JOURNAL OF DANISH ARCHAEOLOGY

VOLUME 3 · 1984
ODENSE UNIVERSITY PRESS

THIS VOLUME IS PUBLISHED WITH GRANTS FROM

The Danish Research Council for the Humanities
The National Agency for the Protection of Nature, Monuments, and Sites.
The National Museum
Dronning Margrethe II's Arkæologiske Fond
Hielmstierne-Rosencroneske Stiftelse

SUBSCRIPTION

Journal of Danish Archaeology is published in one annual volume. Annual subscription rate: 130 Danish Kroner, excl. postage. Subscription orders should be sent to Odense University Press, 36 Pjentedamsgade, DK-5000 Odense C, Denmark.

MANUSCRIPTS

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

BOOKS FOR REVIEW

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

Cover: Uffe Rosenfeldt
Photoset by Syfoma Sats, Svendborg
Printed by Mammens Bogtrykkeri, Odense
ISBN 87 7492 500 8
ISSN 0108–464X

Erratum

Please observe that the two figures on pp. 201 and 202 in Volume 2 have been exchanged by mistake. The figure text of fig. 5 thus relates to the figure on p. 202 and *vice versa*.

In the figure text of fig. 6 p. 202 the economy of rescue excavations is indicated in hundred thousands. It should be corrected to *thousands*.

Contents

Journal of Danish Archaeology vol. 3, 1984, pp. 7–18

Chronological and Regional Variation in the Late Mesolithic of Eastern Denmark

by PETER VANG PETERSEN

As a collaborator to the "Vedbæk Projekt" the author has analysed material variation within the late Mesolithic in eastern Denmark. A result of these studies has been the recognition of five chronological phases within the Kongemose and Ertebølle periods. These phases show a clear resemblance to the development of e.g. projectile points among other Mesolithic groups in Western Europe.

Another important result is the recognition of pronounced regional and local variation within the flake axes of the late Ertebølle culture in eastern Denmark reflecting distinct local groups.

Among sedentary populations, it is anticipated that local patterns of artifact styles, produced and discarded locally, will develop in the same way as dialect groups in language. If so, the existence of local groups of Ertebølle flake axes reflects the presence of territorial and social groups in the Ertebølle resembling the dialectic tribes known from recent hunter-gatherers in Australia and the Kalahari (Birdsell 1968, Wiessner 1983).

THE VEDBÆK RESEARCH AREA

Northeast Denmark has undergone an isostatic uplift since Atlantic time, raising coastal Ertebølle and Kongemose sites above present sea level. Due to the excellent potential for examining changes in Mesolithic coastal cultures in this area of uplift, the "Vedbæk-Project" was initiated in 1974 (1). In 1975 the Mesolithic graveyard at Henriksholm-Bøgebakken was found (Albrethsen and Brinch Petersen 1977), and intensive interdisciplinary investigations have been carried out in the subsequent years. With 35 known sites (fig. 2) documenting a continuous habitation over 300 years the Vedbæk inlet offers an important area for investigation.

The sites

In the 6th millenium bc salt water flooded the Vedbæk valley, creating a shallow inlet with numerous islands and peninsulae inviting habitation. The hunting and fishing population of the Kongemose period (5500 – 4500 bc) occupied the area, which has been populated ever since.

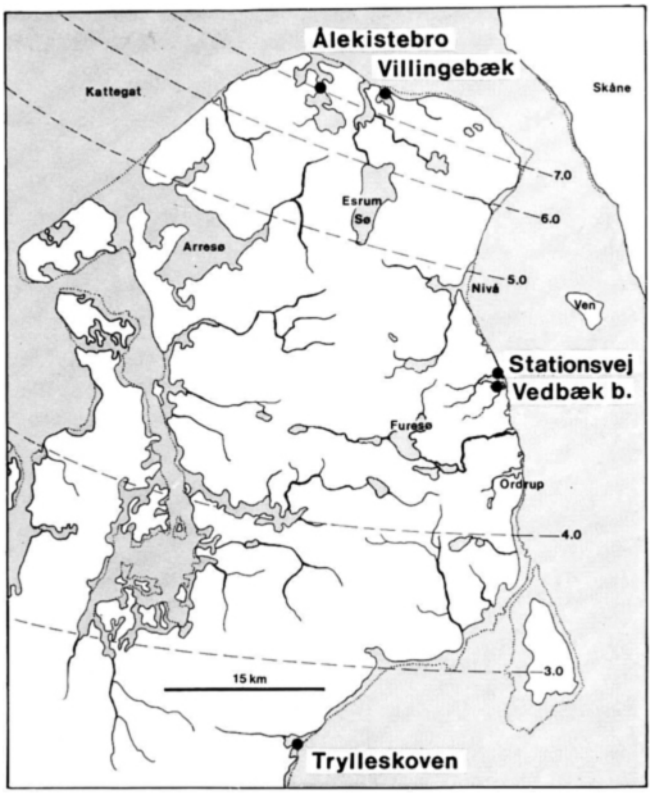


Fig. 1. Northeast Zealand in the Atlantic climatic phase, showing the highest Littorina coast line. The modern coastline is indicated by the fine dotted line. The stippled contour lines indicate the degree of coastal uplift since 3500 B.C. the map also shows the five coastal sites which have given names to the Kongemose and Ertebølle phases in eastern Denmark. Drawn by Svend Åge Knudsen.

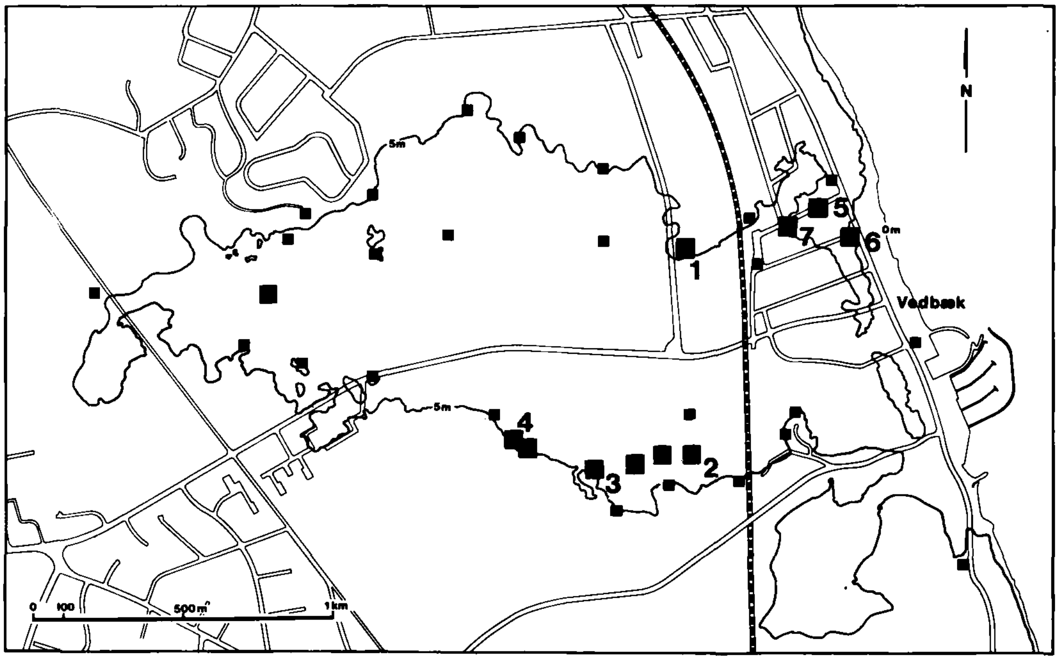


Fig. 2. The "Vedbæk inlet" indicated by the dark 5 meter contour line, and the 35 known Stone Age sites. Mentioned in this article are: 1. Henriksholm-Bøgebakken, 2. Vedbæk boldbaner, 3. Maglemosegårds Vænge, 4. Maglemosegård, 5. Stationsvej 11, 6. Marievej, and 7. Stationsvej 17. Drawn by Svend Åge Knudsen.

Settlement was placed as close to the water as possible. The location of sites on small islands and peninsulae demonstrates that the inhabitants wanted to live as close as possible to the main channel of the inlet where the best fishing grounds were to be found.

The Vedbæk inlet has none of the »kitchen middens« with massive layers of oyster shells otherwise so characteristic of Danish coastal sites. There were no oysters in the Øresund or in the Baltic Sea east of Gedser (Spärck 1940:72). Thin layers of sea shells (mussels and periwinkles) may be found on sites along the shore of the Øresund, but coastal sites in eastern Denmark generally do not contain sea shells.

Stratigraphy

In the Vedbæk investigations, an effort has been made to distinguish culture layers of different ages. It is now clear that the larger sites rich in material – which have of course interested the archaeologists – have been inhabited over a long period. The living horizons in these occupation zones contain a mixture of early and later cultural remains. This mixture is a result of bioturbation – human and canine digging, as well as moles and water voles tunnelling through the culture layers, have turned everything upside down.

Conditions are somewhat better in the lagoon sediments adjacent to the site. Here excavations of the water-logged "refuse layers" reveal thick stratigraphic sequences of sand and gyttja layers deposited during the habitation. In this area of rapid sedimentation, early and later objects are kept neatly apart. The artifacts that have been thrown into the water at varying points in time have remained in stratigraphically different layers. *Maglemosegårds Vænge* is the most important of these sites (2). There are several sand and gyttja layers present with cultural remains from three different phases. Abundant wooden artifacts have made it possible to C-14 date the cultural phases as well as the marine transgressions that deposited these layers (Christensen 1982: 176).

In addition sites on beach ridges at the mouth of the Vedbæk inlet have been investigated. The mouth of the inlet was an attractive settlement area. The continuous formation of beach ridges by material eroded from moraine cliffs north of the inlet created new habitation areas and, as new beach ridges were formed next to the

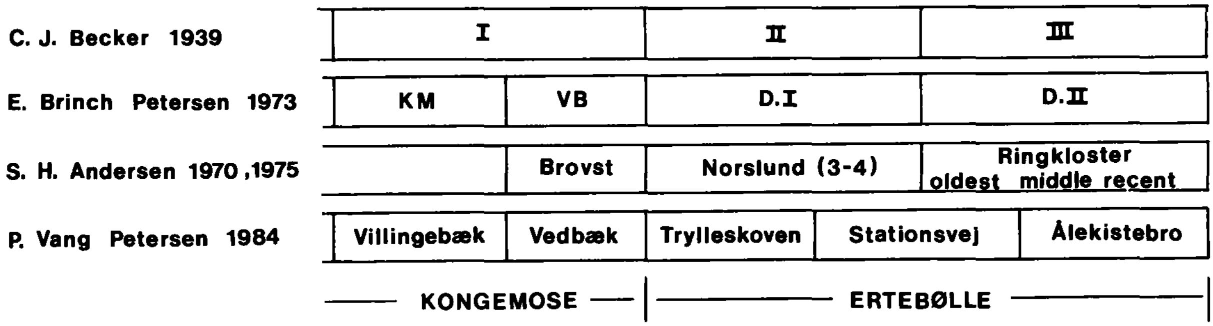


Fig. 3. The development of archaeological chronologies for the Kongemose and Ertebølle periods over the last 45 years in Denmark.

old ones, a horizontal stratigraphy of the occupation of the ridge was created.

The chronological development of material culture in the Kongemose and Ertebølle periods is thus documented by stratigraphical observations, both vertically and horizontally.

The artifacts

Irrespective of the conditions of preservation, the main body of the archaeological assemblage consists of flint artifacts. Consequently, the study of the chronological development of the Vedbæk sites has focused on the lithic materials.

Lithic artifacts from coastal sites consist primarily of waste. Tools are usually broken, and consequently arrowheads are an important group among the flint tools. They appear in large numbers and they have normally kept their original appearance. Due to their small size they were generally not repaired or reworked for other purposes. The arrowheads vary widely in size and shape and analysis has shown that these small flint points provide the best information for dating late Mesolithic sites (fig. 4).

A series of the common flint types – blades, axes and cores – have also been examined and classified according to discrete technological attributes of either/or character, e.g. blades produced by a soft hammer or a hard hammer (fig. 7), handle cores with a negative or a positive platform (fig. 8), axes made from a flake or a core piece, arrowheads having dextral or sinistral orientation, etc. By means of such criteria it has been possible to classify many fragmented pieces that could not have been included if shape or size criteria alone had been used.

CHRONOLOGICAL DEVELOPMENT

Investigations show that five phases of the Kongemose and Ertebølle periods can be established. The development in Vedbæk corresponds to that of the rest of northeast Zealand, and the separate phases are named after the sites (fig. 1) where the inventory characteristic of the individual phases was first recognized or appears in its purest form (Vang Petersen 1979). Each phase is defined by the predominance of various types of arrowheads (fig. 5), but other tool types also contribute to the characterization (fig. 6). This subdivision should be compared to the earlier chronological systems as shown in fig. 3. The coastal sites have previously been inter-

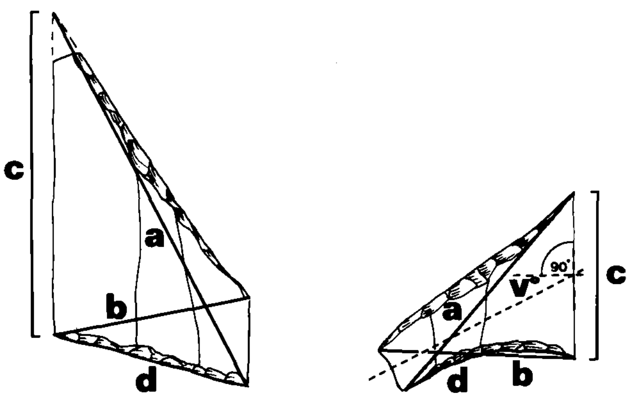


Fig. 4. Measurements and morphological elements used in the typological and chronological analysis of projectile points: a. length of long diagonal, b. length of short diagonal, c. length of leading edge, d. shape of basal transverse retouch, and v° axial angle of leading edge. Above: sinistral, rhomboid arrowhead ($a{:}b \geq 1{,}5$) with straight basal retouch and broad edge ($a{:}c < 1{,}75$). Below: dextral oblique ($v° \geq 10°$) transverse arrowhead ($a{:}b < 1{,}5$) with concave basal retouch and narrow edge ($a{:}c \geq 1{,}75$).

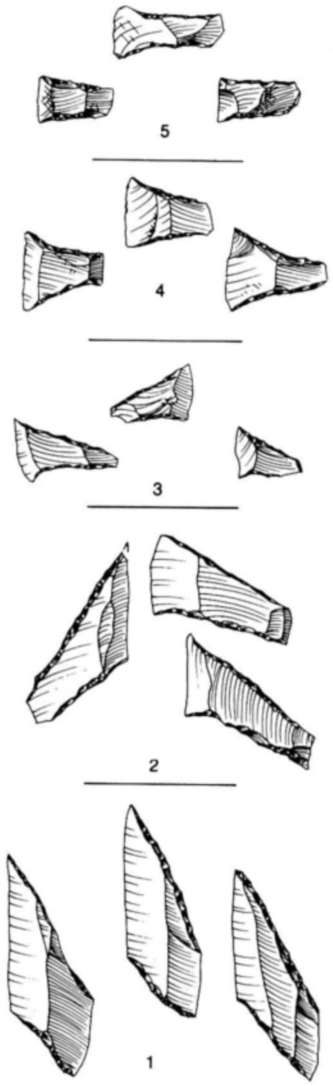


Fig. 5. The succession of projectile point types during the five phases of the late Mesolithic in northeast Denmark: (1). The Villingebæk phase (early Kongemose), (2). The Vedbæk phase (late Kongemose), 3. The Trylleskov phase (early Ertebølle), 4. The Stationsvej phase (middle Ertebølle), and 5. The Aalekistebro phase (late Ertebølle). Drawn by Eva Koch Nielsen. 2:3.

preted as habitations of relative short duration and the characterization of the material aspects of the separate phases has been based on inventories from selected locations. Recent investigations, however, have shown that coastal sites have been inhabited repeatedly for hundreds of years. Even localities that have been used as type sites for phases often cover two or more phases of the cultural development (Vang Petersen 1979: 48–55).

The Villingebæk phase (early Kongemose) 5500 – 5000 bc.

The Villingebæk phase is characterized by large rhomboid arrowheads with a broad edge and a straight basal retouch (fig. 5) (3). The arrowheads are made with the microburin technique and are nearly always sinistral. The blades are long and regular, produced by soft hammer technique with an antler fabricator (Mathiassen 1948: no. 190). Microblades are used as insets in slotted bone points and daggers. The microblades are produced from handle cores, which during this phase generally have negative striking-platforms, i.e., the platform is created by removing a flake from the core (fig. 8). Furthermore this phase contains numerous burins made on blades or flakes. In this phase, named after the site Villingebæk East A (Kapel 1969), flint axes are almost exclusively core tools with a rhomboid cross-section and "normal edge" made by removing flakes parallel to the edge (fig. 10).

The Vedbæk phase (late Kongemose) 5000 – 4500 bc.

