au 3909 + 3918, other finds have internal similarities, in that two objects are closely similar but do not compare well with the third or fourth from the same find (e.g. Au 3812–14, Au 3815 + 3817–19 + 3816 (oathring), Au 3847 + 3853 + 3854, Au 3849–51 + Au 3842, Au 3919 + 3921–24, Au 3641–43, Au 3786–88). Graves with two objects often contain completely different compositions or at least compositions with varying elements (e.g. Au 4062 + 4061, Au 3912 + 3915). Several explanations of this phenomenon are of course possible but a varied supply of gold is at least indicated. This could mean that gold was never available in large quantities or that gold was aquired gradually even by the individuals which owned the gold.

It is always tedious to list printers errors, but I include some which may bewilder readers and supplement them with additional information which does not pertain to be complete.

P. 150: Au 1117 Skohøjerup should be Skovs Højrup; Au 3575 is from Skydstrup, Århus A; Au 4085 is from Mjøls, Rise Sn; Au 4237 is from Espe Højlod; Au 3849–51 and 3842 are not from Bohøj but from a mound near Bohøj; Au 3847 and 3853–54 come from Lusehøj (Thrane 1984); Au 3731 is from Skåne which is not only a peninsula but a major province in Sweden; Au 3899 is part of an armring or armlet like Au 4112; Au 4055 is from the famous Skallerup grave (Aner & Kersten 1977 no. 1269). Au 3911 sits on a miniature sword and so does Au 3912, Au 3923–24 are double buttons. Au 3790 is from Kostræde and is only one of two similar rings, the other ring does not appear to have been analysed and Kostræde does not appear in the findregister. Au 4296 comes from Ballermosen (NM 2–3/56) but is given a wrong number and locality in the text (Lomborg 1956). It is datable to period II. Whether the analysis Au 4296 was made on this piece or on NM 3/36 from Illerisgård as stated is of course uncertain. Au 3727 on pl. 1 should be Au 3627 (Au 3727 is found on pl. 90) Au 3604, 3611, 3621–22 & 3624 come from Munkø, Au 4061–2 from Egehøj, Au 3974–6 from Tjæreborg, Au 4234 from Nørlyng, Au 4298 from Brøndsted, Au 3595 from Vester Nykirke, Au 3747 from Hvidbjerg Sn. Au 3747 from Toftehøj, Au 4368 from Brøndhøj, Au 3261 from Vester Lem Sn., Au 3528–9 from Haderslev Amt, Au 3575 from Skødstrup, Århus Amt acc. to the inv. no., Au 3925–6 from Aldershvile, Au 4289 from Tudvad. Au 4325 I presume to be NM inv no 11/56. There may be many others but they haven't been discovered.

I hope that the writer will agree with me that his book is more of a challenge than a final result to be accepted unreservedly. If I have pointed out some inconsistencies and drawbacks this does not mean that I don't find it a very useful book, but I would have been much happier with a volume integrating archaeology and science more closely.

Henrik Thrane

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Bronsåldersforskning – kring aktuella projekt. Edited by ÅKE HYENSTRAND. Arkæologiska rapporter och meddelanden från institutionen för arkeologi vid Stockholms universitet nr. 16. 1984.

Since 1977 Nordic Bronze Age researchers have gathered every second year to present and discuss their research. The reports from the three first meetings and a recent collection of articles from Sweden, serve as an interesting illustration of developments in Nordic Bronze Age research.

Participants in the first meeting were mainly older and established researchers. The problems delt with, however, reflected new trends in archaeology. Uno Saalo from Finland discussed the interpretation of the thousands of cairns along the Baltic coast. They were built during the same centuries as earthen round barrows in southern Scandinavia and their interpretation raises the old problem of central versus marginal areas. Henrik Thrane discussed economic and social structure on Fyn during the late Bronze Age based on the excavation of a chiefly barrow on South-West Fyn, situated in a center of rich depositions of bronze and gold. He sees the development of centers as relating to the distribution of bronze, a structure that collapsed by the end of the Bronze Age. Also Øystein Johansen discussed the question of middle man trade during the Bronze Age with reference to Southern Norway. Berta Stjernquist presented a critical review of recent hypotheses about Bronze Age social structure. She called for more in debt studies to support or reject the proposed chiefdom model. Also from Sweden Hille Janusson presented the important Hallunda settlement site and its ecological and economic framework. Two articles set themselves apart: Bo Gräslund in a quite original way discusses the two religious concepts of humation and inhumation, and Sverre Marstrander in a very extensive article presents all Norwegian Bronze Age stone axes with a complete catalogue and distribution maps. On the last pages he also discusses their social significance in terms of a proposed chiefdom organization.

During the second seminar on Fyn in 1980 the major theme was Bronze Age settlement and the contributions are more descriptive than in the previous volume. Again the seminar was dominated by more established researchers. Sverre Marstrander presented new finds of rock-carvings, Øystein Johansen a new late Bronze Age settlement site and its implication for the nature of Bronze Age subsistance. Egil Bakka discussed problems of representativity in the Bronze Age of Western Norway, taking up the old problem of how to define a Bronze Age economy in the more marginal areas of Scandinavia. From Sweden Berta Stjernquist and Märta Strömberg presented a local Bronze Age settlement system in their respective research areas, whereas Sten Tesch discribed new important evidence of Bronze Age house-structures, resembling those from Western Denmark. Also from Denmark important new excavations of Bronze Age settlement sites and solid house-plans dated from the early, middle and late Bronze Age were presented by N.A. Boas, Ebbe Lomborg and C.J. Becker. Finally J. Luoto discussed the Finnish settlements of the Bronze Age. The only theoretical article is one by J. Poulsen dealing with various simulation models of land-use and economy in the Bronze Age. But also Henrik Thrane discusses the relationship between settlement structure on South-West Fyn and social and economic organization. Compared with the first conference it is interesting to note that so little is said about economy or social organization. Naturally this also reflects the state of the art. The material is still very scare and therefore difficult to relate to general models.

The conference in 1982 in Lund was different from the two previous ones in two important ways. First a new generation of young Bronze Age researchers made their appearance and secondly, new important methodological approaches were presented.

N.D. Broadbent again took up a critical discussion of the nature of Bronze Age society, criticizing the application of the chiefdom model. By taking a marginal view of Nordic Bronze Age society from Northern Sweden he suggests that South Scandinavian Bronze Age researchers have put to much emphasis on Bronze, which is absent in the North. He also suggests that regional variation is far too great to allow the application of a generel model. One of the new approaches presented by Dan Carlsson was the application of human geography in order to explain the nature of landscape, territory and social organization. Related to this was Stig Welinders presentation of the ecology of a Bronze Age landscape in central Sweden. Also from Sweden Hans Lundmark and Thomas Larsson presented an important contribution to understanding the change from Bronze Age to Iron Age, by applying new interesting methods of spatial analysis. Berta Stjernquist and Märta Strömberg took up the settlement pattern in Southern Sweden during the Bronze Age, whereas both Sverre Marstrander and Hans Persson dealt with respectively Norwegian and South Swedish bronze axes, basicly in a descriptive way. It is probably quite typical that the 4 Danish contributions, by the reviewer, H. Thrane, J. Jensen, and J. Poulsen, all dealt with aspects of social and political organization based on an analysis of the rich Danish evidence of Bronze objects, whereas the Swedish and Norwegian contributions mainly were dealing with monuments and settlement sites. This reflects an important empirical and methodological disparity in Nordic Bronze Age research. Another new approach was finally presented by Elisabeth Herner, who had studied the technology of Bronze Age ornament style as reflected in the punching of stylistic design.

The last conference was held in 1984, again in Norway, and the report has not appeared yet. However, it was also characterized by new approaches and by many new researchers. This trend is also reflected in the recent Swedish collection of articles, edited by Åke Hyenstrand. They are dominated by discussions about the nature of settlements, cairns and other evidence of Bronze Age society. Most of the contributions are presentations of on-going research-programs and they testify the strength of the new generation of Bronze Age researchers in Sweden. The articles quite clearly demonstrate, once again, that our conception of the nature of Bronze Age society in Scandinavia has to be revised. I shall not refer all the individual articles. But it is characteristic that most of them deals with the total structure of the archaeological evidence within local areas. This gives important clues to regional and local variation that we have been badly missing in preceeding years.

As can be seen from this review, the four books give a quite good indication of the expanding scope of Nordic Bronze Age research. This follows after quite a long period with little innovation where research was dominated by a rather small group of established Bronze Age specialists, mainly dealing with classifying burials and bronze objects. In many ways this seems to reflect a general condition of European Bronze Age research, which throughout the fifties, sixties and seventies has been based on an established group of researchers, working within a rather traditional framework. A few innovators have turned up during the 1970'es, but they are still a minority group.

The new trend in Scandinavian Bronze Age research is rather parallelled in England (BAR no. 83). Hopefully we will see a more massive break-through of new approaches and ideas within European Bronze Age research in years to come.

Kristian Kristiansen

HANS NORTMANN: *Die vörromische Eisenzeit zwischen unterer Weser und Ems.* Ammerlandstudien I. Romisch-Germanische Forschungen Band 41. 211 pp., 31 figs., 85 plates with 1644 figures. Verlag Philipp v. Zabern, Mainz am Rhein, 1983.

In 1966 a major archaeological and historical research programme commenced in north-western Niedersachsen. In a broad-based endeavour to clarify the development of settlement in Kreis Ammerland from the pre-Roman Iron Age to present times a long series of major excavations of widely varying sites was undertaken in the years 1966–73. The present work, which deals with the finds from the pre-Roman Iron Age, is the first volume in a series of monographs in which the results of this project are being published.

Kr. Ammerland lies north-west of Oldenburg in the *geest* area between the lower Weser and the Ems, covering an area of 700 sq.km. In comparison with the mass of material which the excavations in this area produced, the amount which can be dated to the pre-Roman Iron Age is very limited. No new grave-finds, no houses, but just 25 features, mostly largish pits, on six different sites. But the volume of material must be viewed in the light of the fact that settlement finds from this period were previously virtually unknown, a situation also inhering over the rest of the *geest* in western Niedersachsen.