The Vedbæk phase is dominated by narrow rhomboid arrowheads and big oblique transverse arrowheads (3). The arrowheads usually exhibit a concave basal retouch, and roughly 33 % are dextral. The microburin technique is discontinued during this phase. Soft hammer blades are still being produced but hard hammer blades become common towards the end of the phase. As the name indicates these blades have been flaked off by means of the hard hammer technique, i.e. by direct percussion with a hammer stone, a technique that results in rather irregular blades (fig. 7). In the Vedbæk phase – named after the site Vedbæk boldbaner (Mathiassen 1946, Vang Petersen 1977) – most handle cores are made on large flakes on which the positive side with the bulb of percussion is used as striking-platform. There are still some burins among the blade tools but, as in the early Kongemose, borers and scrapers are very rare. Flint axes are not distinguishable from those of the Villingebæk phase, nor do the bone and antler materials show any significant changes.

The Trylleskov phase (early Ertebølle) 4500 – 4000 bc.

In the Trylleskov phase a number of characteristic Kongemose types disappear including rhomboid arrow-

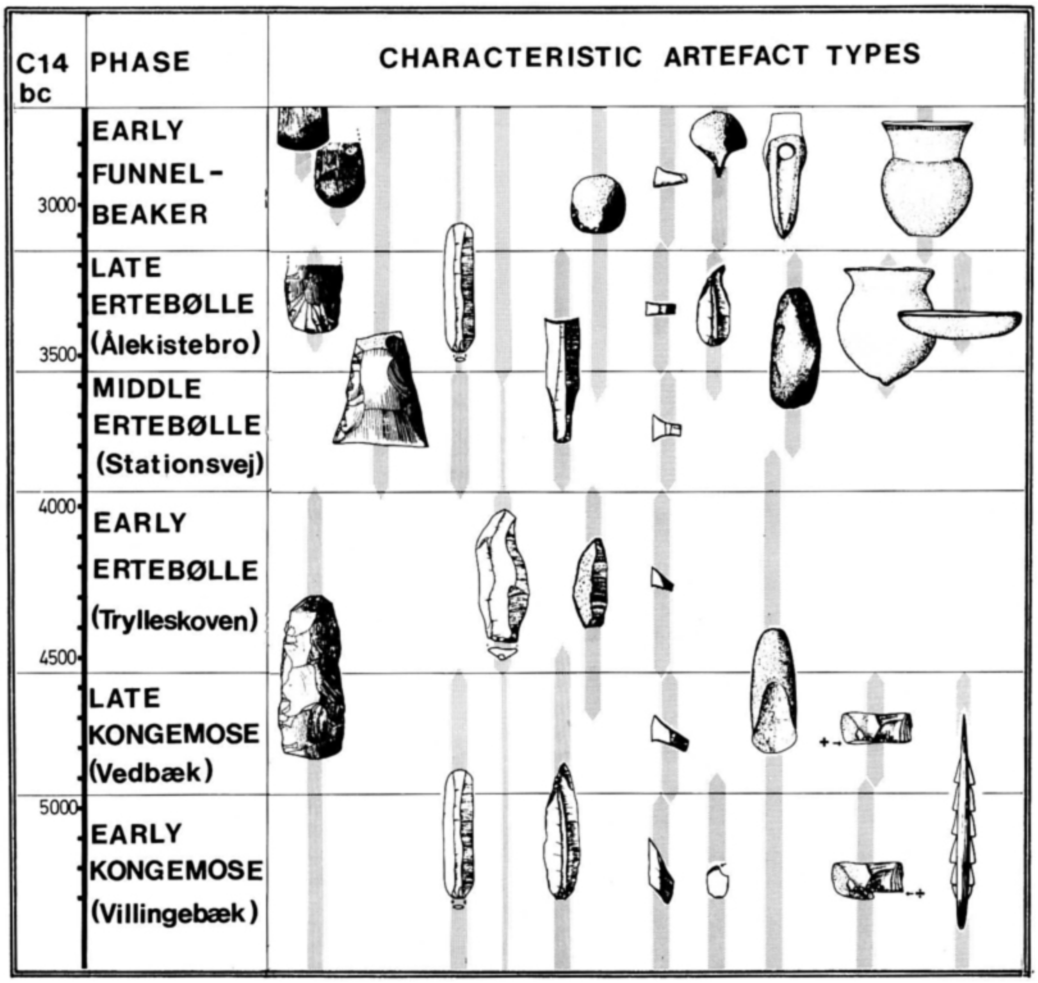


Fig. 6. The appearence of characteristic artifact types in the coastal Mesolithic and Neolithic culture in east Denmark.

heads, microburins, soft hammer blades, handle cores, fabricators, and slotted bone points. The arrowhead category is now completely dominated by small oblique points. Soft hammer blades have been completely replaced by hard hammer blades, often with a dorsal retouch. Burins are made on flakes or hard hammer blades, borers are rare, and scrapers are completely absent. The absence of scrapers is particularly noteworthy in view of their otherwise broad distribution, temporally as well as geographically. Axes are still represented only by core tools. The early Ertebølle has few characteristic flint types. For this reason it was not recognized as a distinct phase until the excavation of the type-site Trylleskoven on the Køge Bugt (fig. 1.) in 1976 (Vang Petersen 1978). This reduced inventory has since then been found at several localities along the Vedbæk inlet.

The Stationsvej phase (middle Ertebølle) 4000 – 3500 bc.

In the Stationsvej phase (4) arrowheads are symmetrical, transverse forms with a broad leading edge and concave sides. The points are made on regular soft hammer blades which have reappeared and once again dominate the blade industry after 500 years of absence. Antler fabricators have also returned, but they are now significantly shorter than they were during the Kongemose. A new and characteristic type is the tanged blade with a concave end-retouch, a type that is also found in the next phase. Burins are common but borers and scrapers are still missing, at least during the first part of the phase. Most important is the emergence of the flake axe, which in this phase completely replaces the core axe. In the Stationsvej phase, the symmetrical flat-trimmed type dominates. In the second half of the

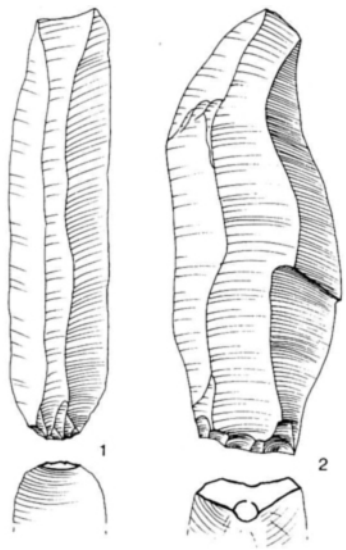


Fig. 7. The difference between: 1, a soft hammer blade, and 2, a hard hammer blade, is seen clearly at the bulbar end of the blade. Drawn by Eva Koch Nielsen. 2:3.

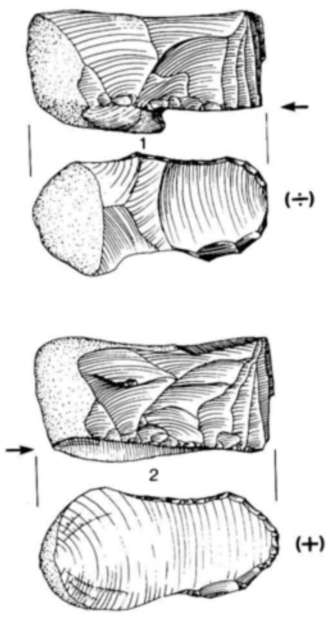


Fig. 8. Handle cores are abundant in the Kongemose culture in eastern Denmark. 1. Handle cores with "negative" striking-platforms, – the negative scar of a flake taken from the core becomes the platform – are prevalent in the early Kongemose while handle cores with "positive" platforms – made on large flakes where the positive side with the bulb of percussion is used as striking-platform – dominates in the late Kongemose. Drawn by Eva Koch Nielsen. 2:3.

phase, pottery makes its appearance in the form of thick-walled, pointed-based vessels. The phase was recognised for the first time at the excavation of the site Maglemosegaard in the Vedbæk area (5), but later a less mixed site from this phase was found on the beach ridge in the mouth of the Vedbæk inlet at Stationsvej 11 (6) (fig. 2).

The Aalekistebro phase (late Ertebølle) 3500 – 3000 bc.

In the latest part of the Ertebølle period, transverse arrowheads are narrow with straight or slightly concave retouched sides. In thise phase named after the site of Aalekistebro (6), soft hammer blades are once again less common, especially towards the end of the phase. Burins are poorly represented, but borers and especially scrapers have become extremely common. There are still the three major types of flake axes, but the symmetrical side-trimmed and the asymmetrical flake axes prevail in northeast Zealand. Core axes are revived, but with a symmetrical, convex cross-section and a "special" working edge, shaped by parallel blade-like removals from the edge (fig. 10). In addition to the pointed-based vessels, flat oval blubber lamps appear and Funnel-Beaker pottery is apparently in use during the last part of the Aalekistebro phase, which probably ends around 3000 bc in Zealand.

The causes of chronological changes

Throughout these phases of the Atlantic Mesolithic culture there are only small changes in the appearance of the most important functional types. Arrowheads, flint axes, blades, and burins are in use throughout the period. However, there are significant changes in shape (for arrowheads) and manufacturing techniques (for axes, blades, handle cores, etc.). Such changes are apparently more common and have happened more quickly than previously presumed. The most likely explanation for most of these shifts in material culture during the Kongemose and Ertebølle periods seems to be changes in taste or fashion.

All over Europe hunters were manufacturing flint tools and new ideas may have arisen anywhere. The parallel development in microlithic artifacts in west and central Europe during the Boreal climatic period

(Clark 1958, Jacobi 1976) indicates that ideas spread rapidly over very long distances during the early Mesolithic.

In the rest of Europe there are few excavated sites from Atlantic time that can be compared to the sites in southern Scandinavia. At the present the best basis for a comparison seems to be La Baume de Montclus in Languedoc (Escalon De Fonton 1976: 1382–89). At this site in southern France, 1500 km from Vedbæk, the stratigraphic sequence shows a development in arrowhead morphology that is strikingly similar to the Danish material and roughly contemporary according to C-14 datings. Narrow scalene triangles and broad trapezes are replaced by rhomboid arrowheads which are later replaced by oblique transverse forms.

Around 4000 bc, these are superceded by symmetrical transverse arrowheads with a broad cutting edge. Various sites with rhomboid or oblique transverse points in the area between southern France and Denmark (Rozoy 1978: 525–34, 489–509) argue that this parallel development is no coincidence. Such examples of similar material development among widely separated groups demonstrate that new types and techniques spread rapidly over Western Europe in the late Mesolithic.

REGIONAL DIFFERENCES WITHIN THE ERTEBØLLE CULTURE

The chronological development of the material culture recorded at Vedbæk is roughly the same among all the Atlantic Mesolithic groups in southern Scandinavia. As already noted, parallels can be found among other European hunters but of course there are also many differences. Culture varies, new ideas are not welcomed with the same degree of enthusiasm everywhere, taste and needs change, and raw materials and food resources are not evenly distributed. Even in a small region like Denmark, pronounced differences between local areas can be observed.

In the early phases of the Atlantic Mesolithic, regional studies are unfortunately complicated by the loca-

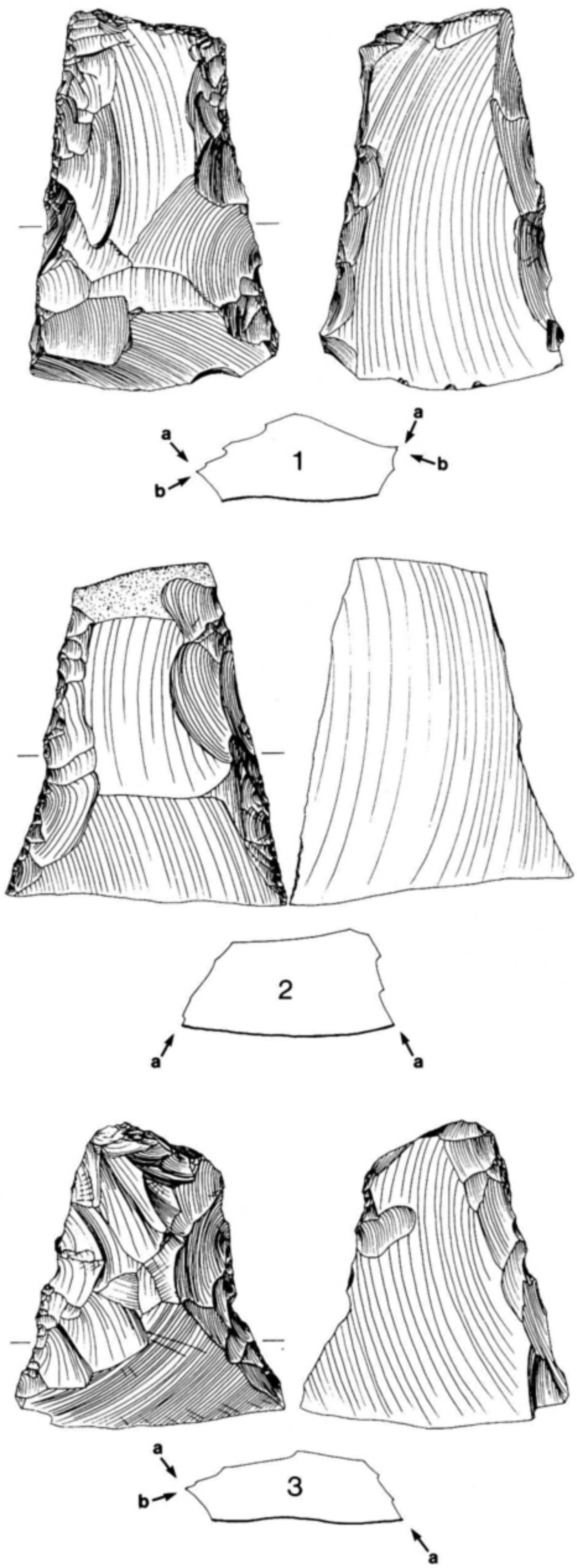
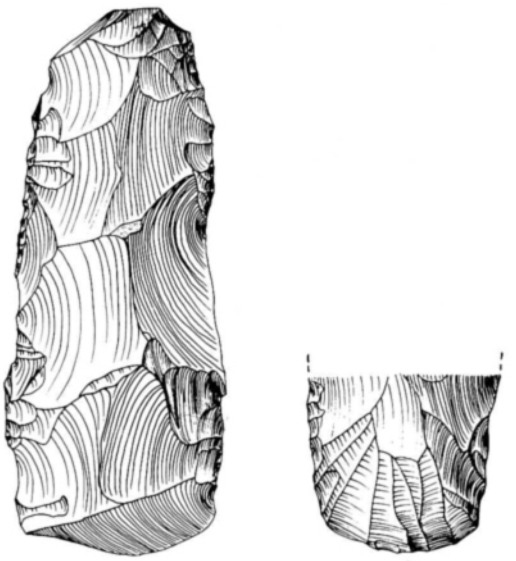


Fig. 9. The flake axes of the Ertebølle culture can be separated into three types: 1. symmetrical flat trimmed, 2. symmetrical side trimmed, and 3. asymmetrically trimmed axes. Drawn by Eva Koch Nielsen. 2:3.



1 2

Fig. 10. The core axes of the Kongemose and early Ertebølle phases have a "normal" cutting edge, created by flakes taken off parallel to the edge (1) whereas the core axes of the late Ertebølle generally show a "special" cutting edge with blade-like removals from the entire face of the edge (2). Drawn by Eva Koch Nielsen. 2:3.

tions of the sites. Due to the uneven land uplift Kongemose sites in eastern Denmark have been found only in the northeastern part of Zealand. In Jutland there is only one properly excavated site, Brovst (Andersen 1970), from the late Kongemose. This site lacks handle cores which, along with the relative absence of slotted bone points in Jutland (Andersen and Malmros 1966: 105), is indicative of regional differences between west Danish and east Danish Mesolithic already during the Kongemose period.

From the early Ertebølle period there are only a few investigated sites. In Jutland, as well as in Zealand, the layers from this phase are often heavily mixed with later material. During recent years it has been possible to isolate and excavate unmixed layers from the early Ertebølle, but the amount of material is as yet not sufficient to permit further statements regarding regional differences.

It is not until the middle and late phases of the Ertebølle culture that properly excavated sites are distributed all over Denmark and allow comparative regional studies. Bone and antler tools have been examined in detail. T-shaped red deer antler axes appear in large numbers in Jutland and on Funen (fig. 11) but they are very rare east of the Great Belt (8). Bird bone points (Mathiassen 1948: no. 152 and 156) and aurochs and wild boar scapulae with holes from the manufacture of bone discs and rings (Mathiassen 1948: no. 203) have a similar westerly distribution (fig. 12, 13). These scapulae, which are actually waste material, are rather numerous in west Denmark, but they have never been found on eastern Danish Ertebølle sites. The finished bone rings are rarely found and it is noteworthy that one specimen was recovered on the Karlsgab site in southwest Zealand (Johansson 1964: 305). This specimen was likely imported into Zealand from the west.

Bone combs (Mathiassen 1948: no. 199–201) are also known solely from sites in Jutland (Andersen 1970: 36). The total number is rather small (fig. 12) and superior conditions for bone preservation at the Jutland "kitchen middens" may contribute to the uneven distribution of these items.

Among the artifact types with an easternly distribution can be mentioned Limhamn axes, which are only found on Zealand and Bornholm on Danish soil (fig. 11) (Becker 1939: 235, Jennbert 1984: 104). Curved antler harpoons of type B (Andersen 1971) have a similar distribution (fig. 14). They appear in eastern Denmark, Scania (Larson 1981: fig. 40), and on the island of Rügen (Klinghardt 1924: 19). Type B harpoons are not found at all in Jutland, but straight antler harpoons of type A are numerous.

The distribution of these bone, antler and stone types indicates a distinct regional border between the eastern and western Danish Ertebølle cultures in the 4th millennium bc. This border through the Kattegat and the Great Belt may also have functioned as a cultural barrier during the early Ertebølle (Andersen 1978, 1980) and Kongemose, but that cannot yet be demonstrated.

The causes of the regional variation

Regional differences in the bone inventories of eastern and western Danish Ertebølle sites are partly to be attributed to the uneven distribution of resources. The depauperation of the fauna of the Zealand forests during Atlantic time is of decisive importance (Aaris-Sørensen 1980). A number of mammals, including aurochs, elk, and brown bear, disappeared from Zealand after the Boreal period and certain raw materials (e.g. aurochs

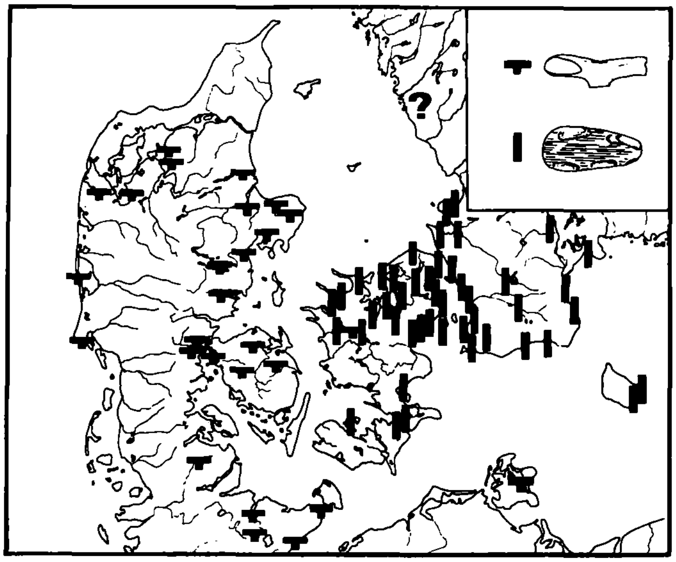


Fig. 11. Distribution of T-shaped red deer antler axes and Limhamn greenstone axes in southern Scandinavia (based partly on Becker 1939 and Jennbert 1984).

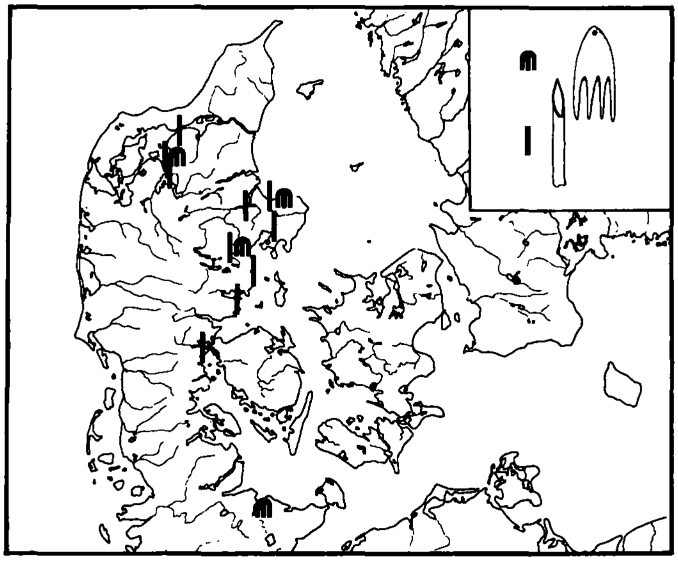


Fig. 12. Distribution of bone combs and bird-bone points dated to the Ertebølle culture in southern Scandinavia.

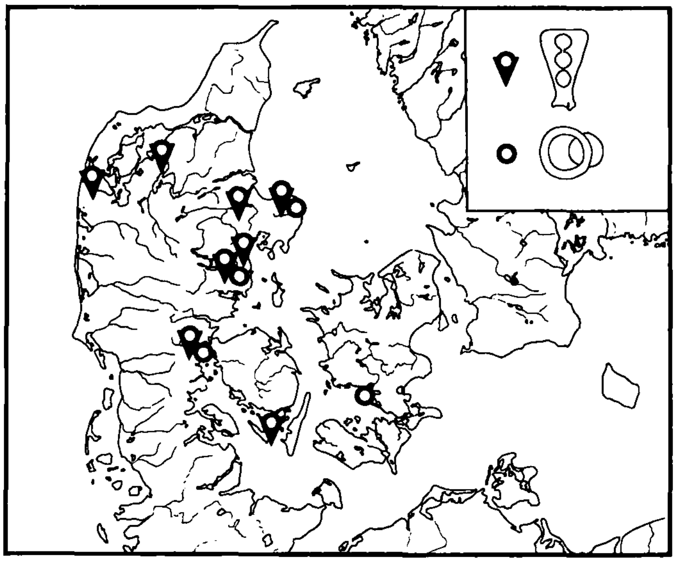


Fig. 13. Distribution of scapulae with circular cuts and bone rings or discs made from scapulae.

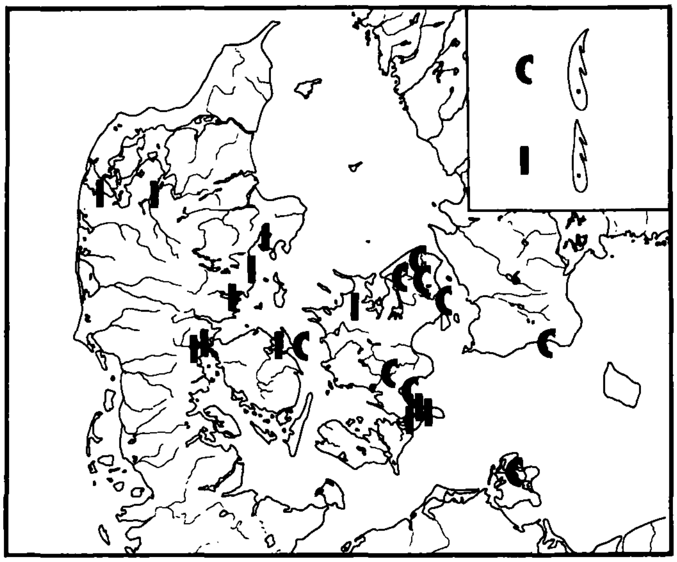


Fig. 14. Distribution of straight (type A) and curved (type B) antler harpoons in southern Scandinavia (based partly on Andersen 1971 and 1975).

scapulae for bone rings) are thus lacking in this area. The manufacture of bone rings from wild boar scapulae (Skaarup 1980) was apparently not a satisfactory solution in the Zealand Ertebølle.

Unlike aurochs and elk, red deer managed rather well in Zealand during Atlantic time and became the primary game animal. There was no scarcity of red deer antler. However, during Atlantic time antler of the Zealand red deer are reduced in size and most of them were simply unsuitable for the manufacture of antler axes. This is probably the reason why antler axes are rarely found on Zealand Ertebølle sites.

The western Danish Ertebølle culture is clearly influenced by continental groups (Andersen 1970: 36), whereas the eastern Danish area exhibits a close resemblance in material culture to the hunting populations of the Scandinavian peninsula. The most obvious similarity is the presence of Limhamn axes on Zealand and Bornholm – a type which is found in great numbers along the Baltic coasts of Sweden (fig. 11). These lightly polished, coarse stone axes have never been found west of the Great Belt.

The regional differences between the eastern and western Danish Ertebølle can be explained partly as a result of the uneven distribution of natural resources (e.g. the absence of elk and aurochs on Zealand) and partly as the result of the presence of a major geographical barrier to communication (the Great Belt), which must have inhibited the exchange of the influences between the European continent (T-shaped antler axes) and the Scandinavian peninsula (Limhamn axes). The emergence of regional differences and the function of the Great Belt as a cultural barrier reflects the Ertebølle people's limited range and limited technology based on the local resources. Apparently the Great Belt was only rarely crossed and the exchange of ideas and exotic artifacts like the bone ring from Karlsgab, was not intensive enough to disrupt differences.

Local groups in eastern Denmark

Regional variation among organic remains is unsuitable for the more detailed study of local difference in material culture, partly because each type is known only in limited numbers and partly because many sites with unfavourable conditions of preservation lack the bone types entirely. Once again we must turn to the flint tools that always appear in large quantity and provide a good medium for the evaluation of technical and stylistic differences between sites.

The flake axes are particularly suitable as they appear in large numbers on all sites and were normally discarded without much resharpening or reworking. The flake axes have thus maintained their original shape, size and some indications of the manufacturing technique.

Comparison of flake axes from eastern Zealand sites dating to the late Ertebølle shows the existence of three local groups of these artifacts (fig. 15):

I. The northeast Zealand group including sites along the Roskilde inlet and the west coast of the Øresund. Here symmetrical side-trimmed and asymmetrical flake axes prevail.

II. The Køge Bugt group including sites on the island of Amager and along Køge Bugt where symmetrical flat-trimmed flake axes make up the majority of the type.

III. The southeastern Zealand and Møn group including sites along the Præstø inlet and on the island of Møn, where symmetrical flat-trimmed axes also prevail, but where they have a very broad cutting edge. The flake axes on the island of Møn have particularly concave curves and broad edges.

Comparable investigations on flake axes and other artifact types would presumably establish the existence of 3–4 similar local Ertebølle groups in the remainder of eastern Denmark. A group on Bornholm is markedly different due to the use of the poor local pebble flint, which precludes the manufacture of regular blades, flake axes and other larger flint types.

The causes of the local differences

The existence of local differences in eastern Denmark shows that the Ertebølle groups not only had a limited range, but also that they were closely attached to specific areas within the region. The hunters of the primeval forest were probably as limited in mobility as the "standwild" game animals they pursued and may very well have defended their territory with equal ardour. In this connection it is tempting to interpretet the recorded instances of manslaughter or murder (Albrethsen and Brinch Petersen 1977: 14), scalped children, and cannibalism (Degerbøl 1942) as results of territorial strife.

In terms of the number, size and richness of finds, the Atlantic coastal sites surpass contemporaneous inland sites on lakes and water courses. Current information indicates that the coastal sites were year-round occupations. The Vedbæk inlet with its surrounding forests could likely have sustained a permanent sedentary population of up to 60 individuals (Vang Petersen 1976; 86). Only highly sedentary populations can explain the emergence of the distinct local groups of artifacts within the Ertebølle culture.

A homogeneous distribution of food resources in the Atlantic coastal environment was of course a pre-condition for the sedentism of the Ertebølle people. This sedentary way of life also made possible intensive fishing, which seems to have fulfilled the major portion of caloric needs, according to carbon isotope analyses of human bones from Vedbæk and other Ertebølle sites (Tauber 1981). Fishing was done to a large extent with traps and nets and yielded the best result when the fishing population was permanently settled close to the fishing grounds.

Like the regional patterning, local differences in material culture may reflect the uneven distribution of resources. The Bornholm group, for example, is distinquished by the poor flint of this island. Furthermore, the manufacture of side-trimmed axes does not require the same high quality flint as the manufacture of flat-trimmed flake axes. This may to some extent explain the popularity of the side-trimmed flake axes in northeast Zealand, where the flint seems to be of lesser quality than in the rest of the island. However, the most important differences within eastern Zealand seem to be of a stylistic nature.

Stylistic groups of flake axes, or other low status objects which are manufactured by everyone and deposited locally, probably develop the same way as dialect groups develop in language – as a result of the social organisation of the population. Territorial hunters cultivate necessary social intercourse, such as marriage contracts with their closest neighbours. Investigations among the Aborigines of Australia and in Africa show that most social interaction takes place within groups of people speaking the same dialect. Within the dialectic group or tribe, which usually includes around 500 members (Birdsell 1968: 232), the communication is intense; there is much less communication with members of other dialect tribes. The linquistic differences between the dialectic tribes seem to be the direct result of the territorial division of the population into socially self-sufficient groups.

Recent ethnoarchaeological investigations among the Bushmen of the Kalahari Desert confirm that the division of social groups not only entails a difference in dialect, but also in material culture (Wiessner 1983; 267). Thus, the size and shape of the projectile points among the San Bushmen indicate membership in a dialect group. Stylistic differences among the Ertebølle flake axes likely reflect a similar social and territorial division in the late Mesolithic.

Further studies of local style zones of Mesolithic material culture will undoubtedly create a firmer archaeological basis for the recognition of territorial and social structures in the Atlantic Mesolithic cultures.

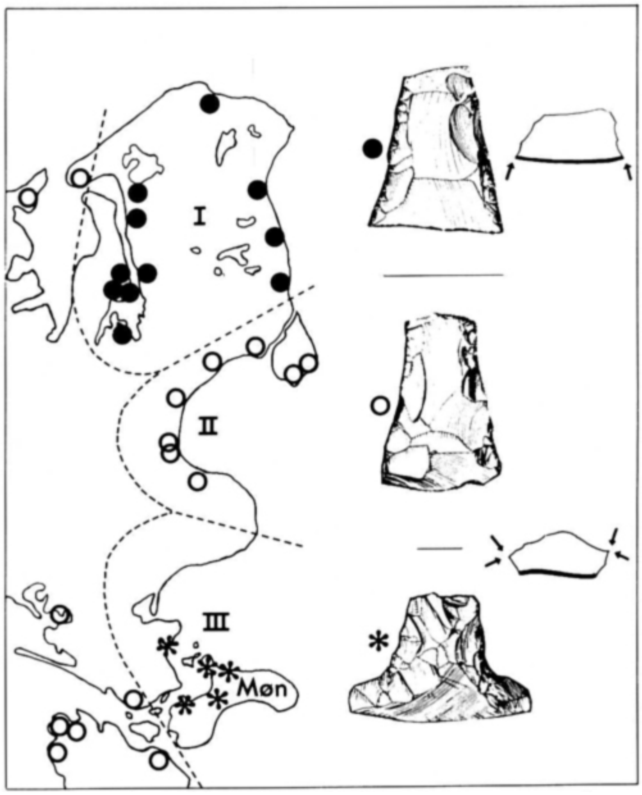


Fig. 15. Local groups of flake axes in the late Ertebølle culture in eastern Zealand: I. the sites in the northeast Zealand group are dominated by symmetrical side trimmed and asymmetrical flake axes. II. symmetrical flat trimmed flake axes prevail in the Køge Bugt group and in III. the southeast Zealand group, that has flake axes with a very broad edge – especially the flake axes from the island of Møn.

Translated by Ul S. Jørgensen

Peter Vang Petersen, The National Museum, Prehist. Dept., Frederiksholms Kanal 12, DK-1220 København K.

NOTES

1. The Vedbæk Project is an interdisciplinary research program with contributors from The Institute of Prehistoric Archaeology in Copenhagen, the Danish National Museum, The Zoological Museum, and the Department of Anthropology, both of the University of Copenhagen, the University of Wisconsin, a.o. The purpose of the project is to reveal, describe, and explain the life of the hunting and fishing population of the Vedbæk inlet between c. 5500–3000 bc (Brinch Petersen 1975).

The author wishes to thank all members of the Vedbæk excavations, especially the leader of the Vedbæk-Project, Erik Brinch Petersen, who has offered much support and inspiration as a teacher at the Institute of Prehistoric Archaeology.

2. Maglemosegårds Vænge, excavated by the Vedbæk Project 1976–79, National Museum, 1st Department, file no. 1553/76. The site was inhabited during the Vedbæk, Trylleskov, and Stationsvej phases.
3. A distinction between rhomboid and oblique transverse arrowheads is made using the ratio between long and short diagonal (fig. 4). Rhomboid arrowheads are defined as (a:b $\geq$ 1.5), Obligue transverse arrowheads as (a:b < 1.5, and v° $\geq$ 10°) whereas symmetrical transverse arrowheads has (v° < 10°). Broad edge is defined as (a:c $\leq$ 1.75) and narrow edge as (a:c > 1.75).
4. This phase was originally named after the Maglemosegård site (Vang Petersen 1979) but the risk of confusing this name with the Maglemose culture and the excavation of a less contaminated site at Stationsvej 11 in Vedbæk made a renaming necessary.
5. Maglemosegård was excavated by the Vedbæk Project 1975–1983. NM I, file no. 1035/75.
6. Stationsvej 11 was excavated by the Vedbæk Project 1982 – 1984, NM I, file no. 3727/82.
7. Aalekistebro was excavated by E. Freundt for the Nationalmuseum in 1946. NM I, file no. 751/46.
8. Only one T-shaped red deer antler axe from Zealand is known to the author. This axe was found in the Aamose in western Zealand NM I, file no. 5549/84, private collection.

REFERENCES

AARIS-SØRENSEN, K. 1980: Depauperation of the mammalian fauna of the island Zealand during the Atlantic period. *Videnskabelige Meddelelser fra dansk – naturhistorisk Forening* 1980 bd. 142.

ALBRETHSEN, S.E. & BRINCH PETERSEN, E. 1977: Excavation of a Mesolithic Cemetery at Vedbæk, Denmark. *Acta Archaeologica* vol. 47, 1976.

ANDERSEN, S.H. & MALMROS, C. 1966: Norslund. En kystboplads fra ældre stenalder. *Kuml* 1965.

ANDERSEN, S.H. 1970: Brovst. En kystboplads fra ældre stenalder. *Kuml* 1969.