Hans Nortmann places the finds from Kr. Ammerland in a broader context in this book by taking up the whole pre-Roman material, both settlement- and grave-finds, from the majority of the *geest* area between the lower Weser and the Ems for original treatment and publication. The new settlement finds from Kr. Ammerland have a key place in this context, as a chronological framework for the whole area included is based upon an analysis of the pottery from here. The central material comprises the finds from 13 of the richest and best-documented pits, most of which are from the major excavations at Gristede. Taking into consideration the sandy natural soil, in which no cutting can stand open for long before erosion and collapse happens, it is certainly right to consider, as the author does, the features dealt with as closed find-contexts. Through a simple seriation, based on the presence or absence of various leading types, these find-contexts are divided into 5 chronological phases. From phase 1, which is chronologically placed through typological affinity to grave-inventories of the early Iron Age corresponding to Montelius' period VI and Schwante's Wessenstedt phase, the series runs upto an early stage of the late pre-Roman Iron Age, with phase 5 scarcely later than Hachmann's *frühe Mittelphase*. The latest part of the pre-Roman Iron Age is not dealt with in this discussion, but will be taken up in connection with the publication of finds from the early Roman Period in volume II of the series.

The author's emphasis of the significance of a chronology built upon local material is obviously correct, and although the background material for the pottery analysis is not particularly comprehensive, the results certainly look like a convincing step in the right direction.

In the publication of the pre-Roman material from the *geest* between the lower Weser and the Ems the book follows a traditional pattern in going through the individual artefact-types, first the pottery, then the metalobjects, with a description of formal variation, distribution, and a discussion of the type's chronological position. It is no surprise that this study shows that the particular area under study, apart from particular local forms, also shows a considerable series of features in common with the Weser-Aller area and the Jastorf group in north-eastern Niedersachsen. Amongst the pottery for instance, the important jar-forms of the Dötlingen and Gristede types from phases 1 and 2 respectively are closely linked in this way to the Nienburg jars in the Weser-aller area, and the general development of the pottery also shows features repeated within the Jastorf area. Amongst the metalwork, the belt-hooks and various pinforms also show a close association with the Jastorf area. With the appearance of fibulae of early La-Tène form and contemporary neck- and arm-rings made in Celtic style, features appear which at this time are not known in Jastorf contexts, but which together with similar finds in the Weser-Aller area show an early connection with the Celtic world. The marked concentration of imported metal vessels of the late Hallstatt/early La-Tene, such as situlae of Rhine/Tessin type and *ciste a cordoni*, along the lower Weser underlines the importance of the Weser area as a major communication route from south to north.

Besides the discussion of the finds, a survey of the burial practice in the research area takes an important place in Nortmann's work. After a characterisation of grave-forms in the early Iron Age, Montelius' period VI, the pre-Roman graves are described in detail. While cremations, placed secondarily in barrows, were dominant in the early Iron Age, this burial form is abandoned entirely in the transition to the pre-Roman Iron Age; primary barrows are raised instead over the funeral pyre itself. When, occasionally, charred remains of grave goods are found they are often buried in a pit below the barrow. The graves are found in larger or smaller groups and sometimes occur in barrow cemeteries which also include earlier barrows of the early Iron Age. Although the majority of the dated graves produce finds of an advanced stage in the pre-Roman Iron Age, there is, according to Nortmann, little doubt that the marked shift in burial practice happens at the transition from the early Iron Age to the early pre-Roman Iron Age. The new grave types, which are still in use in the beginning of the late pre-Roman Iron Age before being replaced by cremation pits under the normal ground surface, are derived from the ring-grave area, where the closest parallels are found in north-eastern Holland. The author associates this western connection with the appearance within the Zeijner culture of Ruinen wommels I pottery, which is closely connected with jars of the Gristede type in western Niedersachsen and Nienburg jars in the Weser-Aller area.

A score of relatively richly-furnished graves take a special place amongst the pre-Roman finds, all including nails, ring-bolts or other iron artefacts which the author believes could only have been used in connection with wagons. This interpretation is supported by the finding of a linchpin together with a number of nails in a grave from Pestruper Heide, Kr. Oldenburg. Linchpins of identical make are known from Celtic areas, and were used to keep the hub of the wheel in place. Because of the fragmentary condition of the finds, the author refrains from commenting on the construction of these vehicles, which could equally well have been two- or four-wheeled. Nortmann's argument that consideration of the other contents of these graves makes it probable that they are women's graves is however important. The evidence is the occurence of belt-hooks, neck-rings and other jewellery in a number of the graves. Since osteological analyses were not used to corroborate this interpretation the possibility must remain open that some of the less expensively furnished graves were men's burials. This applies to those finds which apart from nails, ring-bolts etc., only contain pottery or pins. The wagon graves are dated to the second half of the earlier, and the beginning of the later pre-

Roman Iron Age, and stand quite alone amongst the north-west German material; no particular connection with the Celtic or the north-German/Danish wagon burials is evident.

Through his thorough publication and treatment of the pre-Roman finds from the *geest* between the lower Weser and the Ems, Hans Nortmann has taken research into the pre-Roman Iron Age of north-western Germany a good step forward. As the author himself indicates, the frequently very scanty source-material has set limits on which topics could profitably be pursued. However within these limits the book stands as a solid example of what is best in the German research-tradition. The most comprehensive catalogue with corresponding plates with drawings of all the important finds which have not previously been published also contributes to making the book especially useful. [Translated by John Hines]

Jens-Henrik Bech

JOHN HINES: *The Scandinavian Character of Anglian England in the pre-Viking Period.* – BAR, British Series No. 124, 1984.

The period we are dealing with is the 400 years from the withdrawal of the last Roman legion from England in 406 A.D. to the first Norse Viking attacks on Dorset and Lindisfarne in 787 A.D. and 793 A.D., respectively. During these four centuries England was drastically changed as to the ethnic composition of its population and the political and religious structure of its society. During the 5th century A.D. Angles, Saxons, and Jutes, and possibly also other tribes of continental origin, invade the English south and east coasts and establish themselves in minor kingdoms. Their internal strifes do not calm down until the 8th cent. When Offa of Mercia (757–796) is the first king who can rightly use the title of *Rex totius Anglorum Patriae*. At the same time the Christian mission is so much intensified that during the 7th century the Anglo-Saxon landholds are incorporated into the universal organisation of the Roman Catholic Church. The written and material sources from this period supply and verify each other, and the archaeological finds have also generally confirmed what Beda said in 730 concerning the tribes involved and their areas of settlement on the continent and in England.

All this forms the basis of the present studies, which are introduced by a summary but instructive presentation of the literature from Tacitus to the present, which has light on the history of these four centuries. However, the theme of the book is not the Anglo-Saxon invasion and settlement in England, but the evidence – especially found in the area settled by Angles – of close and early contacts with the Norse or Scandinavian peoples whence the Vikings' devastation and conquests later originated. Thus the title of the book calls these four eventful centuries "the pre-Viking Period".

More than two-thirds of the present work deal with detailed studies of types of artefacts connecting Scandinavia (including Jutland and the Danish islands) with Anglian England during the 5th and 6th centuries. The artefacts include: clasps mainly used in the female dress for gathering a slit sleeve round the wrist, bracteates, shield-shaped pendants, and various types of fibulae: square-headed-, cruciform-, anglian equal-armed-, and annular brooches. Shetelig, Åberg, Leeds, and not least Vierck have earlier dealt with these types and the English-Scandinavian relations they reflect, but Hines' presentation of the material is much more comprehensive, and his analyses and interpretations are of much greater insight than were those of his predecessors. The big find categories, clasps and square-headed brooches are classified according to new principles that seem to facilitate an unambiguous and essential characterization of each separate find. The classification of the rest of the material also includes many critical and independent observations, which lend credence to the comprehensive survey of the distribution of the types.

The studies do not lead to any single, simple, and comprehensive explanation to the parallel phenomena, and no historical sources tell us how to interpretate the material. During the last quarter of the 5th. century wrist-clasps, equal-armed brooches, and certain shield-shaped pendants are introduced into the Anglian area. The closest parallels are found concentrated in western Norway, but as the clasps are part of a female dress that did not exist in England, this phenomenon is best explained as a result of a migration from these coastal regions in Norway to England. It may have been a limited migration, but if so, it must have been a migration of influential people, for the fashion soon spreads all over the Anglian area. Other types in common can best be explained as articles of export from south-east Norway and Denmark, recalling the spread of Scandinavian jewellery on the continent that takes place at the same time. In some instances the Scandinavian influence in the Anglian area seems to have come via Kent, but in other cases Anglian England must be regarded as a station en route for the spreading of Scandinavian types to Kent as well as the continent. Furthermore, finds in Norway and Denmark give evidence of an influence in the opposite direction, i.e. from England to Scandinavia. So during the 5th and 6th centuries the North Sea must have been intersected by numerous lines of communication along which goods, craftsmen, and sometimes whole tribes travelled from shore to shore.

The two next centuries are disposed of in only one chapter. This is probably justifiable, for the relevant source material is quite limited, but it may also reflect certain limitations in the author's interests and his knowledge of the material. But that is only human. Among the sparse evidence of continued Anglo-Scandinavian relations during the 7th and 8th centuries the Sutton Hoo find looms large. However, it is no longer maintained that it reflects direct contact between royal families in East Anglia and Uppland, as recent research has raised doubts as to the Scandinavian origin of several of the artefacts. Likewise the boat-grave may equally well have been inspired by Norwegian as central-Swedish burial customs, but the very close correspondance to Scandinavian material still carries a lot of weight. The English style II-ornamentation so copiously represented at Sutton Hoo, undoubtedly has its roots in Scandinavian ornamental art. Furthermore, it is noticable that this influence even leaves its mark on Anglo-Irish illumination. What is even more important, and which the author does not mention, is that the Anglo-Irish clerical art with its peculiar mixture of Celtic, Oriental, and Germanic elements of style has clearly influenced the stylistic development in Scandinavia from the beginning of the 7th century and throughout the 8th century.