– 1970: Overgangen fra ældre til yngre stenalder i Sydskandinavien set fra en mesolitisk synsvinkel. *Bonde, – Veidemann, – bofast, ikke bofast i nordisk forhistorie.* Universitetsforlaget i Tromsø – 1970.

– 1971: Ertebøllekulturens harpuner. *Kuml* 1971.

– 1975: Nye harpunfund. *Kuml* 1975.

– 1975: Ringkloster. En jysk indlandsboplads med Ertebøllekultur. *Kuml* 1973–74.

– 1978: Flade skælhuggede skiver af Brovst-type. *Kuml* 1978.

– 1980: Nye østjyske fund af mønstrede Ertebøllesager. *Kuml* 1980.

BECKER, C.J. 1939: En stenalderboplads på Ordrup Næs i Nordvestsjælland. Bidrag til spørgsmålet om Ertebøllekulturens varighed. *Aarbøger for nordisk Oldkyndighed og Historie* 1939.

BIRDSELL, J.B. 1968: Some Predictions for the Pleistocene. Based on Equilibrium Systems among Recent Hunter-Gatherers *Man the Hunter*, eds. LEE, R.B. & DEVORE, I. Chicago.

BRINCH PETERSEN, E. 1973: A Survey of the late Paleolithic and the Mesolithic of Denmark. *The Mesolithic in Europe*, ed. KOSLOWSKI, S.K. Warszawa.

– 1975: Vedbækprojektet. *Nyt og Noter fra Kulturmuseerne* 111. København.

CHRISTENSEN, C. 1982: Havniveauændringer 5500–2500 f.Kr. i Vedbækområdet, NØ-Sjælland. *Dansk Geologisk Forenings Årsskrift for 1981.* København.

CLARK, J.G.D. 1958: Blade and Trapeze Industries. *Proceedings of the Prehistoric Society* 1958.

DEGERBØL, M. 1942: Et knoglemateriale fra Dyrholm-bopladsen, en ældre stenalder-køkkenmødding. In MATHIASSEN, TH., DEGERBØL, M. & TROELS-SMITH, J.: *Dyrholmen.* Det kongelige danske Videnskabernes Selskab. Arkæologisk-kunsthistoriske Skrifter I,1. København.

ESCALON DE FONTON, M. 1971: Les civilisations de l'Epipaleolithique et du Mesolithique en Lanquedoc Oriental. *Prehistoire Francaise* I.

JACOBI, R.M. 1976: Britain Inside and Outside Mesolithic Europe. *Proceedings of the Prehistoric Society* 1976.

JENNBERT, K. 1984: *Den produktiva gåvan. Tradition och innovation i Sydskandinavien för omkring 5300 år sedan. Acta Arch. Lundensia, Series in 4. 16.*

JOHANSSON, A. 1967: Sydsjællands oldtidsbebyggelse. *Historisk samfund for Præstø Amt, Årbog* 1964.

KAPEL, H. 1969: En boplads fra tidlig atlantisk tid ved Villingebæk. *Nationalmuseets Arbejdsmark* 1969. København.

KLINGHARDT, F. 1924: *Die Steinzeitliche Kultur von Lietzow auf Rügen.* Schriften der Gesellschaft der Freunde und Förderer der Universität Greifswald, I. Mitteilungen aus der Sammlung vaterländischer Altertümer der Universität Greifswald.

LARSSON, L. 1981: En 7000-årig sydkystboplads. Nyt om gammalt från Skateholm. *Limhamnia* 1981.

MATHIASSEN, T. 1946: En boplads fra den ældre stenalder ved Vedbæk Boldbaner. *Søllerødbogen* 1946.

– 1948: *Danske Oldsager I. Ældre stenalder.* København.

ROZOY, J.G. 1978: *Les Derniers Chasseurs. L'Epipaleolithique en France et en Belgique.* Charleville.

SKAARUP, J. 1980: Undersøisk stenalder *Skalk* 1980, 1. Højbjerg.

SPÄRCK, R. 1940: *Den danske dyreverden – dyregeografisk og indvandringshistorisk belyst.* Københavns Universitet.

TAUBER, H. 1981: 13C evidence for dietary habits of prehistoric man in Denmark *Nature*, vol 292, No 5821.

VANG PETERSEN, P. 1976: Bosættelsesmønstre i atlantisk tid i Nordøstsjælland. *Kontaktstencil* 12. Turku.

– 1977: Vedbæk Boldbaner – Endnu engang. *Søllerødbogen* 1977.

– 1978: Trylleskoven. 7000 år tilbage – med S-banen. *Køge Museum* 1975–77.

– 1979: *Atlantiske bopladsfund fra Nordøstsjælland og Skåne. – Dateringsproblemer.* Unpublished Master's Thesis, University of Copenhagen.

WIESSNER, P. 1983: Style and social information in Kalahari San projectile points. *American Antiquity* vol 48, – No 2. 1983.

Journal of Danish Archaeology vol. 3, 1984, pp. 19–46

Macro and Micro Wear Traces on Lithic Projectile Points

Experimental Results and Prehistoric Examples

by ANDERS FISCHER, PETER VEMMING HANSEN & PETER RASMUSSEN

INTRODUCTION

Prehistoric flint points often show fractures and scratches. Some of these must be the result of use (cf. Hester & Heizer 1973, Paulsen 1975, Odell 1978, Moss & Newcomer 1982, Barton & Bergman 1982, Bergman & Newcomer 1983). In many cases though, the damage may as well be accidental, e.g. because Stone Age people walked on them, or because archaeologists hit them with their tools during excavation. In yet other instances they may represent the work of natural processes such as solifluction and water transport.

With the present study we have tried to discover to which extend damaged prehistoric flint points can yield information on their function. This was done on the basis of experiments the aim of which was to isolate and define types of use wear traces which could be considered diagnostic for the use as points on spears and arrows. In the following we first present the experimental work. Then types of macro- and microscopic characteristica of the projectile function are defined. Finally the experimentally derived results are tested on prehistoric points of different age, size and shape.

EXPERIMENTS

The point types employed

In the experiments we used exact copies (replica, cf. Crabtree 1966) of two completely different Stone Age point types, i.e. Brommian points and transverse arrowheads.

Brommian points date from the late glacial period, or more precisely from the centuries preceding 9000 b.c. (Fischer 1978: 31–34). So far, they have never been found attached to shafts or in any other context which conclusively establishes their field of application. Therefore, several different interpretations of functions have been possible: axe blade, knife, spear point or arrowhead (see e.g. Rust 1943: 214–215, Mathiassen 1947: 178, Becker 1971: 135, and Holm 1973: 12–15). The two first uses must be considered highly unlikely and to us the fourth possibility seems the most obvious. Consequently, in the experiments presented here Brommian points were used as tips on arrows (95 specimens), but we also mounted some on spear shafts (11 specimens).

In Denmark, transverse arrowheads were used from the late mesolithic (approx. 4500 b.c.) and up to the late Neolithic (approx. 1500 b.c.) A number of finds in Denmark and surrounding areas offer evidence for the use of the type of point in question. First it applies to 4 mounted specimens which all served as tips on arrows (e.g. Madsen 1868, pl. 22: 19, Mathiassen 1948: no. 48, Troels-Smith 1960 a: 105). Moreover, a red deer bone with imprint from a transverse arrowhead (Noe-Nygård 1974: pl. V.c, Andersen 1981: 98), and two bones with embedded transverse arrowheads (Noe-Nygård 1974: pl. VI.b, Larsson 1982: 19) (1). As these 3 small heads cannot have produced a cut broad enough for a spear shaft, it is highly likely that they were used as arrowheads. In the experiments, we only used such relatively small transverse arrowheads (33 specimens), and they were all mounted as tips on arrows.

Apart from Brommian points and transverse arrowheads, we also experimented with a few other point types. Two blade points from the Pitted Ware Culture and one late neolithic bifacially retouched point were used as tip on arrows. Furthermore, we used a lancet and a triangular microlith as tip and barb respectively

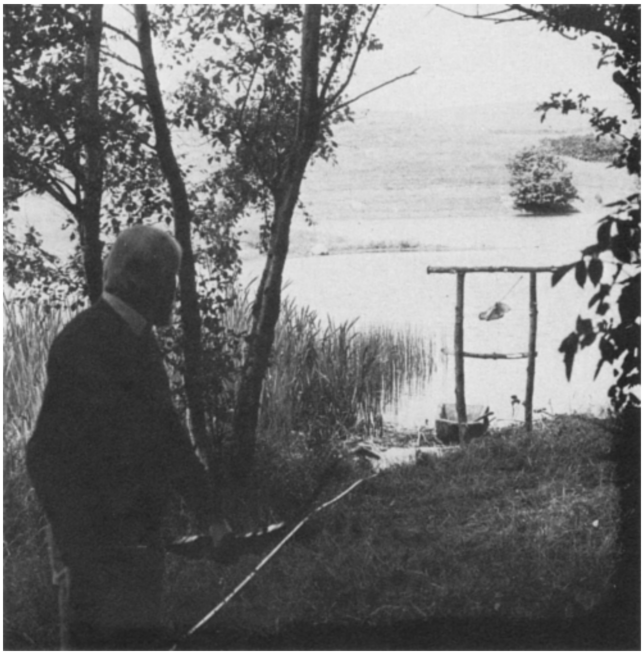


Fig. 1. Snapshot of the shooting experiments. An arrow has just been fired against a shoulder of pork suspended in a wooden frame. The lake in the background ensured that arrows missing the target remained undamaged.

on an arrow corresponding to the one found in the bog of Lilla Loshult in Scania (Malmer 1969).

Field of application

The total of 153 copies of prehistoric flint points, mounted on arrows and spears, were – as part of the experiments – shot against different targets. To evaluate whether the collision with different materials produced different wear traces, each point was shot against one object only, and normally only once. The observance of this principle was often connected with practical problems because the points could go right through the object or simply miss it. It was therefore necessary to catch these arrows in a material which could not produce wear traces. We solved this problem by placing the target in front of a lake free of vegetation (Fig. 1). During the experiments, we used the following simulated hunting objects:

- 12 joints of pork with shoulderblades, hide, fat and meat
- 1 boar head with hide, fat and meat
- 1 boned leg of boar with hide, fat and meat
- 1 newly killed and still warm boar (Fig. 2)
- 1 side of pork wih ribs, hide, fat and meat
- 7 newly killed and still warm sheep
- 4 freshly caught pikes

Moreover, we also shot against a number of objects which a prehistoric hunter could have hit by mistake. The arrows were exposed to the following:

- Collision with birch trunks
- passage through willow bushes with branches having a diameter of up to 2 cm
- passage through wet grass and collision with grass-covered, sandy soil
- passage through dense reed growth in a lake

Finally, we carried through a number of experiments, the object of which was to illuminate some of the types of fractures to which flint points could be exposed, but which had no connection with their use as projectile tips. These experiments were made at a time when we had already established that some of the most characteristic types of fractures connected with the projectile function were bending fractures perpendicular to the length (see below). Therefore, we were particularly interested in establishing whether similar fractures could be made in other ways. The following alternative damaging processes were employed:

- Skinning a boar with Brommian points hafted as knifes in wooden handles
- walking on a heap of flakes and Brommian points, placed on moist, sandy soil
- rolling of a stone, the size of a head, 20 times over a heap of flakes, placed on moist, sandy soil
- dropping of 8 hammer stones, the size of a fist, from a height of 1 m over a heap of flakes, placed on moist, sandy soil.

The manufacture and mounting of the flint points and the bows employed

To ensure that the wear traces resulting from the experimental shootings were directly comparable with the ones occurred on similar points during hunting in the Stone Age, the following considerations had to be made: The flint points had to be exact copies of the prehistoric ones and they had to be mounted as similarly to the prehistoric ones as possible. Finally, they had to be shot with a bow with roughly the same properties as the prehistoric bows.

Fig. 2. Flint-tipped arrow shot into a boar.

A skilled flintknapper produced the flint points used in the experiments (2). As to shafts and mounting of the points, two things were especially important:

1. The shaft diameter and the area of the feathers had to be coordinated in relation to the weight of the points.
2. To ensure maximum directional stability and penetration ability, the weight of the points had to be distributed symmetrically around the longitudinal axis of the shaft and the tip of the point had to be exactly in continuation of the shaft.

The above requirements could easily be complied in the case of transverse arrowheads, since there is prehistoric evidence for the mounting of this type (cf. page 19). However, the mounting of Brommian points presented large problems. Firstly, because no prehistoric examples are known and secondly, because it was difficult to mount these thick and often curved points in such a way that the directional stability of the points became optimal. In practice, the solutions described in Fig. 3 were chosen. The mounting of Brommian points as tip on spears is also shown in Fig. 3.

In the experiments we mostly used a 50 lbs. laminated recurve bow. On the basis of reconstructions (3) of the bow types known from the Danish Stone Age (e.g. Becker 1945, Troels-Smith 1960a, Petersen 1979, Andersen 1975 and 1980), it was possible to demonstrate that these bows were often very strong, but the cast, i.e. the velocity at which the limbs of the bow are straightening out, was poor compared with the employed recurve bow. The latter is not as strong as the prehistoric bow, but its cast is better. So, the discrepancy between the completely different qualities of prehistoric and modern bows was to a certain extent equalized. Therefore, it is probable that the experimental points were fired at a velocity which corresponded to the velocity of arrows fired from prehistoric bows.

MACROSCOPIC WEAR TRACES

Definition of macro fractures

The shooting experiments as well as the alternative damaging processes often resulted in wear traces which could be seen with the naked eye (fig. 7–19). A cursory inspection of the material reveals that all types of fractures are variations on a few themes. The explanation of this uniformity is found in the physical limits of the

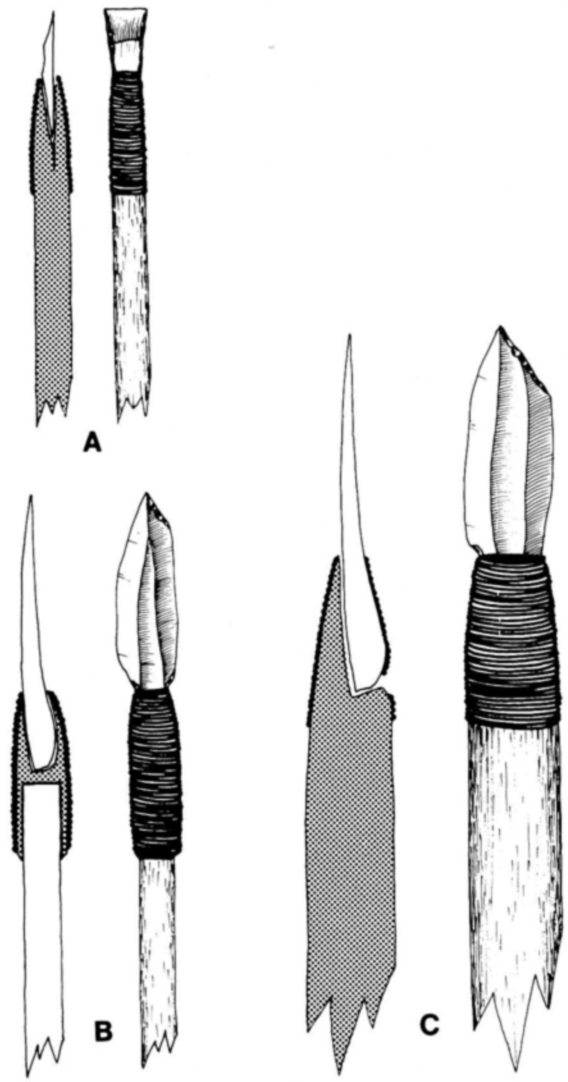


Fig. 3. Hafting principles employed in the experiments.
A. Transverse arrowhead mounted on a 8,8 mm thick pineshaft. The point was fitted into a notch which was cut athwards to the tree-rings. Here it was fixed with bitumen extracted from birch bark and finally secured with flax-thread. The shaft had 3 parabolic feathers, 125 mm long and approx. 15 mm high, mounted parallel to the longitudinal axis of the shaft.
B. Brommian point mounted as arrowhead. The point was fitted into a notch cut into a pine foreshaft, where it was fixed with bitumen extracted from birch bark or with fishglue and then secured with flax-thread.
Points weighing more than 15 g were mounted on 10 mm thick pineshafts. These had 3 feathers, approx. 140 mm long and 28 mm high, mounted parallel to the longitudinal axis of shafts. Points weighing less than 15 g were mounted on shafts similar to those used for the transverse arrowheads.
C. Brommian point mounted as tip on spear. The point was secured with flax-thread.

initiation and path of fractures in brittle materials, such as flint (Cotterell & Kamminga 1979, Lawrence 1979, Tsirk 1979). We made use of this fact when preparing a classification system which covers all macroscopic fractures observed in the experimental material. The system, which is primarily intended for fractures on flint points, follows as far as possible the definitions and nomenclature of use fractures of the Ho Ho Committee (Ho Ho Commitee 1979).

In our classification, distinction is made between two main groups of macro fractures. They are determined by fundamentally different impacts on the flint specimen. First, cone fractures which result from force applied over a relatively small area and where the fracture is found close to the contact area (Fig. 4A). Secondly, bending fractures where the force is distributed over a relatively large surface, and where the fracture does not necessarily initiate close to the contact area (Fig. 4B).

In spite of many attempts, we have not succeeded in distinguishing and defining varieties of cone fractures connected with the projectile function only. For practical reasons, the smallest cone fractures are therefore disregarded in the following. Bending fractures have been divided into 6 varieties on the basis of their path and termination (see definitions on Fig. 5). Through a further division of the different types of fractures according to size and their orientation and position on the flint objects, we are – by means of a long process of "trial and error" now working with a total of 11 characteristic and clearly definable types of fractures.

Projectile point diagnosticating macro fractures

The connection between the 11 types of fractures and the various materials and damaging processes appears from table 1. According to the table, several of the types are primarily or only combined with projectile points. The most frequent fractures – connected with the use as arrowheads and spear points only – are in the following named *diagnostic for the projectile function* (fracture types nos. 7, 8, 9, and 10 in table 1). They are all varieties of bending fractures.

The most simple projectile diagnosticating fractures are step terminating bending fractures (e.g. Fig. 7 A–D). These are a result of pressure from the ends of the flint objects, i.e. pressure parallel to the broad sides (and the length). In case of occasional damaging processes, such

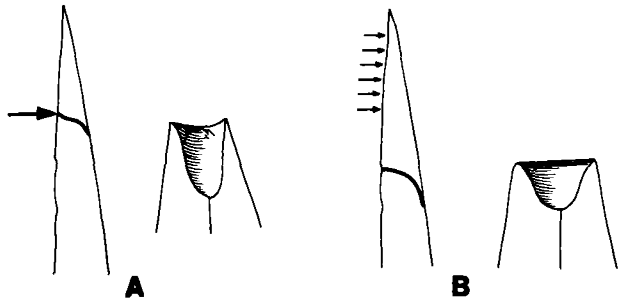


Fig. 4.
A. Example of cone fracture (seen in longitudinal section and in dorsal view). The force is applied over a relatively limited area and the fracture initiates in the immediate vicinity of the contact area.
B. Example of bending fracture (seen in longitudinal section and in dorsal view). The force is applied over a relatively large area and the fracture does not necessarily initiate in the immediate vicinity of the contact area.

as walking on the flint objects (e.g. fig. 19) and in connection with almost any other use than as a projectile point (4), any bending fracture will, however, initiate by means of pressure more or less perpendicular to the broad sides.

The probably most easily recognizable projectile point diagnosticating fractures are bending fractures from which "spin-offs" initiate (e.g. Fig. 8, 12, and 14). The experiments demonstrate that the size and location of the spin-offs are highly determined by the character of the forces from which the connected bending fractures derive. Bending fractures resulting from pressure perpendicular to the broad side (and length) of the flint objects will only result in spin-offs on one broad side, just as these spin-offs will be relatively limited in extent (Fig. 6 A).

But on the projectile points where the forces run parallel to the broad sides, the spin-off fractures may, however, have considerable dimensions: Immediately after the completion of the bending fracture, a considerable degree of kinetic energy may still remain in the projectile shaft. The two fracture surfaces may therefore be pressed together with much force. As the orientation of the force (perpendicular to the fracture surfaces and into the flint specimen) is almost optimum for the appearance of retouches, very long spin-offs may thus occur on one or even both broad sides (Fig. 6 B).

Spin-off fractures on both sides, initiating from one and the same bending fracture (e.g. Fig. 12), can in

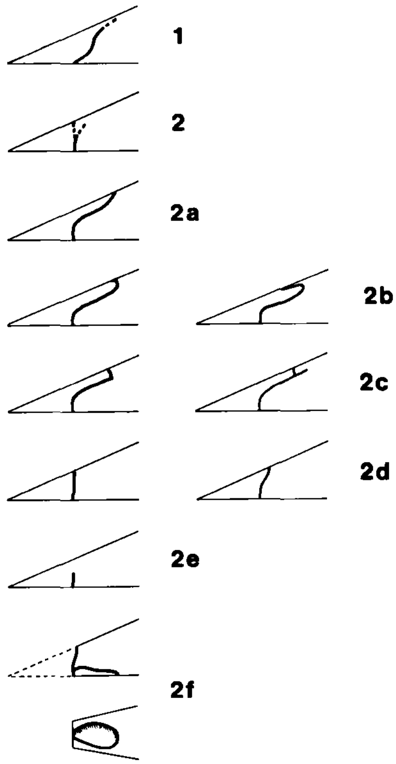


Fig. 5. Definition of macroscopic fractures on projectile points of lithic materials.

1: *Cone fracture (cone initiating fracture).* The fracture initiates from a point or a small, well-defined area, having a concave profile in the area of initiation (shown in longitudinal section).

2: *Bending fracture (bending initiating fracture).* The fracture initiates from a large area and has a straight or convex profile along its whole area of initiation.

2a: *Feather terminating bending fracture.* A bending initiating fracture which before meeting the opposite surface of the specimen runs parallel to this, and which meets the surface in an acute angle or in a curve less than or equal to 90°.

2b: *Hinge terminating bending fracture.* A bending initiating fracture which before meeting the opposite surface of the specimen runs parallel to this, and which meets the surface in a curve larger than 90°.

2c: *Step terminating bending fracture.* A bending initiating fracture which before meeting the opposite surface of the specimen runs parallel to this, and which thereafter makes an abrupt change of direction to meet the surface in a right angle.

2d: *Snap fracture (snap terminating bending fracture).* A bending initiating fracture which meets the opposite surface of the specimen without having at any point run parallel to this.

2e: *Embryonic bending fracture (unfinished bending initiating fracture).* A bending fracture where part of the fracture path ends before having reached the surface of the specimen. Thus, the fracture has not divided the specimen.

2f: *"Spin-off" fracture.* Cone fracture which initiates from a bending fracture and which removes parts of the original surface of the specimen (shown in longitudinal section and from the side).

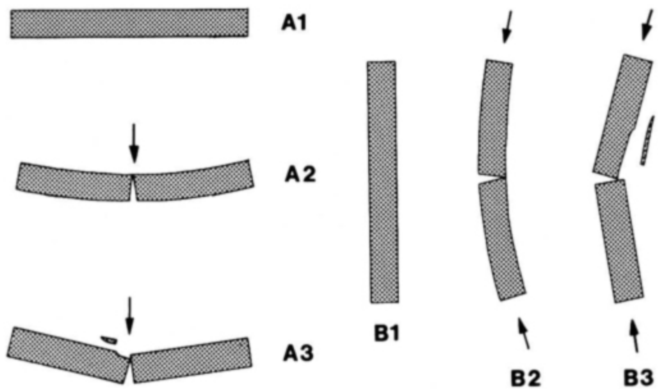


Fig. 6. Theoretical examples of the occurrence of bending fractures as a result of pressure from the broad sides and ends respectively.
A1: Flint specimen prior to pressure.
A2: Flint specimen exposed to pressure from one broad side making the specimen bend and finally break.
A3: Continued pressure from the broad side makes the surfaces of the fracture touch each other producing a small spin-off fracture.
B1: Flint specimen prior to pressure.
B2: Flint specimen exposed to pressure from the ends making the specimen bend and finally break.
B3: Continued force from the ends presses the surfaces of the fracture against each other producing a large spin-off fracture.

practise hardly occur in any other way than through the use as projectile point. This type of fracture is therefore considered diagnostic for the projectile function, irrespective of the dimensions of the fractures (Fig. 7).

If spin-off fractures occur on one side only, certain dimensions are required for them to be considered diagnostic. The larger the object, the larger is the required spin-off fracture.

The experiments shows that in the case of objects having the size of the largest Brommian points, spin-offs with a length of 6 mm or more are considered diagnostic. In the case of transverse arrowheads and similar small points, it seems safe to say that the fractures should be at least 1 mm long.

On the basis of the few experiments made so far, we cannot forward any definite proof to the effect that the types of fractures which we call projectile diagnosticating occur on spear points and arrowheads only. In case of use-wear analysis aiming at functional interpretation of prehistoric flint artifacts, it is therefore advisable to consider the morphology and general conditions of preservation of the objects before projectile points are identified on the basis of macro fractures (cf. note 4). Moreover, it should be noted that in the moment of detachment, flakes are exposed to forces very similar to the ones to which projectile points are exposed. Identification of projectile points should therefore be made on the basis of fractures which with certainty occurred after production of the flint specimens in question (5).

Type of macro fracture vs. hunting object

By means of the classification system for macro fractures presented here, it is now possible, subject to above reservations, to identify flint objects used as projectile points. However, the system affords no possibility of identifying the kind of material hit by the points. All diagnostic types of fractures occur in connection with shooting of animals as well as fish, willow branches and birch trunks (see table 2). However, subjectively it is often possible to distinguish between fractures arising from shots into soft and hard materials respectively. So, it seems that future experiments may enable us to reach a more detailed identification of the objects shot at.

Type of macro fracture vs. type of weapon

As appears from table 1, all types of macro fractures are found on spear points as well as arrowheads. So, at present we cannot identify the type of weapon. But there is a certain trend in the extent of the fractures. Some of the spear points show bending fractures which, as far as number and size are concerned, are larger than the fractures seen on the arrowheads.

Frequency of macro fractures

In table 2 we have compared the frequency of macro fractures occurring in connection with shooting into different materials. It appears from the table that projectiles shot into whole animals and into joints of animals are showing relatively high frequencies of projectile diagnosticating fractures and macro fractures generally. The most surprising result in this connection is that several of the fractures occured on points which did not hit bones (cf. table 1).

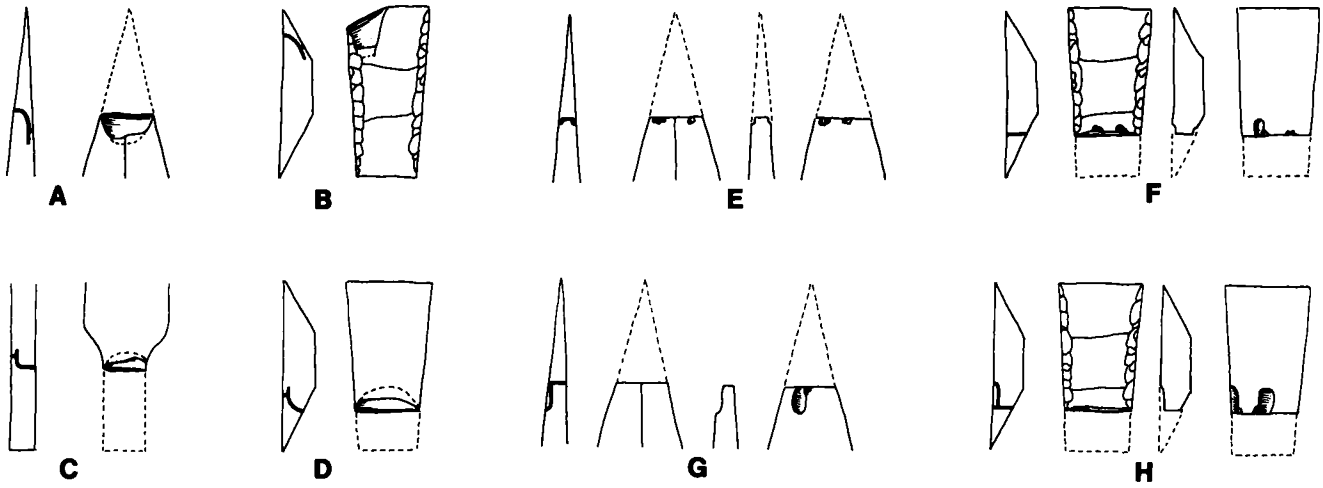


Fig. 7. Idealized examples of Brommian points and transverse arrowheads showing step terminating bending fractures (A, B, C and D), bifacial spin-offs (E and F) and unifacial spin-offs (G and H).

Macro fracture frequency vs. type of weapon

For the experiments as a whole, the frequency of projectile diagnosticating macro fractures on Brommian points used as tips on spears and arrows is 55% and 40% respectively (cf. table 2). Since the spears were not tested on as many objects as the arrows, these figures should, however, be read cautiously. More comparable figures appear from the shooting at whole, newly killed animals. Here the frequencies are 56% and 37% respectively. So, it is likely that the two types of weapons may result in different chances of fractures. But we cannot forward any definite proof on the basis of the existing material, which as for spears represents 11 points only.

Macro fracture frequency vs. hunting object

For arrows shot into simulated hunting objects such as a whole boar, whole sheep and shoulders of pork, the frequency of macro fractures is 39%, 41% and 45% respectively (cf. table 2). On this basis we assume that the frequency of diagnostic fractures on flint points shot into largish animals is generally about 40%, irrespective of the species of animal.

Macro fracture frequency vs. point morphology

In general, it applies to projectile points meant for hunting that their edges are either pointed or transverse or represent hybrids between these two basic shapes. When choosing the types of points used in the experiments, we tried to ensure that the entire spectrum of possible edge shapes were tested. So, Brommian points without retouch at the distal end represent the one extreme and the transverse arrowhead the other. Brommian points with distal retouch and the few other types used represent the intermediate shapes. With this selection of points we expect to have gained comprehensive insight into all types of macro fractures found on projectile points of flint and similar varieties of stone. This assumption is not contradicted by the outcome of the experiments, since all projectile diagnosticating fracture types are seen on pointed and transverse edges as well as on the intermediate shapes (cf. table 1). Therefore, it is very likely that the identified diagnostic macro fractures will also apply to other point types than the ones described in this article.

The frequency of projectile diagnosticating fractures on the 23 Brommian points and the 27 transverse arrowheads shot into newly killed anmals is 39% and 41% respectively (cf. table 2). On this basis it is difficult to say that the two point types have considerably different chances of being damaged when used as tips on arrows. This also applies to points shot into joints of boar and bacon meat. The fracture frequencies are here similar or a little higher. If the limited numbers of projectiles in some of these experiments are considered, the differences can be explained simply by the different

FIELD OF APPLICATION		NO. OF SPECIMENS				CONE-FRACTURE	EMBRYONIC BENDING FRACTURE	BENDING FRACTURE					SPINN-OFF FRACTURE			
						L ≥ 1 mm (L ≥ 3 mm)		Parallel to longitudinal axis, v < 30°	Obtuse or perpendicular to longitudinal axis, v ≥ 30°				On both sides and/or edges	On one side and/or edge		
														L ≥ 1 mm (L ≥ 6 mm)		L < 1 mm (L < 6 mm)
Function	Material worked	Brommian points	Transverse arrowheads	Other types of points	Flakes				Snap-terminating	Feather-terminating	Hinge-terminating	Step-terminating		on side, v < 45°	on edge, v ≥ 45°	
Arrowhead	Hide, fat and meat, warm ("alive")	7	3				2 - / - -		2 - / - -	- 1 / - -		2 1 / - -	2 - / - -		1 - / - -	3 - / - -
	Hide, fat and meat cold ("rigor mortis")	15	1				3 - / - -		5 - / - -			2 - / - -	2 - / - -			4 - / - -
	Hide, fat, meat and possibly bone	10	9			2 4 / - -			1 1 / - -	- 1 / - -	- 1 / - -	3 1 / - -	- 1 / - -	2 - / - -		- 1 / - -
	Hide, fat, meat and unspecified bone	18				7 - / - -			15 - / - -			9 - / - -	1 - / - -	3 - / - -		12 - / - -
	Hide, fat, meat and ribbone or soft part of shoulderblade	10	17	2		- 3 / - -	1 3 / - -	1 1 / - -	3 7 / - -			3 13 / - -	5 2 / - -	- 4 / - -	- 5 / - -	3 3 / - -
	Hide, fat, meat and hard part of shoulderblade or backbone	10	2	3		1 - / - -	5 - / - -	1 - / - -	4 - / 1 -	- 1 / 1 -	2 1 / - -	11 - / 2 -	3 - / 3 -	4 2 / 1 -	2 - / - -	5 - / - -
	Fish	10					1 - / - -		2 - / - -				2 - / - -			
	Trunk of birch	5	1				8 - / - -	1 - / - -	7 1 / - -	1 - / - -	1 - / - -	7 - / - -	4 - / - -	3 - / - -		9 - / - -
	Twigs and branches of willow	3										1 - / - -				
	Reed growth	4														
	Grass and soil	7				1 - / - -						1 - / - -				
	Water	5														
Spearhead	Hide, fat, meat and possibly bone	2							1 - / - -		1 - / - -	1 - / - -			1 - / - -	1 - / - -
	Hide, fat, meat and unspecified bone	9				2 - / - -			3 - / - -			6 - / - -	3 - / - -	1 - / - -	1 - / - -	2 - / - -
Knife	Hide of a boar	2				1 - / - -										
Walked upon		22			193	4 - / - 67	1 - / - 9		9 - / - 29	- - / - 2	1 - / - 3					1 - / - 2
Rolled upon by a stone					36	- - / - 13	- - / - 4		- - / - 14							- - / - 3
Droped stones upon					53	- - / - 50	- - / - 16		- - / - 52		- - / - 4					- - / - 11
	Fracture type					No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
	Projectile diagnostic fracture type											+	+	+	+	

Table 1. The combination of damaging processes and fracture types produced. The 11 types of macro fractures are defined at the top to the right. Dimensions given in paranthesis applies to Brommian points and flakes. The types considered diagnostic for the projectile point function are marked by pluses at the bottom of the tabel. The four types of specimens involved in the damaging processes are distinguished in the following way: In each square the number of fractures on Brommian points, transverse arrowheads, other types of points and flakes are given at the top to the left, at the top to the right, at the bottom to the left and at the bottom to the right respectively.