The poems Beowulf and Widsith, whose subjects derive from Scandinavia, and partly from the period before the Anglian invasion of England, also bear witness to the cultural relations between Scandinavia and England. Hines gives a thorough account of their contents and deals with the problems concerning their interpretation and dating. The very wide span of years for their dating, the end of the 7th century to the beginning of the 9th century, is, however, only given with reserve.

The thesis of the book is that close and manifold relations have existed between Anglian England and Scandinavia prior to the Viking Age, and the thesis seems to be fully documented. Close-reading Alucuin's letter to King Ethelred of Northumbria, which reflects the writer's immediate reaction to the Lindisfarne disaster, Hines is able to show that the attackers were by no means unknown to Alcuin and his contemporaries – it was their changed and violent behaviour that shocked them. What actually happened in 787 and 793 can be put quite succinctly, "What was new was that the Scandinavians were no longer traders but raiders." [Translated by Ul S. Jørgensen]

Mogens Ørsnes

Kolloquien zur allgemeinen und Vergleichenden Archäologie (AVA-Kolloquien) and *Materialien zur Allgemeinen und Vergleichenden Archäologie (AVA-Materialien)*. Edited by H. MÜLLER-KARPE, Kommission für Allgemeine und Vergleichende Archäologie des Deutschen Archäologischen Instituts, Bonn. München (C.H. Bech). 1981–.

On the occasion of the 150th anniversary of the *Deutsches Archäologisches Institut* in 1979 a new section of the Institute was created: The *Kommission für Allgemeine und Vergleichende Archäologie* under the direction of H. Müller-Karpe. The first volume of the *AVA-Kolloquien, Allgemeine und Vergleichende Archäologie als Forschungsgegenstand* (1981), presents summaries of papers by students and scholars from 15 German universities and by professor Müller-Karpe himself, given at an initial conference in 1981. This volume contains the manifesto of the commission which calls for documentation and systematization of archaeological sources within seven main disciplines: settlement archaeology, the archaeology of economy, trade, and crafts (*Wirtschaftsarchäologie*), the archaeology of art, social archaeology, the archaeology of religion, chronological archaeology, and the archaeology of cultural contacts.

This is perhaps the most capacious research programme ever presented in the world of archaeology, and indeed the following 20 works published by the commission show the diversity of research sponsored by it. That the programme is set out by Müller-Karpe is only a logical consequence of the impressive work he has done over the last 20 years in order to gather and summarize archaeological sources on a global basis (e.g. *Handbuch der Vorgeschichte* I–IV, 1966–1980. – *Prähistorische Bronzefunde*, 132 vols. and being continued. 1969–.). Müller-Karpe has become the German archaeologist most devoted to the universality of the German Archaeological Institute already adopted at its foundation in 1829. From the very beginning the Institute established satelite institutes in those parts of the Mediterranean and the Near East where research was being done in the archaeology of the Ancient World. The new commission has been given the task to support studies primarily in those fields that are not within the scope of the regional branches of the Institute.

The two series under review are complementary in the sense that while the *AVA-Materialien* deal with very dispersed themes, the *AVA-Kolloquien* contain contributions to general issues. Besides the introductory volume of the *Kolloquien* mentioned above, the following titles have appeared: 2. *Zur geschichtlichen Bedeutung der frühen Seefahrt* (1982). – 3. *Archäologie und Geschichtsbewusstsein* (1982). – 4. *Zur frühen Mensch – Tier – Symbiose* (1983).

From the first volumes of the *AVA-Materialien* we list the following: 1. H. Müller-Karpe: *Neolithische Siedlungen der Yangshao-Kultur in Nordchina* (1982). – 2. T.O. Höllmann: *Neolithische Gräber der Dawenkou-Kultur in Ostchina* (1983). – 3. R. Kenk: *Früh- und hochmittelalterliche Gräber von Kudyrg im Altai*. – 4. R. Kenk: *Frühmittelalterliche Gräber aus West-Tuva* (nos. 3 and 4 in one volume, 1982). – 5. G. Hecker & W. Hecker: *Pacatnamú. Vorspanische Stadt in Nordperu* (1982). – 6. E.F. Mayer: *Chanchán. Vorspanische Stadt in Nordperu* (1982). – 7. P. Kaulicke: *Gräber von Ancón, Peru* (1983). – 8. O Rönneseth: *Gräber im nordwestlichen Tibesti (Tschad)* (1982). – 9. P. Yule: *Lothal. Stadt der Harappa-Kultur in Nordwestindien* (1982). – 10. H. Müller-Karpe: *Neolithische Siedlungen der Džejtun-Kultur in Süd-Turkmenistan* (1982). – 13. H. Todorova: *Kupferzeitliche Siedlungen in Nordostbulgarien* (1982). – 14. P. Yule: *Tepe Hissar. Neolithische und kupferzeitliche Siedlung in Nordostiran* (1982). – 15. J. Říhovský: *Lovčičky. Jungbronzezeitliche Siedlung in Mähren* (1982). – 18. G. Kutscher: *Nordperuanische Gefässmalereien des Moche-Stils* (1983). – 19. G. Fussman: *Surkh Kotal. Tempel der Kuschan-Zeit in Baktrien* (1983). – 20. H. Müller-Karpe: *Jungbronzezeitlich-früheisenzeitliche Gräberfelder der Swat-Kultur in Nord-Pakistan* (1983). – 21. M. Dohrn-Ihmig: *Neolithische Siedlungen der Rössener Kultur in der Niederrheinischen Bucht* (1983).

Ten out of these eighteen works are source-collections in that they gather information from published or unpublished, written sources about major find complexes or monuments of central importance (nos. 1–4, 6, 7, 9, 10, 14, 20). In three of the volumes Müller-Karpe has collected documentary evidence about sites in Central Asia and China. Other volumes (nos. 13, 14, 15, 21) are single monographic publications of recently excavated sites or new surveys of related sites and materials.

In contrast to other German publications, like e.g. those of the *Römisch-Germanische Kommission*, the new series of *AVA-Kolloquien* and *-Materialien* look modest and are all in octavo, mostly in soft binding. The quality of printing, however, is blameless, although some of the illustrations tend to be rather uniform and schematic, being in the style known from other publications by Müller-Karpe. This technique is possibly the most rational way to cope with a vast material. In most of the volumes the graphic and photographic presentation is of a standard that proves that even high quality archaeological reports can be produced at a moderate cost.

Also published by the *Kommission für Allgemeine und Vergleichende Archäologie* are the *Beiträge zur allgemeinen und Vergleichenden Archäologie* and the *Forschungen zur Allgemeinen und Vergleichenden Archäologie* (both by C.H. Beck, München).

P.O. Nielsen

Geofyzika a Archeologie – Geophysics and Archeology. 4th meeting of geophysicists and archeologists in Liblice, Czechoslovakia, 1–4. November 1982. Ed. by E. Pleslova-Stikova. Interni tisk n.p. Geofyzika Brno a Archeologickeho ustavn CSAV Praha. Praha 1983.

This volume is a result of a four days symposium in Liblice, in November 1982, where about 50 archeologists and 15 geophysicists, geologists and engineers participated to report on the progress in the application on geophysical methods in archeology in Czechoslovakia. In addition, a few of the papers deal with investigations in Egypt and with reviews of methods and results from Poland, GRD (East Germany) and Austria.

For one not familiar with Czechoslovakian language it is very difficult to extract useful informations from this book as from the about 30 scientific papers presented, 27 are given in Czechoslovakian, the remaining three in German, English and Polish.

For all the papers a few lines of introduction, short figure captions and in many cases not very informative summaries are given in English. As the reviewer, like probably most of the readers of this journal, cannot understand Czechoslovakian, this review is based only on summaries and the figures presented, which of course does not give justice to the papers scientific value and standard.

The volume is organized in three sections. The first section, and by far the largest, deals with geophysical methodology, prospection and archeological verification during the years 1979 to 1982 in Bohemia (110 pages), Moravia (30 pages), Slovakia (15 pages), and Egypt, GRD, and Poland (30 pages). The second section consists of one paper about archeomagnetic dating (21 pages) and the third section gives summaries on experiences with air photography and remote sensing in Czechoslovakia and Austria (12 pages).

From the geophysical prospecting methods used, magnetometry was by far the most popular one, with resistivity methods on second place and thermal, electromagnetic, gravimetric, and seismic methods therafter, about in that order. Most spectacular appeared to be magnetic results from Bohemia presented by F. Marek and E. Pleslova-Stikova. Detailed on 1 × 1 m grid based magnetometer readings revealed double ditch circular structures of prehistoric age at Lochenice and Bylany with diameters of 70 and 100 m respectively. In addition long linear magnetic and further isomagnetic features could be identified. On another side, Makotrasy, a large square enclosure, ca. 1200 m long, of the Funnel Beaker culture, was magnetically outlined and a multitude of smaller anomalies related to individual settlement objects have been indicated. At the site Mzecke Zehrovice, Central Bohemia, a well known Celtic sanctuary and La Tène settlement, magnetic anomalies are related to metallurgical waste, hearths, hut structures, ditches etc. In all, 20 ha area has thus been surveyed in detail in Bohemia during the last couple of years. Similar magnetic prospection was reported from Moravia (V. Hasek *et al.*) and Slovakia where the method was also applied to outline fortifications of the Middle Ages.

The other geophysical methods mostly serve as supplementary tools, as integrated geophysical studies can greatly improve interpretation: Almost all archeological structures and objects exhibit magnetic anomalies, but not every magnetite anomaly is necessarily related to archeology. There may be geological "noise" or metallic objects from recent times.