EXPERIMENTS				Number of examened points	Number of points with diagnostic macro fractures	Number of points with non-diagnostic macro fractures only	Number of un-damaged points	Frequency of points with diagnostic macro fractures
Point type	Mounted on	Shot into	Distance (m)					
Brommian point	**Arrow**	**Whole boar**	**10**	**23**	**9**	**6**	**8**	**39%**
	Spear	Whole boar	3-4	2	2	0	0	100%
	Spear	Boar head	1-3	6	3	0	3	50%
	Spear	Whole sheep	2	3	1	1	1	33%
	Arrow	Boned leg of boar	4	5	3	0	2	60%
	Arrow	**Pork with bones**	**10**	**42**	**19**	**5**	**18**	**45%**
	Arrow	Fish	1-3	10	1	0	9	10%
	Arrow	Reed growth	-	4	0	0	4	0%
	Arrow	Grass and soil	-	7	1	1	5	14%
	Arrow	Willow bush	3	3	1	0	2	33%
	Arrow	Birch trunk	4	5	3	2	0	60%
Transverse arrowhead	**Arrow**	**Whole sheep**	**10**	**27**	**11**	**4**	**12**	**41%**
	Arrow	Pork with bones	2-10	5	4	0	1	80%
	Arrow	Tree trunk	10	1	0	1	0	0%
Other point	Arrow	Pork with bones	4-5	5	2	0	3	40%

Table 2. The combination of macro fractures and experimental shootings. The 3 experiments of highest significance are shown in bold-faced types. Five points which hit water only are not included.

properties of "living" and cold meat. The former is tougher than the latter and may thus result in somewhat higher chances of fractures on penetrating projectiles. Therefore, we assume that the frequency of diagnostic fractures on flint points shot into largish animals is approx. 40%, irrespective of the morphology of the points.

In a later paragraph, we will discuss assumptions of macro fracture frequencies vs. hunting objects and point morphology in relation to data from prehistoric finds.

MICROSCOPIC WEAR TRACES

The projectile points used in the experiments show wear traces which can be observed in a microscope only (6). We used an Olympus model BHM metallurgical microscope with magnifications ranging from 50x to 400x. Prior to the examination, the points were cleaned in potassium hydroxide (10%) as well as hydrochloric acid (10%).

An examination of micro wear traces makes heavy demands on the quality of the flint. It is e.g. impossible to see micro wear traces on light and coarse-grained flint. Some of the points forming part of the macro analysis were of such a quality and were therefore excluded prior to the examination. The micro use-wear analysis thus included a total of 58 Brommian points and 27 transverse arrowheads which all served as tips on arrows. The examination included microscopic inspection of all sides and edges of the points.

Projectile diagnosticating micro wear traces

None of the examined points show the same micro wear traces as the ones seen on e.g. knives and scrapers, where it is possible to establish whether the tools were used in meat, bone, hide etc. (Keeley & Newcomer 1977, Keeley 1980). The reason why such wear traces are not seen on the points is undoubtedly the particular

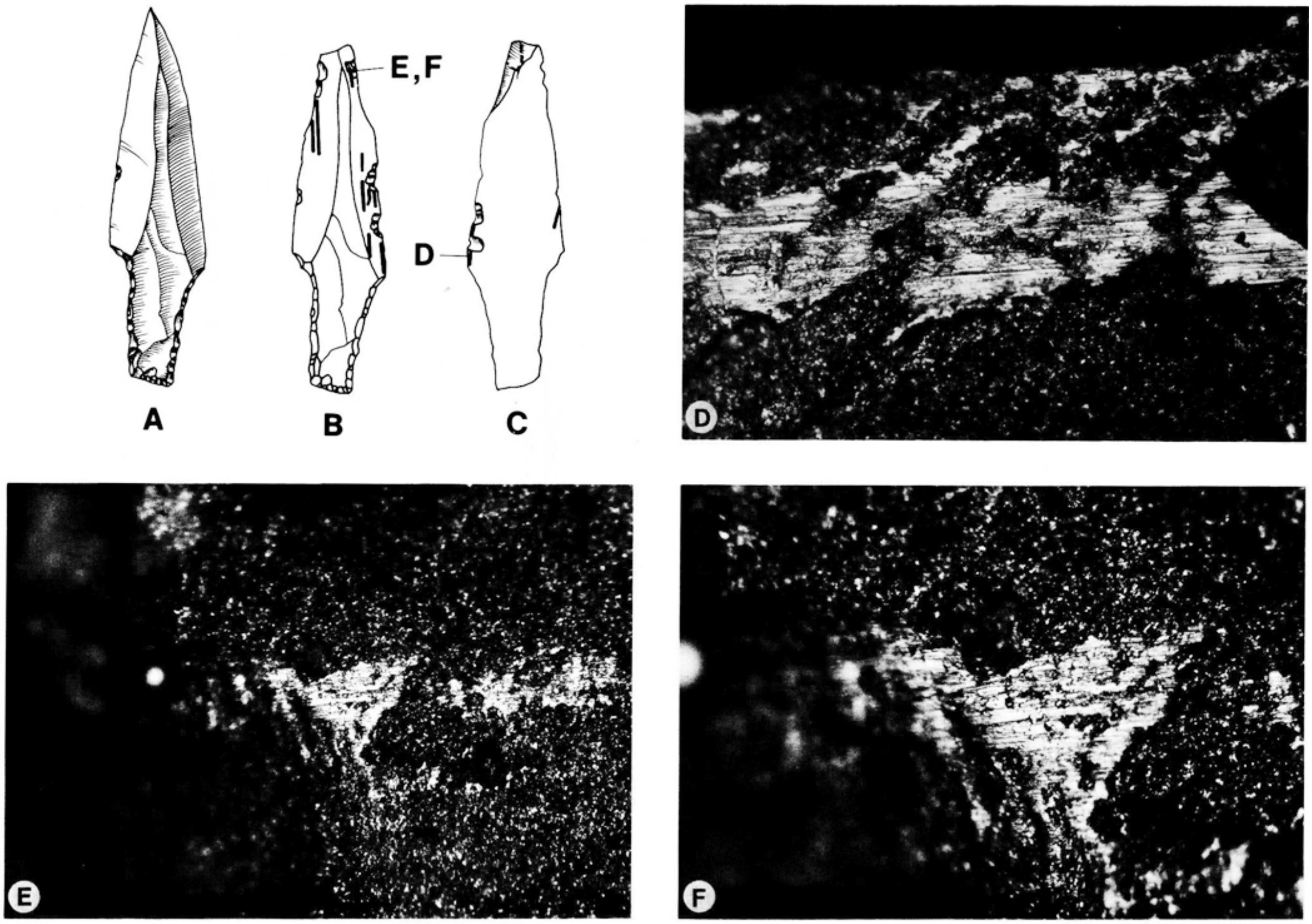


Fig. 8. Experimental Brommian point shot into a shoulder of pork. – A: Point prior to use. 2:3. – B + C: Point after use with indications of macro and micro wear traces. The dark lines indicate position and orientation of the micro wear. The tip shows a bending fracture which, in places, is step terminating and from which 1 mm long spin-offs initiate. There are also a number of cone fractures along the edges. – D: Photomicrograph of linear polish and striations. The shining part is the surface which was polished during use. In the polish are many striations oriented parallel to the longitudinal axis of the point. 1:167. – E: Linear polish with striations initiating at the bottom of a small spin-off fracture, continuing up over the edge of the fracture and running onto the surface of the point. 1:83. – F: On this photo, the focus is on the edge of the spin-off where the linear polish with striations is very developed. At the top of the picture, the polish is seen dimly at the bottom of the fracture. 1:167.

use of points. As opposed to all other tools which are normally in long and active contact with a material during use, a point is only in active contact with a hunting object in a split second. Such an extremely brief contact is apparently not sufficient to produce any of the mentioned types of wear traces. But another type of wear traces can be seen on the points, i.e. *linear polishes* and *striations*.

Linear polishes are plastic changes in the very surface of the flint, and in a light microscope they appear as long, shining stripes on the flint. Striations are very small scratches in the surface (Fig. 8D).

If the wear traces are observed in a scanning electron microscope (SEM) (7), they are not light and shining, but the SEM's three-dimensional surface view of the objects results in a far better observance of the changes in the surface of the flint (Fig. 14 G–I).

Several of the experiments clearly illustrate the reason for the occurrence of linear polishes and striations on the points: When a flint point hits the game or a similar object, small or large chips are usually separated from the point. The remaining part of the point continues into the animal and because of the resistance of the surrounding material, the chips are scoring the

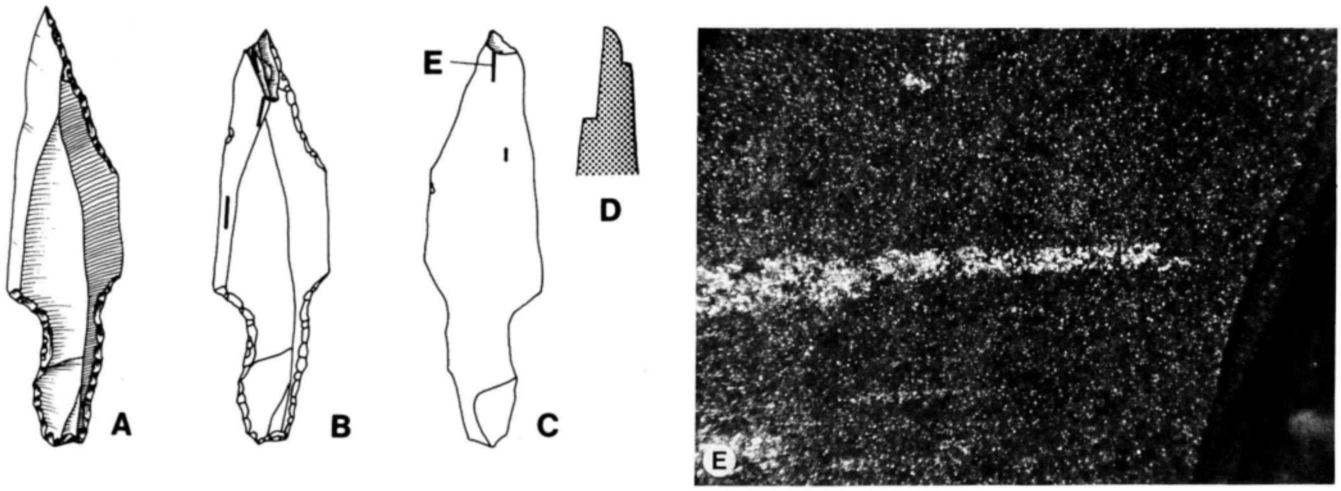


Fig. 9. Experimental Brommian point shot into a boar where it cut a rib in two and wedged between two ribs on the opposite side. – A: Prior to use. 2:3. – B + C: Point after use with indications of macro and micro wear traces. The tip shows a step terminating bending fracture initiating from the dorsal side, and running onto the ventral side. Spin-offs, up to 13 mm long, initiate from the bending fracture on the dorsal side. Further, a number of cone fractures are seen along the edges of the flint blade. – D: Cross section of the tip of the flint point. – E: Photomicrograph of linear polish and striations oriented parallel to the longitudinal axis of the point. The orientation and location of the wear traces indicate that the point was used as a projectile tip. 1:42.

point polishing and scratching its surface. The experiments demonstrate that the chips from the flint points are the cause of the occurrence of wear traces (Fig. 8E and F). The figure shows that the wear traces initiate at the bottom of a small macro fracture and continues uninterrupted up over the edge of the fracture and further over the blade of the point.

The score direction of the chips on points is normally parallel to the longitudinal axis (e.g. Fig. 9 and 15). Minor deviations from this orientation are seen in some cases. These deviations occur when e.g. an arrow hits a bone and is forced in another direction than the original (Fig. 16).

The question now is whether the linear polishes and the striations, which turned out to be connected with the projectile function can occur in any other way than through the above use. The wear traces' regular orientation parallel with or roughly parallel with the longitudinal axis of the points is important in this connection. Certain conditions must be fulfilled for wear traces to be created in such a way. The small flint chips which are the direct cause of the occurrence of micro wear traces must be exposed to a combination of pressure and movement oriented parallel with the longitudinal axis of the points. If the points are used for other purposes than as projectile points, the pressure and the move-

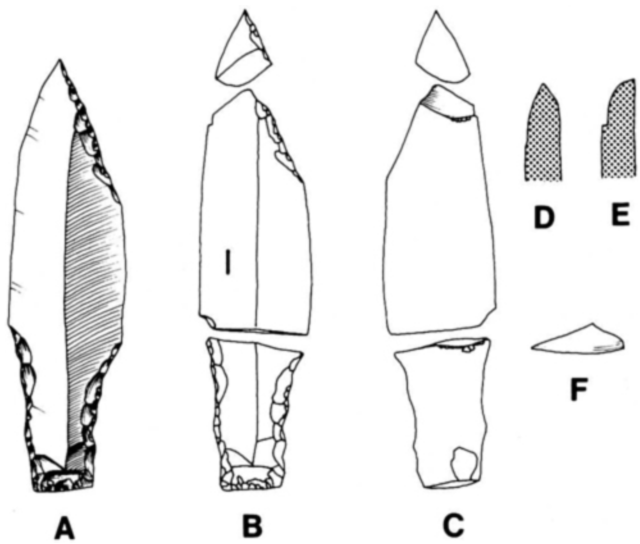


Fig. 10. Experimental Brommian point shot into a boar where it first cut a path between two ribs and then collided with a rib in the opposite side. – A: Point prior to use. 2:3. – B + C: Point after use. The proximal end shows a snap, from which several unifacial spin-offs, max. 1 mm long, initiate. The tip shows a bending fracture which is feather terminated at the one side (D) and step terminated (E) at the other. From this bending fracture, several spin-offs, less than 1 mm long, initiate. – D + E: Cross sections of bending fracture. It is step terminated at the one side, and is consequently diagnostic for the projectile function. – F: Snap fracture with faintly developed ondulations.

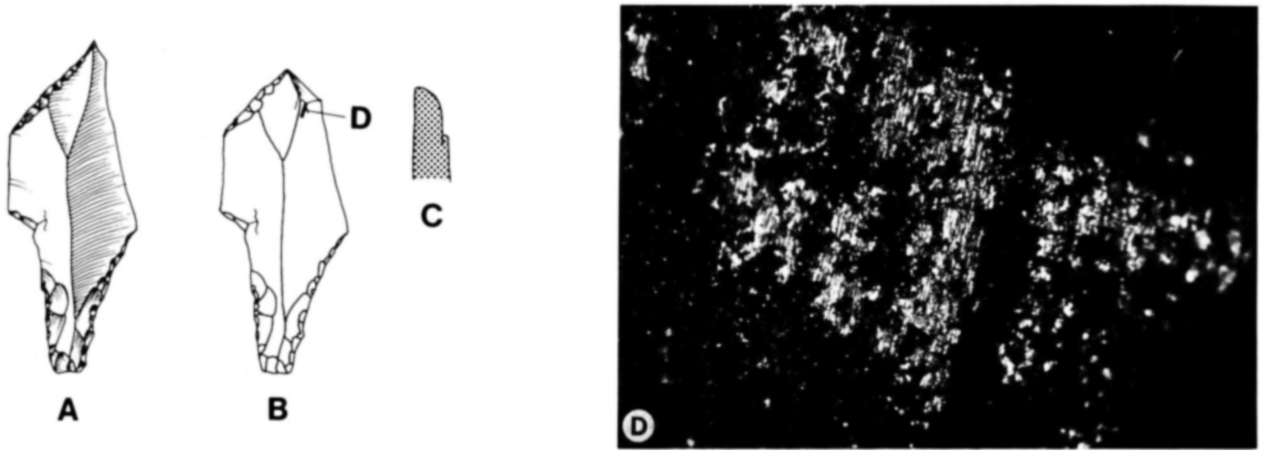


Fig. 11. Experimental Brommian point shot into a willow branch approx. 2 cm thick. – A: Prior to use. 2:3. – B + C: After use. The tip shows a step terminating bending fracture. – D: Photomicrograph of linear polishes and striations. 1:83.

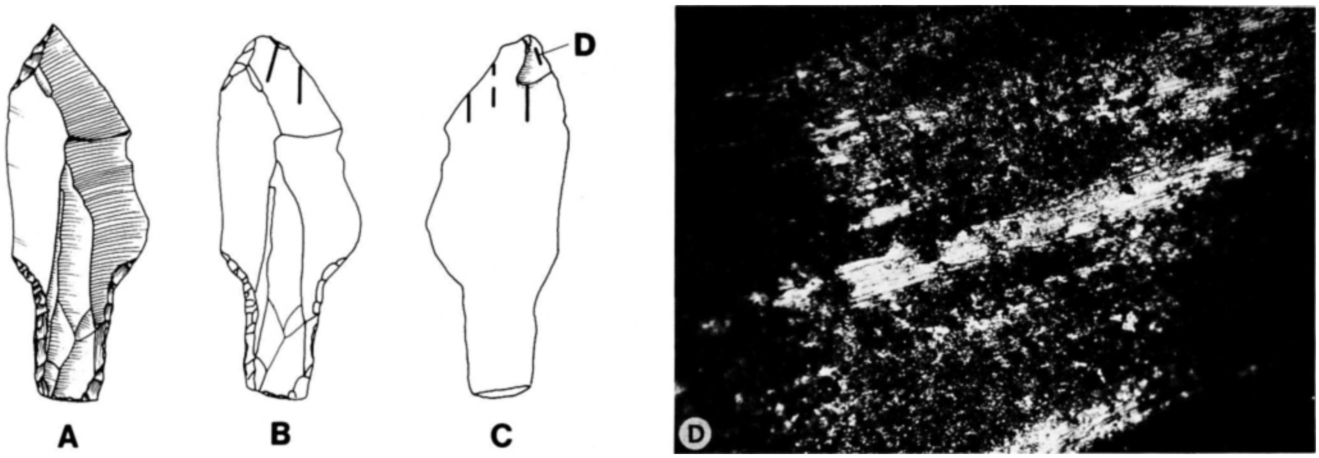


Fig. 12. Brommian point shot into a boar where it went through the chest, forced its way into the heart and stopped with the tip protruding into the thoracic cavity. – A: Prior to use. 2:3. – B + C: After use with indications of macro and micro wear traces. Two step terminating bending fractures are seen on the ventral side. From these, a spin-off fracture, well over 1 mm long, initiates on the dorsal side. – D: Photomicrograph of linear polishes and striations. 1:83.