A few cases are reported on the application of resistivity method for outlining subsurface masonry at sites from the Middle Ages, in churches, as well as in Egypt (Memphis). Elektromagnetic prospection, potentially much faster than resistivity surveys, was reported only once as a test for the application of an equipment operating in the 100 MHz frequency range. Although the survey apparently was successful, from the summary alone it is impossible to gain a clear picture of the method and the results.

Two reports on thermic measurements in churches are also presented and are of special interest as such surveys are relatively scarce and results may be useful in planning of remote sensing surveys. Using instruments that measure infrared radiation, temperature differences of up to a few degrees have been found. To enhance temperature gradients, the time of measurements is important due to variable heat capacity and conductivity in the underground. Tests therefore have been conducted under non equilibrium conditions, when strong frosts began to set in.

A thorough analysis of archeomagnetic dating investigations using the method of Thellier to determine paleointensities was reported by O. Orlicky and J. Tirpak. Ages from 5000 B.C. to 900 A.D. have been found. The accuracy of the method has been improved greatly during the last decade due to modification in the techniques and development of standard curves, and we can expect from this method important results in the future, particularly when combined with inclination and evt. declination records.

In summary, this volume presents an overview of the geophysical methods presently applied in Czechoslovakia, with the results obtained from 1979 to 1982. The heterogenity of the papers, demonstrated by the highly variable value of the English summaries indicates, that almost no editorial effort has been spent in producing this volume. In conclusion, it is advisable to consult a dictionary on Czechoslovakian language to retrieve the information about geophysical prospection of the important sites presented.

G. Schoenharting

Recent Excavations and Discoveries

Please observe the following abbreviations:
s. *sogn*, Danish parish
h. *herred*, Danish district
a. *amt*, Danish county
All places mentioned in this list can be located on the map p. 223 and identified by their no.

PALAEOLITHIC

1. JELS, South Jutland. Oksenvad s., Haderslev a.
Late-glacial settlement site. In the autumn of 1983 towards the end of the investigation of Jels 1 – the first settlement site of the Hamburgian Culture recorded in Denmark (cp. *JDA* vol. 2 pp. 7–11) – systematic reconnaissance excavations revealed another Hamburgian settlement site only 30 m from the first one. During the summer of 1984 *Haderslev Museum* thoroughly excavated this new site, Jels 2. The excavation covered 225 m^2 and yielded a rich material: approx. 135 arrow-heads (all of the Halvete type), 150 scrapers (some with and some without longitudinal edge-retouch), 120 burins (predominantly dihedral burins on a retouch), 175 Zinkens (both single- and double-Zinkens), 14 perforators, and 19 combination tools. Furthermore, there were approx. 90 broken Zinken-points. So Jels 2 is not only much richer than Jels 1, it is in fact the largest Hamburgian settlement site found so far as regards area as well as tool-frequency. Furthermore, the excavation showed that this site as well as Jels 1 is ploughed up, and that the relatively few artefacts found below the top soil have been buried by various kinds of bioturbation (uprooted trees, animal activities, etc.). These disturbances also explain the total absence of man-made structures. The presence of a fireplace is, however, indirectly revealed by pieces of burned flint. Judging by types and technique Jels 2 must be roughly contemporaneous with Jels 1 and should consequently be allocated to the Havelte Group. – *Haderslev Museum* 1610. [Jørgen Holm]

MESOLITHIC

2. SPARREGÅRD, Falster. Brarup s., Maribo a.
Settlement site. In September 1984 a rescue excavation of an Ertebølle kitchen-midden was carried out at Sparregård in North-western Falster. There were remains of common mussel, cockle, common European periwinkle, whelk, and oyster. This is the southernmost record of oyster on an Ertebølle site. Besides flint tools there was a large number of animal bones and several bone tools, whereamong fragments of a flat bone ring of the west-Danish type. Furthermore, large quantities of pottery were gathered, which, along with the flint material, date the settlement site to the middle and latest Ertebølle period. – *Nationalmuseet*, Prehist. Dept. 1121/75. [Peter Vang Petersen]

3. MAGLEBY NOR, Langeland. Magleby s., Svendborg a.
Settlement site. On a former islet in the reclaimed Magleby inlet a small early Maglemose settlement site was excavated in 1984. Near the northern bank of the islet two concentrations (hut-sites?) were unearthed. They contained flint waste and a few bone fragments and bone tools. Further faunal remains were found in waste layers off the islet, which was here covered by sediments from the Atlantic transgression. The predominence of microliths suggests that this is a small, highly specialized, seasonal site. – *Langelands museum* 11372. [J. Skaarup]

4. STENBROGÅRD, Central Jutland. Kobberup s., Viborg a.
Settlement site. In 1984 on a sandy headland near Tastum Lake south of Skive a Maglemose settlement was investigated. The settlement consisted of only a small area with various kinds of flint artefacts and waste flint. The find can be dated to the middle of the Boreal Period. – *Skive museum*, 290A. [Agner Nordby Jensen]

NEOLITHIC

5. TIBIRKE, North-east Zealand, Tibirke s., Frederiksborg a.
Wooden trackway. These remains, which were partly overlayered by an Iron Age road, were originally excavated by G. Kunwald in 1946. Two of the hazel posts from this excavation have recently been C-14 dated to 2300 ± 85 and 2150 ± 85 bc (C-14 years), so the road dates back to the transition period between the Funnel-Beaker and the Single-Grave Cultures. In 1946 78 wood samples were taken, and the analysis shows that 70 (i.e. 90 %) are hazel, the remainder being oak, birch, and willow. Hazel preserves very poorly, and this fact as well as the small diameter of the posts – less than 10 cm – show that they cannot have supported a bridge, but must have been hammered down to support a road built on soft ground. – *Nationalmuseet*, Dept. of Natural Science and 1st. Dept. 3361/80. – Lit. *Fra Nationalmuseets Arbejdsmark* 1944 p. 79ff. – *Skalk* 1984: 4. [C. Malmros]

6. LEJRE, Zealand, Allerslev s., København a.
The site of a passage grave. Prompted by the discovery of 25

polished axes by an amateur archaeologist the museum effected a rescue excavation of a ploughed-down passage grave site in Hulegårds-Marken at Lejre. The passage grave, which turned out to be a double grave, has been located on the crest of a pronounced elevation of the ground. The floor layer yielded many artefacts including transverse arrowheads, blades, polished axes and chisels, tanged arrowheads, amber pendants, and pottery. The artefacts could generally be dated to MN V. The sacrificial layers outside the entrances were not preserved. – *Roskilde museum*, 611/84. [Tom Christensen]

6 a. THE SEA OFF BORNHOLM.
Single find. An Early Neolithic lugged vessel found in a fisherman's net was delivered to *Bornholms Museum* in 1984. It was dredged from the bottom of the Baltic Sea 6–7 nautic miles WNW of Hammeren. The vessel is 20.8 cm tall, has a short, cylindrical neck and a spherical belly with a flattened base (fig. 1). Greatest diam. 17.1 cm. Five horizontally pierced lugs are placed just below the greatest width. It is the third vessel of this type found in the waters near Bornholm (cf. S. Nielsen: Et nyt fund af en øskenkrukke fra havet ved Bornholm. *Bornholmske Samlinger* 1975: 79–84). – Deposited at *Bornholms Museum*, Rønne. – *Nationalmuseet*, Prehist. Dept. A51090.

7. KLINTEHØJ, Lolland. Birket s., Maribo a.
Settlement site. In the Lolland-Falster area only few Neolithic settlement sites have been investigated. In this area the period is mostly represented by graves – especially the large number of megalith graves – and by single finds. In the autumn of 1984 a trial excavation was carried out near the cost at the foot of an escarpment facing south, on the outskirts of an extensive area of meadowlands. A culture layer appeared, the contents of which dated it to the Middle Neolithic Funnel-Beaker Culture – *Lolland-Falsters Stiftsmuseum*, Maribo, 800–1984–36. [Karen Løkkegaard-Poulsen]

8. SARUP, Funen. Hårby s., Odense a.
Causewayed enclosure. At Sarup in south-west Funen parts of the fortified systems from the Fuchsberg- and the MN-phases respectively, were investigated. The investigation, which mainly dealt with sections that had not previously been excavated, showed that the ditches of both fortified systems had been dug up during the Neolithic period – in the case of the latest system as many as four times within the same period. Dug-up ditches have been recorded in similar fortified systems elsewhere. – *Forhistorisk Museum*, Moesgård, and *Fyns Stiftsmuseum*, Odense. – Lit.: *Kuml* 1973–74, and 1980. *Archäologisches Korrespondentzblatt 5, 1975.* [Niels Andersen]

9. DAMSBO, Funen, Jordløse s., Svendborg a.
Megalithic grave. In September 1984 a ploughed-down megalithic grave was investigated. The grave has consisted of a broad chamber encased in a clay mantle, surrounded by a 2 m wide circular ditch filled with stones. The circular ditch contained Fuchsberg pottery. On the bottom of the chamber were more than 300 artefacts (a.o. a richly ornamented miniature battle axe) and a large heap of bones. – *Forhistorisk Museum*, Moesgård, and *Fyns Stiftsmuseum*, Odense. [Niels Andersen]

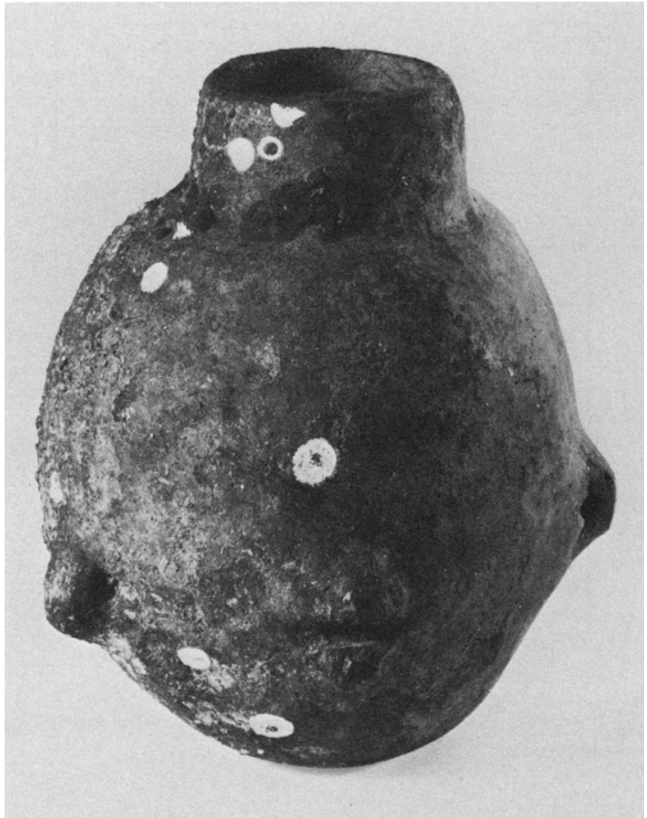


Fig. 1. Early Neolithic lugged vessel dredged from the bottom of the Baltic off Bornholm (No. 6a) (L. Larsen photo, the National Museum). Height: 20.8 cm.