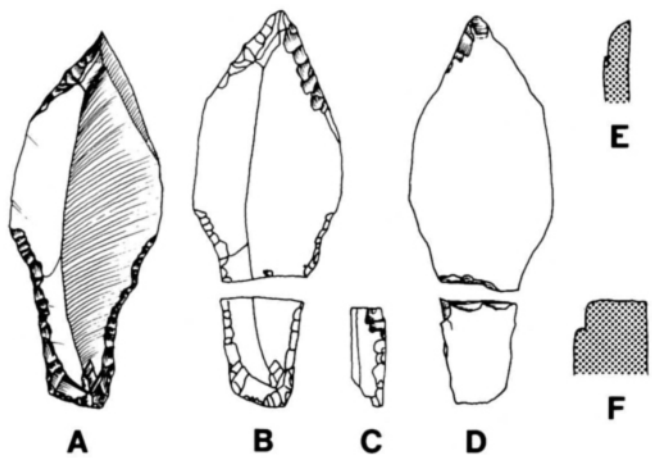


Fig. 13. Experimental Brommian point used as tip on spear. The spear was thrown against the head of a boar and the tip went through hide and meat and grazed the lower jar. – A: prior to use. 2:3. – B – D: After use. The distal end was heavily damaged on collision with the jar bone. On the tip is a small step terminating bending fracture. Moreover, a series of cone fractures is seen along the front edge of the blade. The proximal end shows a step terminating bending fracture from which several spin-offs initiate. The spin-offs on the blade are bifacial. The largest of these which removed parts of the retouch are very similar to burin blows. – E – F: Cross section of step terminating bending fractures on tip and proximal end.

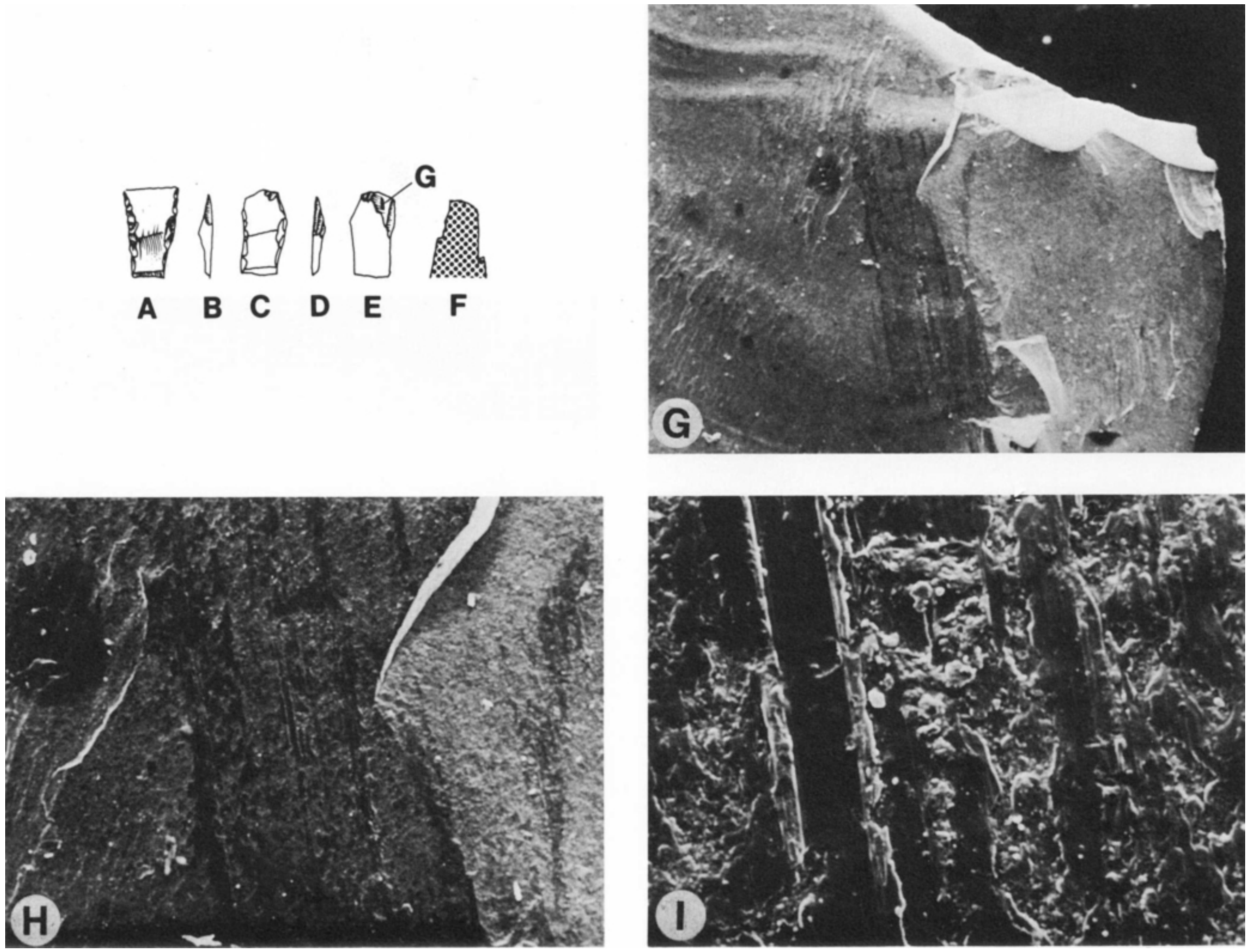
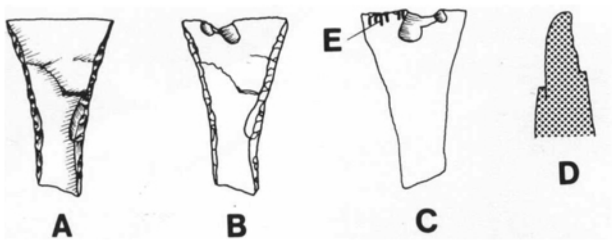


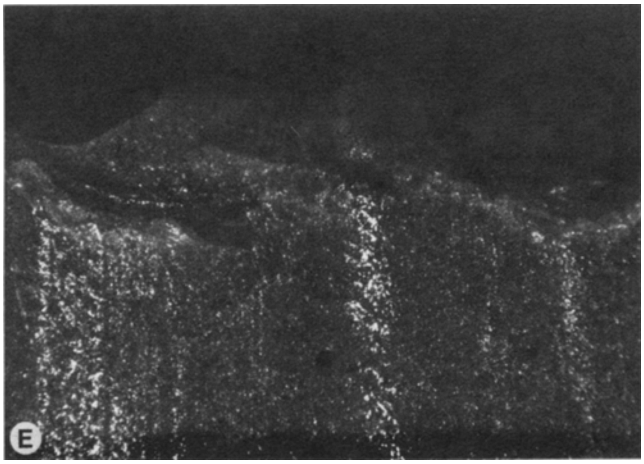
Fig. 14. Experimental transverse arrowhead shot through the chest of a sheep. – A: Prior to use. 2:3. – B–E: After use. The edge is heavily damaged. The fractures consist of several bending fractures and spin-offs. – F: Cross section of the edge at a place where a step terminating bending fracture is the basis of a spin-off. – G: SEM-photo of wear traces which are seen as long, dark lines oriented approximately perpendicular to the edge. 1:40. – H: Section of G. A very distinct striation is seen at the arrow. 1:110. – I: Section of H. To the right, at the arrow, polish of the originally uneven surface is seen. To the left are several striations of which one in particular is cut very deeply down into the surface of the flint. 1:1100.

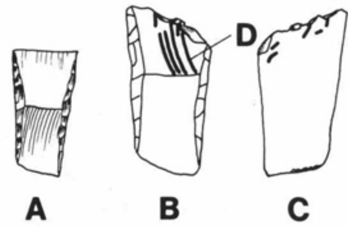
ment will be oriented more or less perpendicular to the longitudinal axis of the flint specimen and the micro wear traces will accordingly not run parallel with the longitudinal axis. If used as a knife, characteristic surface covering polishes will be created which are clearly connected to the edge (Fig. 20 and 21). In the absence of definite proof, it seems reasonable to presume that linear polishes and striations occur only on flint points used as projectiles. In the following these wear traces are therefore considered diagnostic for the projectile function.

Micro wear traces vs. hunting object

The experiments show that it is impossible to establish what the projectile point hit. As appears from table 3, the projectile diagnosticating wear traces occur when an arrow is shot into animals, willow branches, birch trunks as well as soil (Fig. 11). The only exception being fish where a socalled fish polish may occur on the point (9) (Fig. 22).







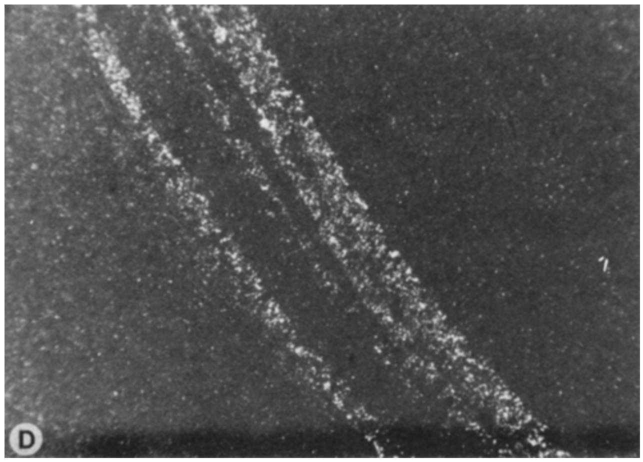


Fig. 15. Experimental transverse arrowhead shot at a right angle against the chest of a sheep where it first splintered a rib and then made a cut in the lower part of the spine. – A: Prior to use. 2:3. – B + C: After use. The whole edge shows macro fractures, i.e. small cone fractures and a large step terminating bending fracture (C) from which several spin-offs, up to 3 mm long, initiate on the dorsal side. – D: Cross section of the edge with a step terminating bending fracture, from which a (step terminating) cone fracture initiate. – E: Photomicrograph of linear polishes and striations initiating from the edge and running parallel with the length over the blade. 1:42.

Fig. 16. Experimental transverse arrowhead shot into a sheep where it hit a rib. – A: Prior to use. 2:3. – B + C: After use. There are macro fractures along almost the entire edge. A snap terminating bending fracture is seen on the ventral side. From this, two spin-offs initiate on the dorsal side of which the longest is approx. 2 mm. The proximal end shows a snap terminating bending fracture and several small cone fractures. – D: Photomicrograph of wear traces. The linear polishes and striations are turning, probably because the point changed its course on collision with the rib. 1:42.

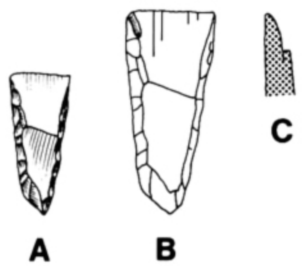


Fig. 17. Experimental transverse arrowhead shot into a sheep where it produced a cut in a rib on each side of the chest. – A: Prior to use. 2:3. – B: After use. A small step terminating bending fracture initiates from the left side of the edge. The dorsal side shows micro wear traces oriented parallel with the length. They are so faintly developed that it would hardly be possible to see them on a prehistoric specimen. Therefore, they are considered non-diagnostic. – C: Cross section of the step terminating bending fracture.

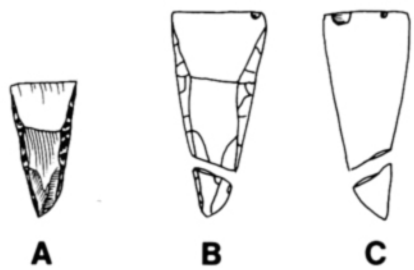


Fig. 18. Experimental transverse arrowhead shot through the chest of a sheep. – A: Prior to use. 2:3. – B + C: After use. The edge shows several very small cone fractures and two small, non-step terminating bending fractures. Micro wear traces oriented parallel with the length are seen on the dorsal and the ventral side. They are faintly developed and are consequently considered non-diagnostic.

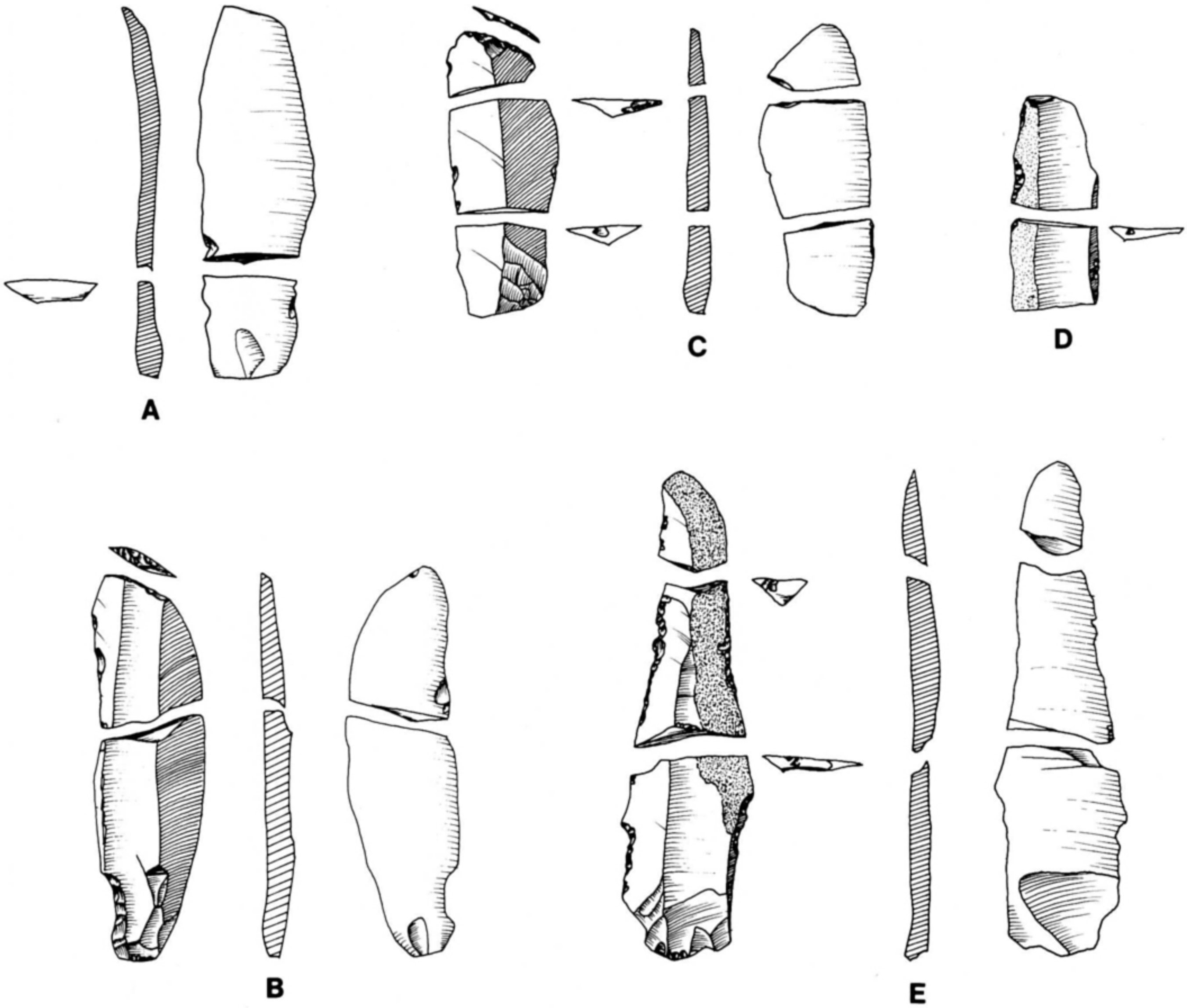


Fig. 19. Examples of bending and cone fractures produced by "accidental" processes. The fractures on A, B and D are the results of dropping of hammer-stones on a heap of flakes, and on C and E of walking on a heap of flakes. The bending fractures are generally of the snap type and very often there are secondary cone fractures on top of them (e.g. B, C and E). E represents one of the few accidentally produced bending fractures from which spin-offs initiate. They are unifacial and relatively small related to the size of the flake. 2:3.

The frequency of micro wear traces vs. hunting object

On arrows shot into simulated hunting objects, such as whole boar, shoulders of pork and whole sheep, micro wear traces are observed having roughly the same frequencies, i.e. 61%, 66% and 66% respectively (see table 3). This means that the chances of micro wear traces on projectile points shot into life-like hunting objects are roughly 60%.