10. MORUP MØLLE, North-west Jutland, Bedsted s., Thisted a.
Graves. In an escarpment facing north-west and sloping down towards the meadows along Hvidbjerg Å (river) four Early Neolithic inhumation graves have been investigated. All the graves were NNW-SSE aligned and lay in a 12 m long row at intervals of 40–50 cm (fig. 2). In the section of the escarpment containing the graves the elevation of the ground dropped 1 m from the southernmost to the northernmost of the graves.

Flint waste and a few potsherds from EN C show that the graves have been laid out on a former settlement site. The excavation yielded no indications that the graves had been covered by a long barrow or any other structures that would have made them conspicuous. The graves had only been dug 20–40 cm into the underground.

It should be noted that the size of the graves diminished from the biggest grave at the top of the escarpment (grave 1) to the smallest grave furthest to the north and almost at the bottom of the escarpment (grave 4). The distribution of the grave goods was also in accordance with their respective sizes:

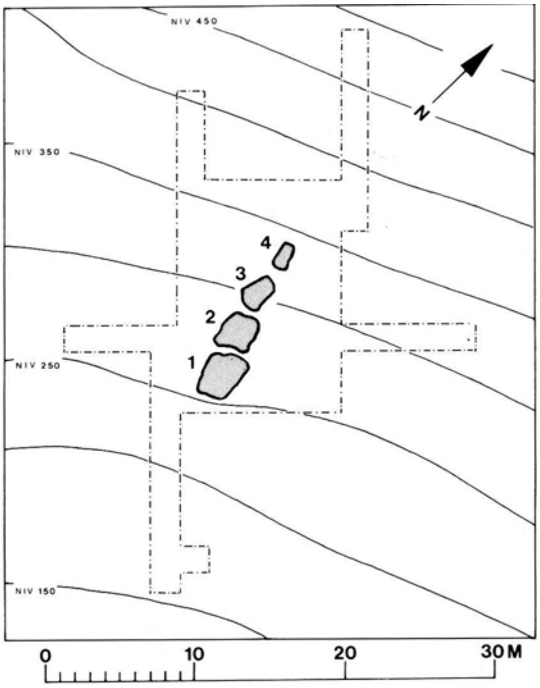


Fig. 2. Four graves from the Early Neolithic at Morup Møllle, North-West Jutland (No. 10).

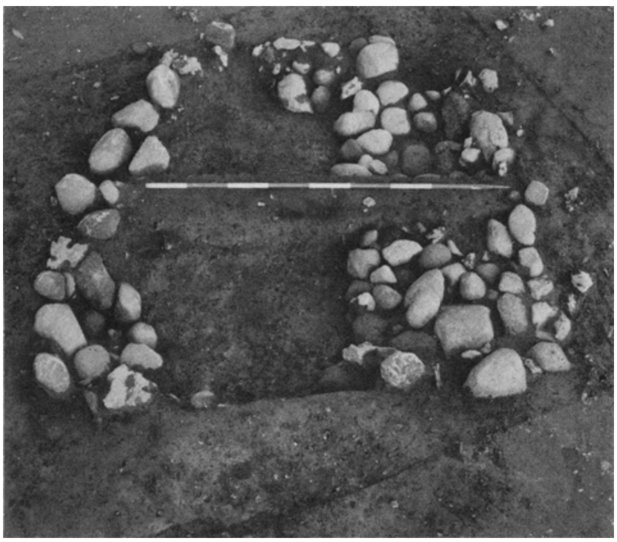


Fig. 3. Morup Mølle (No. 10). Grave 2 seen from the south (J.-H. Bech photo).

there were numerous amber pendants in graves 1 and 2, only two in grave 3, and grave 4 contained no grave goods at all.

Among the pendants in grave 1 several were oblong, had a clearly marked waist, and no perforation. This type of pendant is known from Early Neolithic graves and sacrificial finds. This dating of grave 1 clearly goes for the other graves as well due to the uniform nature of the find.

Grave 1 was 3.5 m long and up to 2.75 m wide, and was filled with head-sized stones. Most of the stones lay directly on top of the grave and have presumably covered a wooden coffin. Below the stone layer at the south-end of the grave were approx. 170 amber pendants.

Grave 2 was 2.5 m long and up to 2.4 m wide and had slightly diverging sides so that the grave had a lay-out shaped like a trapeze, which also seemed to be the case with the other graves. As appears from fig. 3, apart from the stone lining along the sides of the grave there is also a row of tightly packed stones along the eastern longitudinal side. These stones must have flanked a narrow wooden coffin placed in the central area of the grave with no stones. A string of amber pendants taken from the southern part of the grave as a sample has so far not been further analysed.

Grave 3 was 2.7 m long and 1.9 m wide, and along its edges was a stone lining consisting of hand- to head-sized stones. At the middle of the grave and in its northern section were three large stones. The only grave goods were two amber pendants found in the southernmost end of the grave.

Grave 4 was the smallest one, measuring only 2.05 × 0.95. It had been equipped with a single row of hand- to head-sized stones along its edges, most of which had been removed by ploughing during the course of time. There were no grave goods. – *Museet for Thy og Vester Hanherred*, Thisted, 1961. [Jens-Henrik Bech]

11. KJØLVEJEN, Randers. Hornbæk s., Viborg a.
The site of a passage grave. Ploughed-down mound with traces of a megalithic chamber measuring approx. 13 × 5 m and ENE-WSW aligned. Along the south side of the mound was found pottery from the Middle Neolithic period Ib. The fill also contained settlement pottery from the Middle Neolithic period, and below the mound traces of ard-ploughing were recorded. – *Kulturhistorisk Museum*, Randers 332/82. [Bjarne H. Nielsen]

BRONZE AGE

12. GUNDSØGÅRD, Zealand. Gundsømagle s., København a.
Settlement site. The museum has investigated parts of a settlement site from the Late Bronze Age periods IV and V. The remains of four long-houses were found along with a large number of pits containing pottery. – *Roskilde Museum*, 572/83. [Tom Christensen]

NEOLITHIC AND BRONZE AGE

13. VIBBERSTOFT, north-west Jutland. Villerslev s., Thisted a.
Barrow. The ploughed-down barrow measuring 25 × 1.25 m before excavation was situated on the crest of a hill close to the banks of the Limfjord. The barrow consisted of six phases and

contained one primary grave and three secondary ones. The primary grave consisted of a circular stone pavement with a diameter of 4 m. At the centre of the stone pavement was an east-west aligned bed for a coffin, containing the remains of a wooden coffin and, at the east end, teeth and traces of a skull. On the stone pavement next to the coffin was an earthenware vessel from late Single-Grave Culture. The grave was covered by a mound with a diameter of 10.5 m and an original height of 1.5 m. The mound was surrounded by a well-preserved stone circle. The second phase was built in exactly the same way and included a secondary grave with traces of a cist, but no artefacts. In phases 3 and 4 the lower part of the side of the mound was covered by a stone pavement. The stone pavement of phase 3 contained 2 cup-marks, and a similar cup-mark was found on one of the stones in a grave dug 0.5 m into the top of the second phase. The grave contained no artefacts but should probably be dated to the Late Neolithic period or the Early Bronze Age. The latest structure in the barrow was a secondary grave from the Late Bronze Age, period IV. It consisted of an oval excavation filled with pebble gravel and large limestone fragments. Besides burnt bone it contained a sword, a pair of tweezers, an awl, a small double-edged knife, and a fragment of a razor. – *Museet for Thy og Vester Hanherred*, Thisted, 1966. [Anne-Louise Olsen]

14. TOFTEPARKEN, North Jutland. Års s., Ålborg s.
Settlement site. At the investigation of a hillock on the north side of Halkær river-valley traces were found of a settlement from three different periods. The latest structure was a house-site from the Late Bronze Age (A324). The house-site is approximately east-west aligned, 18 m long, 5.5 – 6 m wide, has recessed entrance-posts, rounded gables, and a fire-place at the west end. Around the house-site was a number of pits with pottery and charred grain.

Situated partly below this house-site was a rectangular house-site from the Late Neolithic period (A350). This house-site is 7.5 m long, 4 m wide, and WSW-ENE aligned. The sunk floor has been dug 10–15 cm below the surface. The fill covering the sunk floor and the fill in the post-holes contained pottery and a fragment of a flint dagger. To the west of these house-sites was a large flat-bottomed pit (A 355). The pit is SW-NE aligned, measures 8.75 × 5.0 m, and is approx 0.3 m deep. It contained pottery from the Upper-Grave period of the Single-Grave Culture and some flint waste. Though there were no post-holes, the pit may actually be a sunk floor of a house-site. – *Vesthimmerlands Museum*, Års 228. [Mogens Hansen]

PRE-ROMAN AND ROMAN IRON AGE

15. HØJGÅRD, South Jutland. Gram s., Haderslev a.
Urn cemetery. In an area measuring 5 × 60 m along the edge of a gravel pit at Enderupskov between Gram and Ribe a total of 12 urn-graves has so far been found. One of them contained a sword, a shield, a spear, and two Hanovarian fibulae. Two cremation pits both containing weaponry and equipment. The burial ground can be dated to period IIIb of the Pre-Roman Iron Age and the beginning of the Early Roman Iron Age. The contents of the urns are varied and exciting, ranging from richly equipped urns to urns containing only burned bones. – *Haderslev Museum* 1706. [Per Ethelberg]

16. GAMMEL SOLE, Central Jutland. Øster Snede s., Vejle a.
Settlement. In 1984 an area along the motorway, measuring 50 × 205 m was partially excavated. It contained 35 house-sites of varying sizes, all dating from the Early Roman period. Only the post-holes from the roof-supporting posts and the entrance-posts were preserved. The houses represent two or three phases and are grouped in a series of farmsteads in a village. There were many pits and two wells. On the same location an area measuring 20 × 200 m was excavated in connection with the construction of a natural gas pipeline in 1983. – *Vejle kulturhistoriske Museum*, m 879. [Dorthe Mikkelsen]

17. KJÆRSING, Esbjerg.
Settlement site. In June-July 1984 a large Iron Age settlement at Solbakkegård in Kjærsing was excavated. The site has been known since the 1930s when a. o. G. Hatt, H. Kjær, and P. V. Glob excavated two house-sites with paved stables. Since then the settlement site has constantly been harassed by destruction, partly because it is located on land that was part of Esbjerg's old aerodrome, a busy activity area during the war, and partly because the area has since been intensively cultivated, drained, and ploughed. Thus the pavement was no longer preserved, but in spite of everything much of the settlement site was still intact. The 10,000 m^2 that were thoroughly investigated in 1984 contained 30 houses of varying sizes and a dozen pits with abundant artefacts. Furthermore there were 6 widely spaced urn-graves in the northern corner of the site. The houses were distributed into two groups (cf. fig. 4): one to the north consisting of 22 houses in a row, all of them WNW-ESE aligned, and one group further to the south consisting of a line of 8 houses. These were similarly oriented, except one which was NNE-SSW aligned. Between the two groups was an area devoid of finds. As regards size and shape they did not differ markedly from the usual early Iron Age house-type. They had wall-ditches and pairs of roof-supporting posts inside the houses. On the basis of size and shape they can be divided into three groups: 1) small storage-houses measuring 4 × 4 with two pairs of roof-supporting posts, 2) somewhat bigger houses with a length of 9–12 m and four pairs of roof-supporting posts, and 3) large houses with a length of 15–20 m and 6–8 pairs of roof-supporting posts. Due to intensive agricultural cultivation there were only few remains of fences, but in several places, especially around the houses, it was possible to prove their presence. Furthermore, a double fence could be established over a fairly long strech of land. The habitation seems to have been of fairly short duration. Only few of the houses had been reconstructed or repaired, and likewise only few of the house-sites overlapped (there were only two phases). Apart from one house, dated by its type to Per. I of the Pre-Roman Iron Age, the large amount of pottery found in refuse pits and post-holes dates the main occupation to the transition period between the Pre-Roman Iron Age and the

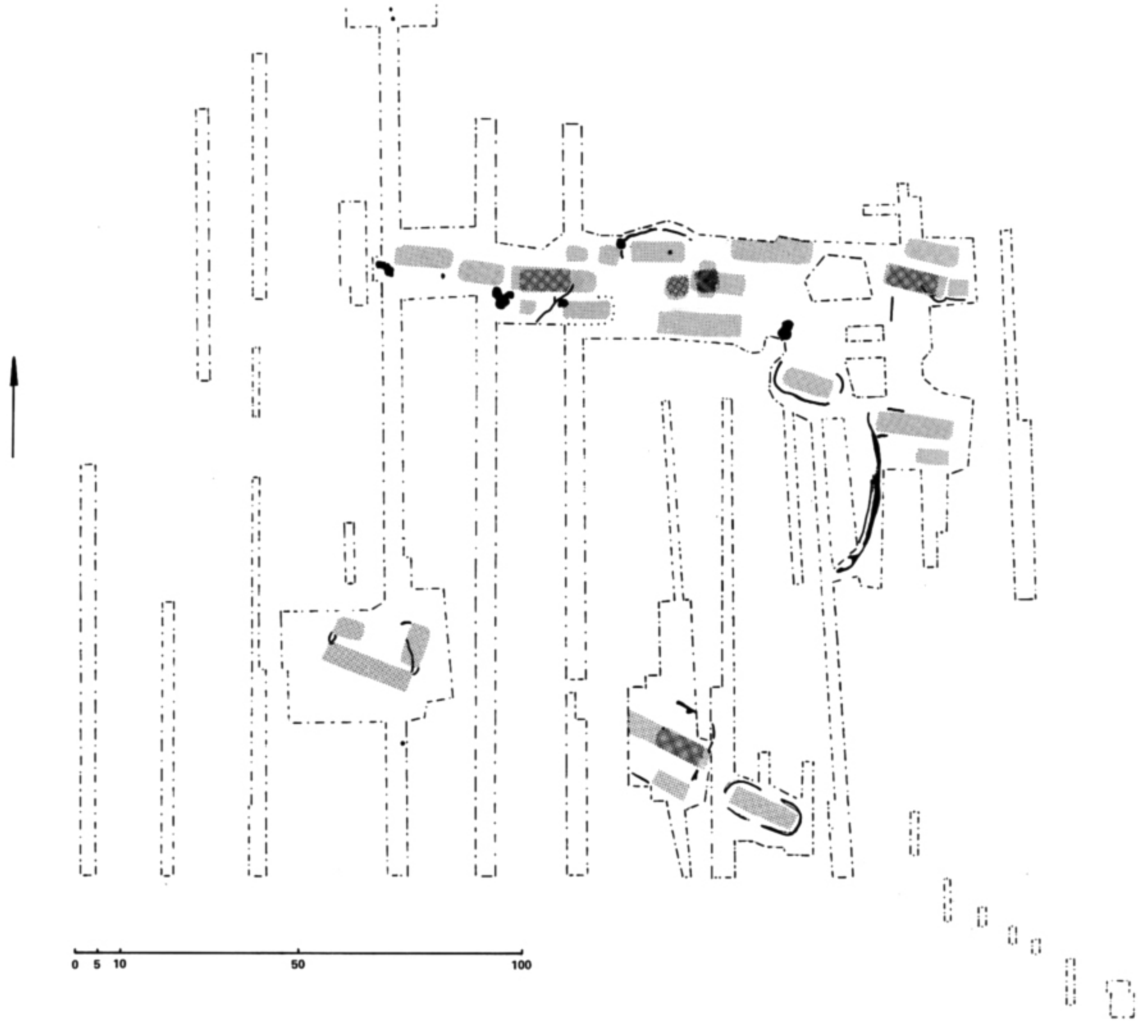


Fig. 4. Kjærsing, Esbjerg. Late Pre-Roman/Early Roman Iron Age Settlement (No. 17).

Early Roman Iron Age, i.e. to around the Birth of Christ. – *Esbjerg Museum*, j. no. 864. – *Nationalmuseet*, Prehist. Dept., C22620. – Lit.: Thomsen, N.: Jernalderens brolagte stalde. *Fra Ribe Amt* 1960–63: 266–80. – Villadsen, H.: En Boplads fra den senere Jernalder. *Fra Ribe Amt* 1932–35: 361–65. [Henrik Christiansen]

LATE ROMAN AND GERMANIC IRON AGE

18. SELKÆR, East Jutland. Kastbjerg s., Randers a.
Settlement. In 1984 1000 m^2 containing refuse layers, preserved wooden wells, post-holes, and one sunken hut dating from the early Germanic Iron Age were excavated within the boundaries of the present-day village Selkær. The structures contained large amounts of pottery, iron scoria, millstones, and manufactured wood. Furthermore, traces were found of settlements from the early middle ages, the late middle ages, and the 18th cent. – *Djursland Museum*, Grenå, 1993. [Esben Kannegaard Nielsen]

19. NØRRE SNEDE, Central Jutland. Nørre Snede s., Skanderborg a.
Settlement site. The excavation of villages from the 3rd to 7th centuries (cp. *JDA* vol. 1, p. 181) was continued. In 1984 an area of 9000 m^2 with 30 long-houses, 6 smaller houses, and 12 small buildings was excavated. Around the houses were several systems of fences with a total of approx. 20 outhouses. – *Vejle Kulturhistoriske Museum*, M211. [Torben E. Hansen]

20. VORBASSE, South-central Jutland. Vorbasse s., Ribe a.
Settlement site. In 1984 the excavation of the extensive settlement area (cp. *JDA* vol. 2, pp. 127–136) with farmsteads and villages from the Iron Age and Viking Age was continued. Inside an area of 16,000 m^2 the following structures were investigated:

Third to 5th cents. A.D.: two farmsteads, each with 3–5 phases. This included the excavation of 8 long-houses, 2 smaller houses, 2 small buildings, 2 sunken huts, and 6 wells. Furthermore, wheel tracks and traces of ard-ploughing were recorded.

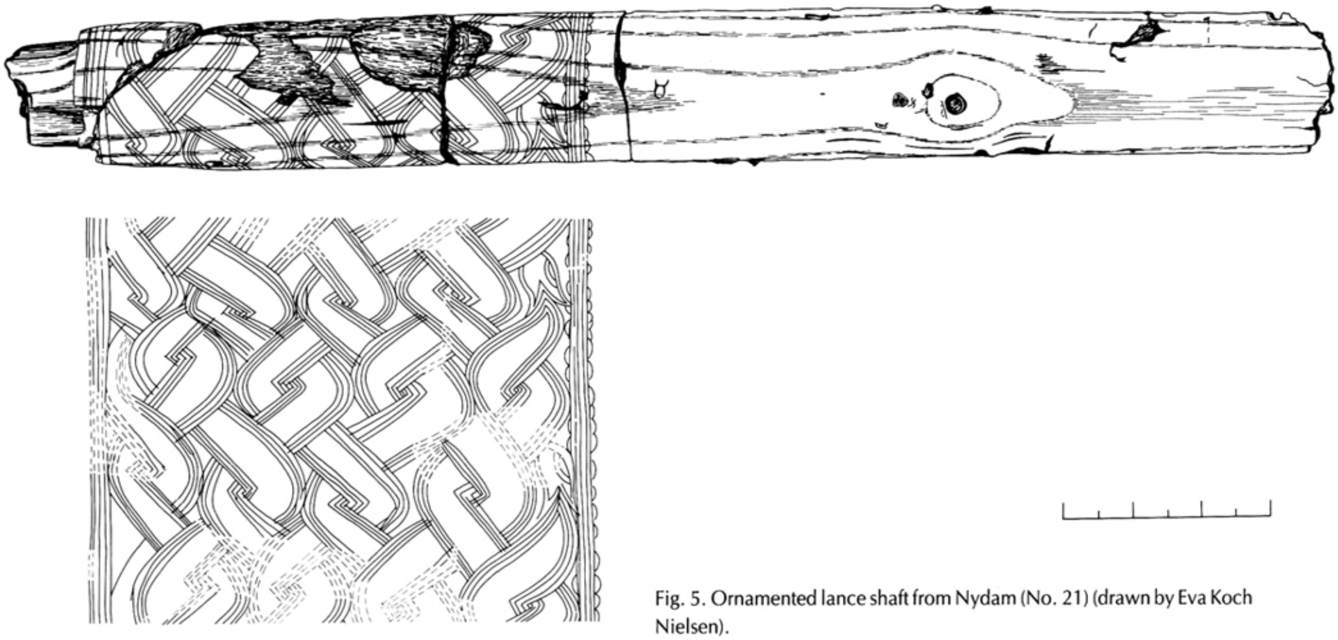


Fig. 5. Ornamented lance shaft from Nydam (No. 21) (drawn by Eva Koch Nielsen).

Eight and 10th cents. A.D.: two and a half enclosed farmsteads with 2 long-houses, 14 smaller houses, 2 sunken huts, and 2 large wells with fully preserved wooden structures.

Eleventh cent.: a farmstead with one house of the Trelleborg-type, and 3 smaller houses. – *Vejle Kulturhistoriske Museum* and *Nationalmuseet*, Prehist. Dept. 1124/84. [Steen Hvass]

21. NYDAM III, South Jutland. Sottrup s., Sønderborg a. **Votive offering of weapons.** In 1984 a new votive offering was found approx. 90 m from the spot where Conrad Engelhardt excavated three big boats and weaponry from the late Roman Iron Age in 1859–63, and approx. 60 m from the spot where the richly decorated silver fittings for scabbards dating from the Early Germanic Iron Age were found in 1888, – the find that is known as Nydam II.

The investigation covered an area of around 104 m^2, yielding around 150 iron weapons, including: lance points, sword blades, umboes, and knives. Only few items were of bronze: some fittings for shields, one knife hilt button, a U-shaped tip for a sword scabbard, and a sword hilt button with ends shaped like animal heads. The excavation was heavily disturbed by peat-diggings, but between these were untouched sections with stratified swamp peat. Sword blades and spear points were stuck into the peat, which must have been a steady lake bank at the time of the offering. In a small area parts of the original surface were preserved showing poorly preserved fragments of shield boards, lance shafts, arrow shafts, and bows made of yew tree. Around 20 lances had their shafts preserved, and these all displayed fine braided patterns in accordance with the patterns found by Engelhardt in Kragehul bog in south-west Funen. (fig. 5).

Nydam III has so far been dated to Early Germanic Iron Age. The investigation was carried out in collaboration with *Haderslev Museum*. – *Nationalmuseet*, Prehist. Dept., 1426/75. [Peter Vang Petersen]

VIKING AGE

22. BAKKENDRUP, West Zealand. Bakkendrup s., Holbæk a. **Burial ground.** In 1979 skeleton remains were found north of the village Bakkendrup. An investigation showed that there was a series of interments from the Viking Age. Along with a number of settlement pits a total of 10 graves containing more or less well-preserved skeletons was investigated. Most of the graves were rather simply equipped with iron knives and whetstones. A few graves were somewhat more elaborately equipped with a.o. bronze belt-ornaments and beads of glass and quartz, and a gilt disc-shaped fibula of bronze. Furthermore, a pit was investigated, containing a complete female outfit consisting of two cup-shaped bronze fibulae, a wooden casket with iron fittings, an iron key and an iron knife, but no skeleton remains. Furthermore, bones from at least seven individuals were gathered along with a few artefacts found in the earth heaps around the investigated area.

In 1983 another excavation was made south of the 1979 excavation. This investigation yielded five interments. The material from these graves includes iron knives, whet-stones, ring-headed pins, spindle-weights, wooden caskets with iron fittings, glass beads, and a gilt disc-shaped fibula with an imitation effigy on one side and a stylized Christ-figure on the other.

The burial ground should be dated to the latter half of the 9th century. The 15 investigated graves probably only make up a small part of the original burial ground, the rest of which has

Fig. 6. Piece of antler with runic inscription from Kalundborg (No. 28) (L. Larsen photo, the National Museum).

Fig. 7. Boxwood knife handle with carved decoration from Fuglslev (No. 30) (M. Aagreen photo).

been destroyed by ploughing and gravel-digging. – *Rigsantikvarens arkæologiske Sekretariat.* [Svend E. Albrethsen]

23. LADBY, Funen. Kølstrup s., Odense a.
Soundings were made in the tumulus over the **Ladby Viking ship burial** prior to a renovation of the hall and the mound. The sections showed intact parts of the mound and gave stratigraphical evidence, that the tumulus was made in the Viking Age. Surrounding the mound was a circle of vertical posts of 20 cm diam. giving the diam. of the mound as 29 m. – Fyns Stiftsmuseum, Odense, j.nr. 1923. – Lit.: K. Thorvildsen: *Ladbyskibet.* Nordiske Fortidsminder VI, 1, 1957. – H. Thrane in *Skalk* 1985: 1 pp. 3–7. [H. Thrane]

24. KAAGÅRDEN, Langeland. Lindelse s., Svendborg a.
Cemetery. Already in 1900 Jens Winther of Langelands Museum excavated a richly equipped, stone-covered horseman's grave from the 10th century at Kaagården, south Langeland. The finds from this grave and from a couple of earlier graves that had been inexpertly excavated (containing a.o. gilt rein-fittings, fragments of a oval brooch, and an axe) have been described by J. Brøndsted in *Acta Arch.* VII (1936).

In the autumn of 1983 LMR was notified in order to examine a ploughed-up stone pavement. In the autumn of 1984 a trial excavation was undertaken (2500 m^2). In 10 ditches a total of 16 interments was found, 7 of which were excavated. All the graves were located on the eastern slope of a small hillock approx. 100 m from the coast-line. The investigated graves revealed the poorly preserved remains of 6 individuals and a horse. This latter lay in the grave originally excavated by Jens Winther. The graves were not aligned alike, and only approx. half of them were covered by stone pavements. A common feature was the presence of burned animal bones and remains of fireplaces on top of all the examined graves.

The most interesting grave (B) contained the bodies of two women. The grave goods consisted of an iron knife, an iron buckle, and a 22 cm long two-pronged iron fork with a wooden handle.

The other graves also contained moderate quantities of grave goods. All the bodies were equipped with iron knives (one of which had a handle with silver-thread windings). Furthermore, there were one mille fiori bead, the decomposed remains of iron buckles, and a small double-conical bronze bead with a flat rear-side. There are probably more graves on this cemetery; and as many of them are located only 15 cm below the surface, it is hoped that the investigations may be continued before the graves are destroyed by ploughing. – *Langelands Museum,* Rudkøbing, 11563. [Annemarie Kruse]

25. LILLE KNUDS HOVED, Fur. Fur s., Viborg a.
Single find. In 1961 at Lille Knuds Hoved a turf-built structure was found of the same type as the presumed boat-houses (nausters) at Harrevig (cp. Th. Ramskou in *Aarbøger f. nord. Oldk. Hist.* 1960 pp. 168–173). So far it has been impossible to give a close dating of these structures. In 1984 a stirrup from the mid 10th century was found at the structure at Lille Knuds Hoved, indicating a Viking Age date for this site. – Fur Museum 70. [John B. Bukk]

26. KJØLVEJEN, Randers. Hornbæk s., Viborg a.
Cemetery. During the investigation of a ploughed-down mound (see no. 11) a Viking Age burial ground was discovered. In 1984 approx. 3500 m^2 were investigated yielding 58 graves. Another 20 have been located by means of trial trenches. Some of the graves were placed so that they formed a tangent to the above-mentioned mound. Most of the others were ENE-WSW aligned. The graves varied considerably. Some were simple interments, some were covered by large stones, some had a frame of hammered-down pointed posts. One grave was simply filled with stones, and the body had been placed in a cist. One grave contained fittings from a coffin and a large number of nails whose position show that this is a burial in a waggon-body. The grave goods were very varied; there were a large number of knives, a few whet-stones, oval brooches, a triple-fluked brooch, bronze needles, amber and glass beads, the metal fittings of a casket with a lock, 2 iron keys one of which fits the lock of the casket, a spindle-weight, a belt-buckle and other belt-fittings. The man's outfit consisted of lance points, axes, and a spur. In connection with some of the bronze artefacts woollen and flaxen textiles were preserved and possibly also some fur. Furthermore the find included an hemispherical earthenware vessel and a soapstone sherd. – *Kulturhistorisk Museum,* Randers, 332/82. [Bjarne H. Nielsen]

Fig. 8. Bygholm, Horsens (No. 31). Foundations of parish church seen from the south.

MEDIEVAL

27. MARGRETHEHÅB, Roskilde.
Settlements. On the western outskirts of Roskilde approx. 1.5 km from its centre, Roskilde Museum has undertaken an extensive investigations to forestall construction work planned in that area. Excavations were made in two areas: Margrethehåb I is a small farmstead consisting of two smallish long houses and a sunken hut, covering an area of 1500 m^2. The material seems to date the site to the 11th century. Seventy-five m west of site I on a hill-top surrounded by ditches and meadows site II was found. In the centre of the site, which covers approx. 10,000 m^2, was a 28 m long and 6 m wide long-house with curved long sides and heavy roof-supporting posts in the walls. In the surrounding area was a number of out-houses and stack sheds, and short sections of fences were preserved in various places. Furthermore the area contained a large number of refuse pits and other remains including an oven.

Besides Baltic ware the material includes knives, needles, bronze fittings, and bone artefacts. This site, which must be interpreted as a large farm, must be dated to the first half of the 12th century. – *Roskilde Museum* 623/84. [Tom Christensen]

28. KALUNDBORG
Single find. In collaboration with the National Museum *Kalundborg og Omegns Museum* has carried out an investigation of the medieval settlement in the north-western part of *Højbyen*, approx. 200 m north of the church. In a sediment from the 13th–14th centuries a piece of antler was found with a Latin inscription in runes (fig. 6). Translated the inscription goes as follows: 'may a wonderful vessel be made for flowers and twigs'. On the other side the name 'Josef' was inscribed. This Latin sentence is part of a quotation or a riddle known from 15th century manuscripts from Basel and England. – *Kalundborg og Omegns Museum*, 2/84. [Lisbeth Pedersen & Marie Stoklund]

29. VIBORG SØNDERSØ
Settlement. During June-August 1984 a series of trial excavations was carried out in a largish area at Viborg Søndersø. The purpose of the investigation was to get an idea of the scope and extension of the Early Medieval settlement found in 1981. The settlement covers the time span from approx. 1,000 to 1,300 A.D. At the end of the period the water level of the lake had risen approx. 2 m, so the bottom part of the occupation layer is below the present-day water level. Consequently the conditions of preservation for organic material are uncommonly good. Thus remains have been found of both shingled houses and mud-and-wattled houses. To preserve the valuable occupation layer the municipality of Viborg has decided not to develop the area. – *Viborg Stiftsmuseum.*

30. FUGLSLEV, East Jutland. Fuglslev s., Randers a.
Wooden structure and single find. In 1982 in a tract of bogland south of Fuglslev Church a drainage ditch was dug revealing various timbers. A dendrochronological dating by the Wormianum Laboratory, Højbjerg, gave the result 1077 A.D. The bog was seriously threatened by deseccation, which is why trial excavations were initiated in 1984, yielding the following results: In the middle of the bog the lower part of a wooden structure was found, consisting of a 13 m long NS shingle or stave wall flanked by heavy logs on one side. Between the timbers and the fill were wooden tools, wooden vessels, bones, slag, and pottery that could be allocated to Late Viking Age/ Early Medieval time. Roughly in the middle of the timber layer was a boxwood knife handle (fig. 7) two sides of which were ornamented with a carved relief consisting of six pictures

framed by arcade arches and ring chains respectively. The picture closest to the knife-blade was covered by four silver-thread windings. The pictures represent fabulous animals and birdmen. – *Djursland Museum*, Grenå, 1945 [N.A. Boas]

31. BYGHOLM, Horsens.
Church site and churchyard. A few hundred m west of Bygholm skeleton remains were found during the excavation for the foundation of a factory building in July 1984. A hitherto unknown church with a churchyard dating from the Early Medieval had been found, and a rescue-excavation was initiated by the National Museum Dept. of Medieval Hist. and Vejle kulturhistoriske Museum, jointly. It is the first rural parish church in southern Scandinavia to have been totally excavated.

On a hillock the remains of the foundations of a small travertine church were found (fig. 8). It consisted of chancel and nave and measured 6 × 16 m. The chancel had been built first as a small rectangular building, to which the nave has been added. Immediately north-west of the stone church were post-holes from a wooden building measuring 7 × 13 m. This must be construed as a wooden church as it has partly co-existed with the churchyard, so this site is perhaps another example of a stone church built next to a wooden church. Furthest to the west on the churchyard 6 post-holes were found clearly representing a bell frame.

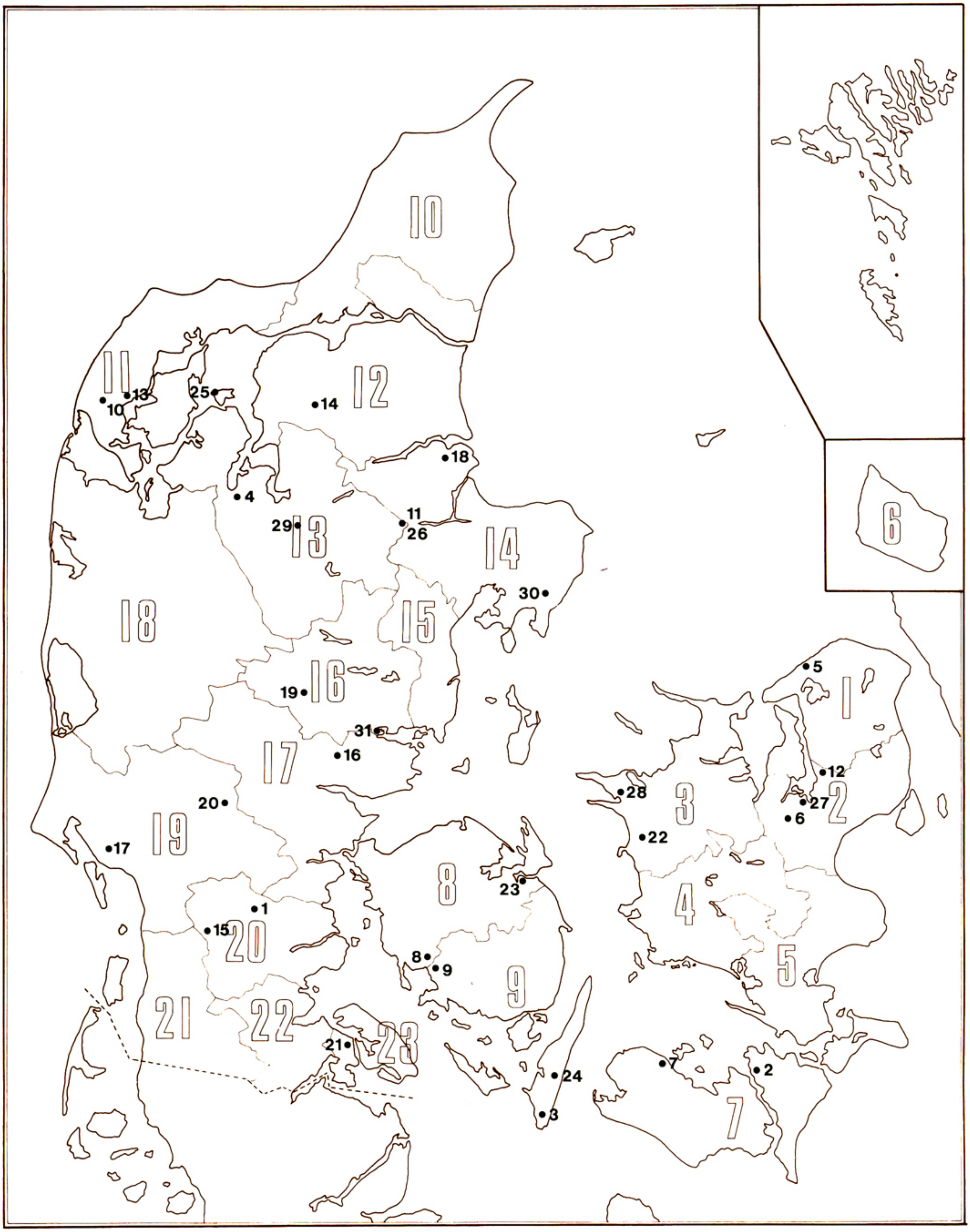
The churchyard, which covered approx. 3100 m^2, was surrounded by a ditch, and within the churchyard were almost 600 graves. It seems that one group is of immediate interest: in approx. 70 graves the skeletons are framed by stones, e.g. one at the crown of the head, one at the feet, two at the cheeks, and two at the ankles. So far this phenomenon seems not to have been investigated. Among the anthropological results can be mentioned that the bodies were generally shorter than for instance contemporaneous people in Viborg, which may indicate a difference between people in town and country. Two small abnormalities appear surprisingly often in the skeletons from Bygholm – abnormalities that have been of no fatal consequence to the people, but which strongly suggest inbreeding among the local community. A segregation of the sexes (women to the north and men to the south), which is known from other chuchyards, doesn't seem to have taken place here.

So far the dating is very uncertain. The church and churchyard were founded in the 12th or even the 11th century and ended in the 14th century, when the agricultural crisis and the foundation of Bygholm may have played their parts. – *Vejle kulturhistoriske Museum* og *Nationalmuseet*, Dept. of Medieval hist. [Jakob Kieffer-Olsen & Peter Pentz].

'Recent Excavations and Discoveries' was translated by Ul S. Jørgensen.

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	9. Svendborg	17. Vejle
2. København	10. Hjørring	18. Ringkøbing
3. Holbæk	11. Thisted	19. Ribe
4. Sorø	12. Ålborg	20. Haderslev
5. Præstø	13. Viborg	21. Tønder
6. Bornholm	14. Randers	22. Åbenrå
7. Maribo	15. Århus	23. Sønderborg
8. Odense	16. Skanderborg	



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