Two of the arrows shot into the boar clearly illustrate that micro wear traces are not always seen on projectiles shot into hunting objects. We know for certain that the two arrows would have been fatal. The one arrow went into the boar immediately in front of the right hind leg, passed the abdominal cavity and cut a hole, approx. 2 cm long, in the lower vena cava. The other arrow went into the animal behind the right foreleg, went through the anterior wall of the right ventricle at an oblique

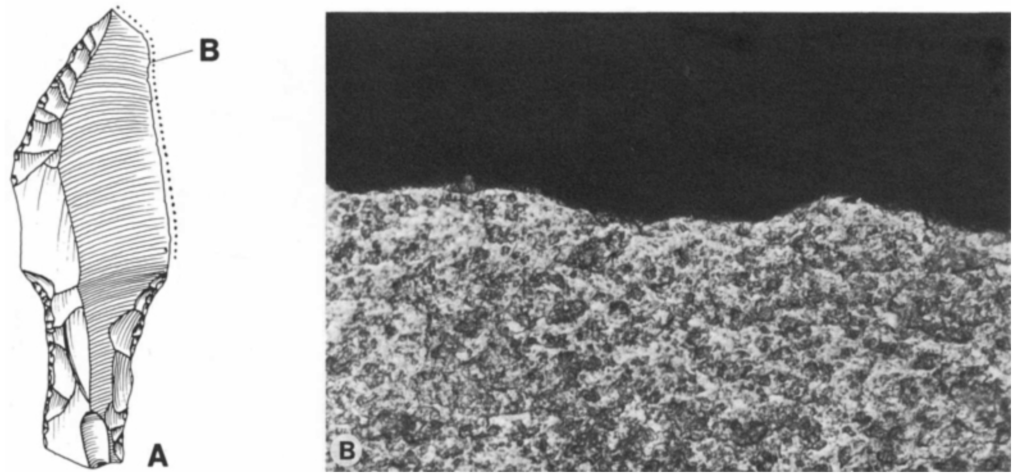


Fig. 20. Brommian point used for approx. 45 min. as knife for skinning a boar. A well-developed meat polish is seen along the edge. The polish is dull and the contrast to the unpolished surface of the flint is relatively insignificant. The polish follows the small elevations and depressions of the original flint surface so the surface is very granulated and uneven. Drawing 2:3, microphoto 1:333.

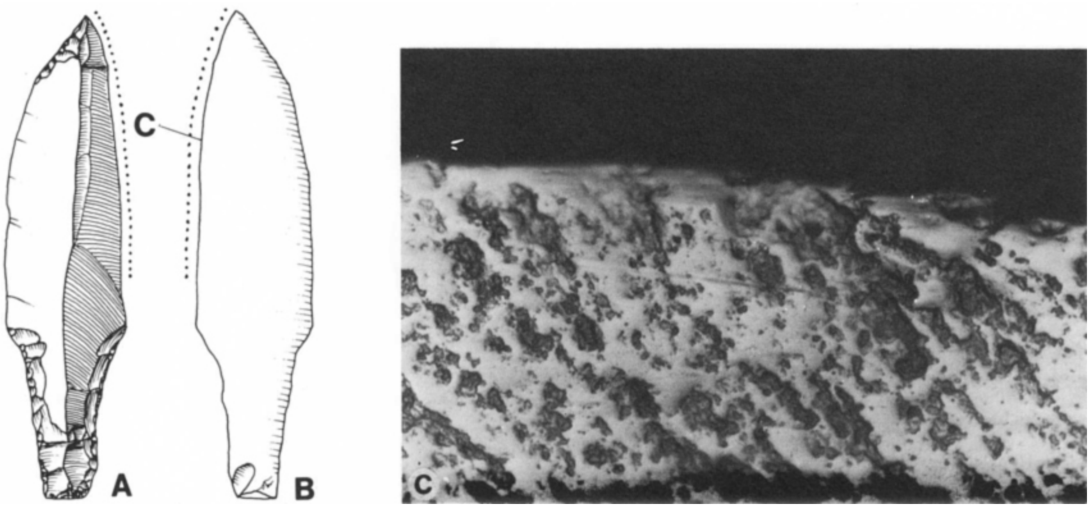


Fig. 21. Brommian point used for 15 min. as knife for cutting grass. A plant polish is seen along the edge. The polish is shining, even and smooth and covers a relatively wide belt along the working edge. Striations oriented parallel with the edge are seen in the polish. Drawing 2:3, microphoto 1:333.

angle and into the left thoracic cavity. The point hitting the heart shows diagnostic micro and macro wear (Fig. 12), while the one hitting the vena cava shows no wear traces at all. So, the two arrows clearly illustrate the framework within which we must work when moving from experiments to the study of prehistoric projectile points: On the one hand, it is possible – on the basis of the presence of wear traces – to establish for certain that a point was used. On the other hand, absence of wear traces does not necessarily mean that a point was not used, since the above example shows that even a fatal shot can result in the point being intact without any wear traces at all.

The frequency of micro wear traces vs. point morphology

If we consider the 23 Brommian points and the 27 transverse arrowheads shot into largish life-like hunting objects, the frequency of projectile diagnosticating

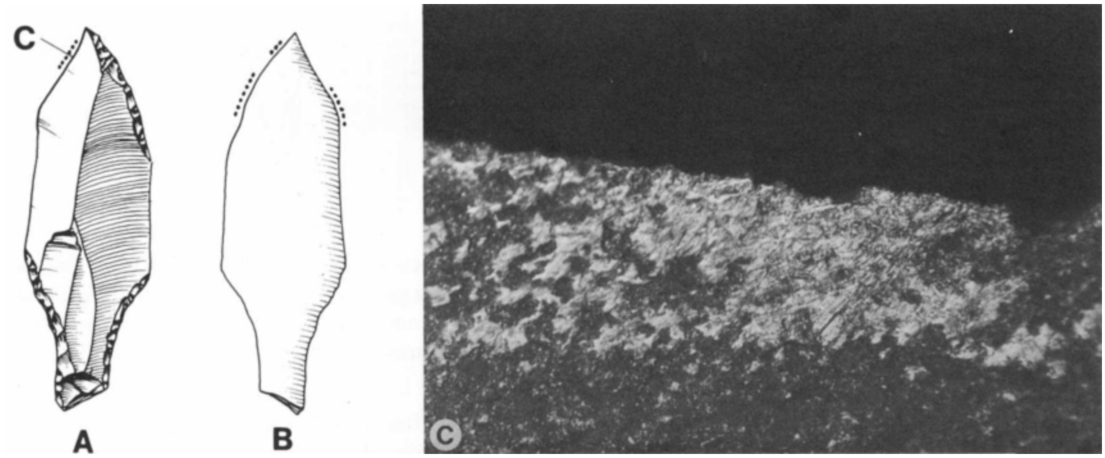


Fig. 22. Brommian point shot into a pike. The tip shows areas with fish polish. The polish is relatively bright and the contrast to the unpolished surfaces of the flint is significant. Superficially striations oriented in all directions are seen in the polish. 1:167.

micro wear traces is roughly similar, i.e. 61% and 66% respectively.

The points must be considered representatives of the whole range of edge morphologies of arrow tips (cf. page 25). We therefore assume that the frequency of diagnostic micro wear traces on points shot into animals is approx. 60%, irrespective of the morphology of the points.

MACRO AND MICRO WEAR TRACES ON PREHISTORIC FLINT POINTS

For the purpose of testing the applicability of the projectile diagnosticating macro and micro wear traces described in the preceding passages, we have analysed a selection of prehistoric flint points. The analysis included a number of points from different sites pur-

EXPERIMENTS		Number of examened points	Number of points with diagnostic micro wear traces	Number of points with non-diagnostic micro wear traces	Number of undamaged points	Frequency of points with diagnostic micro wear traces
Point type	Shot into					
Brom-mian point	Whole boar	23	14	2	7	57%
	Boned leg of boar	5	1	2	2	20%
	Pork with shoulder-blade	12	8	0	4	66%
	Fish	4	3	0	1	75%
	Reed growth	4	0	0	4	0%
	Grass and soil	5	1	0	2	20%
	Willow bush	3	1	0	2	33%
	Birch trunk	2	2	0	0	100%
Transverse arrowhead	Whole sheep	27	18	8	1	66%

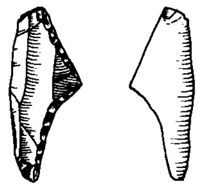
Table 3. The combination of micro wear traces and experimental shootings. (8).

posively chosen so that the analysed material included a large number of Brommian points and transverse arrowheads as well as all Danish finds of animal skeletons with attached flint points referable to a morphological type. The purpose of the analysis was to obtain answers to the following questions:

1) Are the above defined projectile point diagnosticating characteristics found on prehistoric flint points?

2) Are hunting object and point morphology influencing the frequency of projectile diagnosticating wear traces?

Before we present a conclusive reply to these questions, we shall give a description of the prehistoric points and the circumstances of their discovery. The individual sites are mentioned chronologically.



A B

Fig. 23. Hamburgian point ("Kerbspitze") from the lower layer at Stellmoor. The tip shows a hinge terminating bending fracture initiating from the distal retouch and running a little down the opposite edge. From this fracture, spin-offs initiate on both broad sides. 1:1,5.

Stellmoor – Lower Layer

Water-deposited layer from the Hamburgian culture, excavated north-east of Hamburg (Rust 1943). The layer is dated to pollen zone I, ex. Iversen, and most likely to the middle part of said zone, the Bølling period (Usinger 1975: 123 and 136). A C-14 analysis (W-261) established its age to 10500 ± 200 b.c. The find contains 5 *Kerbspitzen.* Among the 4 which could be subjected to a thorough macro fracture analysis, 2 show projectile diagnosticating bending fractures (Fig. 23). The fifth is shot into the vertebra of a reindeer and its tip is not visible. An X-ray (10) has shown that there is at least one bending fracture perpendicular to the length on that part of the point which is hidden in the bone. The visible part of the object shows a non-diagnostic bending fracture. None of the points were examined for micro wear traces.

Ommelshoved

Site of the Brommian culture, situated on the beach of the north-eastern part of Ærø. The material comprises 111 more or less fragmented Brommian points and a handful of unretouched blades of the same age, all found within an area of approx. 25 times 5 m. No other late paleolithic objects were found, so the excavator interprets the place as a "kill site" (Holm 1973: 11).

Of the 110 points examined, 12 show projectile diagnosticating macro fractures. The number of these fractures may originally have been a little larger, since later damage, such as water wear blurred the original shape of several of the points. The existing diagnostic fractures include 7 step terminating bending fractures (Fig. 24 B and E), 3 unifacial spin-offs more than 6 mm long (Fig. 24 C) and 2 spin-offs extending over both broad sides (Fig. 24 E).

All point surfaces show varying degrees of physical or chemical disintegration because of water wear, solifluction, decalcification etc. The least damaged specimens were analysed for micro wear traces, and one of these showed linear polish which may – subject to reservations – be called projectile point diagnosticating. Another showed clear diagnostic wear traces at the bottom of a large macro fracture (Fig. 24 F).

Bromme

Excavated settlement in the south-west of Zealand (Mathiassen 1947), dated to pollen zone II, the Allerød period (Iversen 1947).

The material comprises 65 Brommian points of which 1 must be considered unfinished, whereas 8 were re-worked into burins or scrapers. Only 3 of the points show projectile point diagnosticating macro fractures. But the number may originally have been larger since 9 of the points had been exposed to so heavy, secondary damage that the wear traces may have disappeared. The existing diagnostic macro fractures include two cases of step terminating bending fractures and two spin-offs of a length of more than 6 mm (Fig. 24A).

The surfaces of all points are worn as a result of periglacial soil movements. Moreover, several of them are made of such light flint that they are unsuitable for the observance of micro wear traces.

Stellmoor – Upper Layer

Water-deposited layer from the Ahrensburgian culture (Rust 1943). By means of pollen analysis, the sediment is dated to the Younger Dryas period, pollen zone III (Schütrumpf 1943).

The abundant material included among other things the oldest known bows and arrowshafts in the world. In two of the arrowshafts, broken proximal ends of tanged points were found (11). A third arrowshaft was found in the immediate vicinity of a tanged point (Fig. 25B) in the abdomen of the skeleton of a reindeer. The circumstances of the discovery indicate that the flint point was originally mounted on the arrowshaft and shot into the reindeer (Rust 1943: 191). Moreover, a number of shoulder blades with holes in them indicate that the numerous reindeer discovered were shot with flint points mounted on arrowshafts (Rust 1943: 186–187). This is further supported by two reindeer vertebrae with embedded fragments of flint points (Rust 1943: Tafel 87 and Möller 1975). Of the 45 points examined in detail, 19 showed projectile diagnosticating macro fractures (18 tanged points and 1 Zonhoven point). There were 11 step terminating bending fractures (Fig. 25 A and D), 4 spin-offs over two broad sides

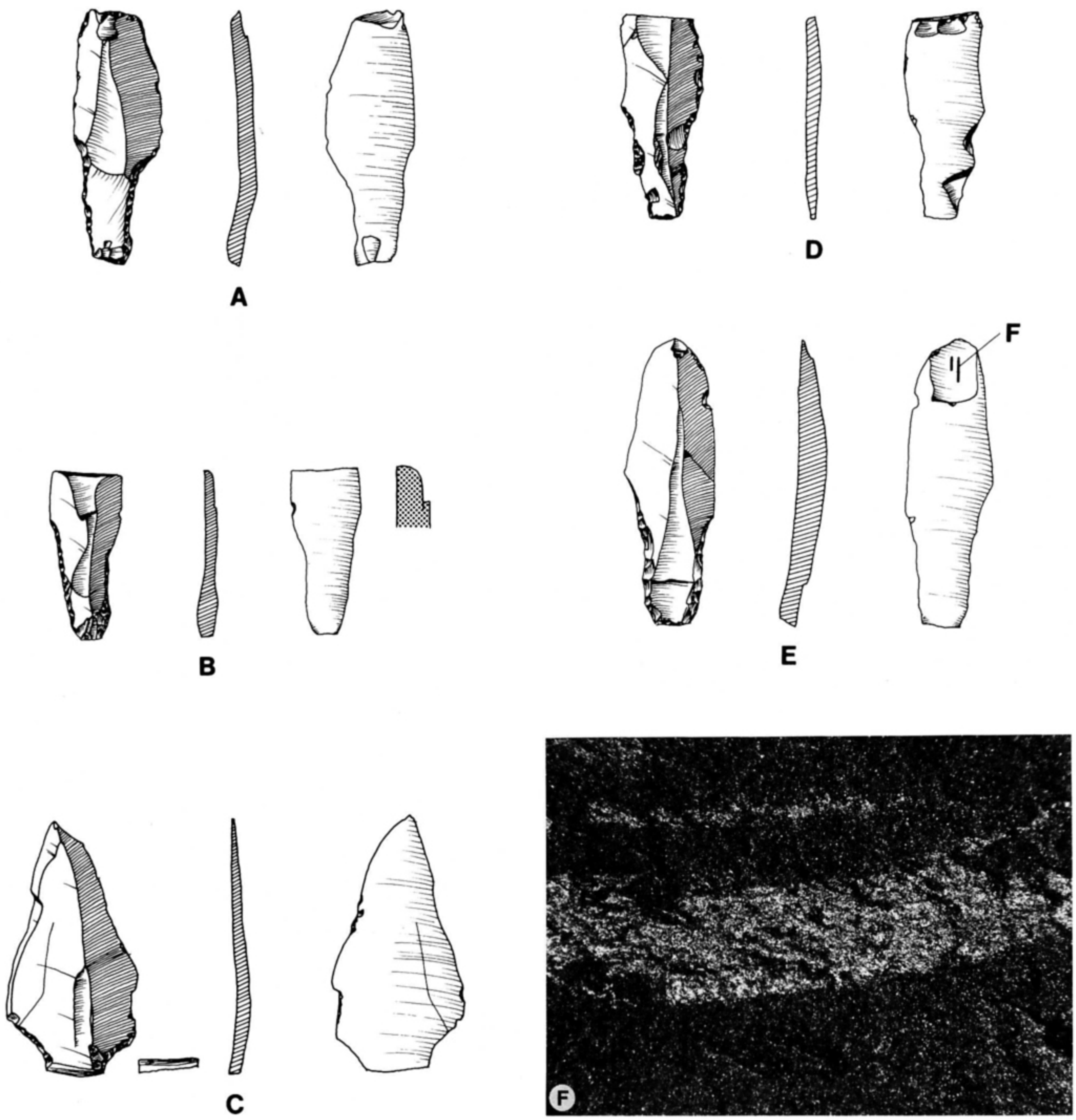


Fig. 24. Examples of Brommian points with wear traces. A is from Bromme (*locus classicus*) and B – E from Ommelshoved. 2:3. – A: The distal part shows a step terminating bending fracture from which unifacial spin-offs, more than 6 mm long, initiate. – B: The distal part shows a step terminating bending fracture. – C: The proximal part shows a bending fracture from which a spin-off, more than 6 mm long, initiate. – D: The edges are heavily water worn. The tip shows a snap fracture from which unifacial spin-offs, less than 6 mm long, initiate. The wear traces are non-diagnostic. – E: The tip shows a step terminating bending fracture from which bifacial spin-offs initiate. There are linear polishes at the bottom of the bending fracture. Both the macro and micro wear traces on this point are fine examples of diagnostic wear. – F: Photomicrograph of linear polish, oriented parallel to the longitudinal axis of the point. 1:42.

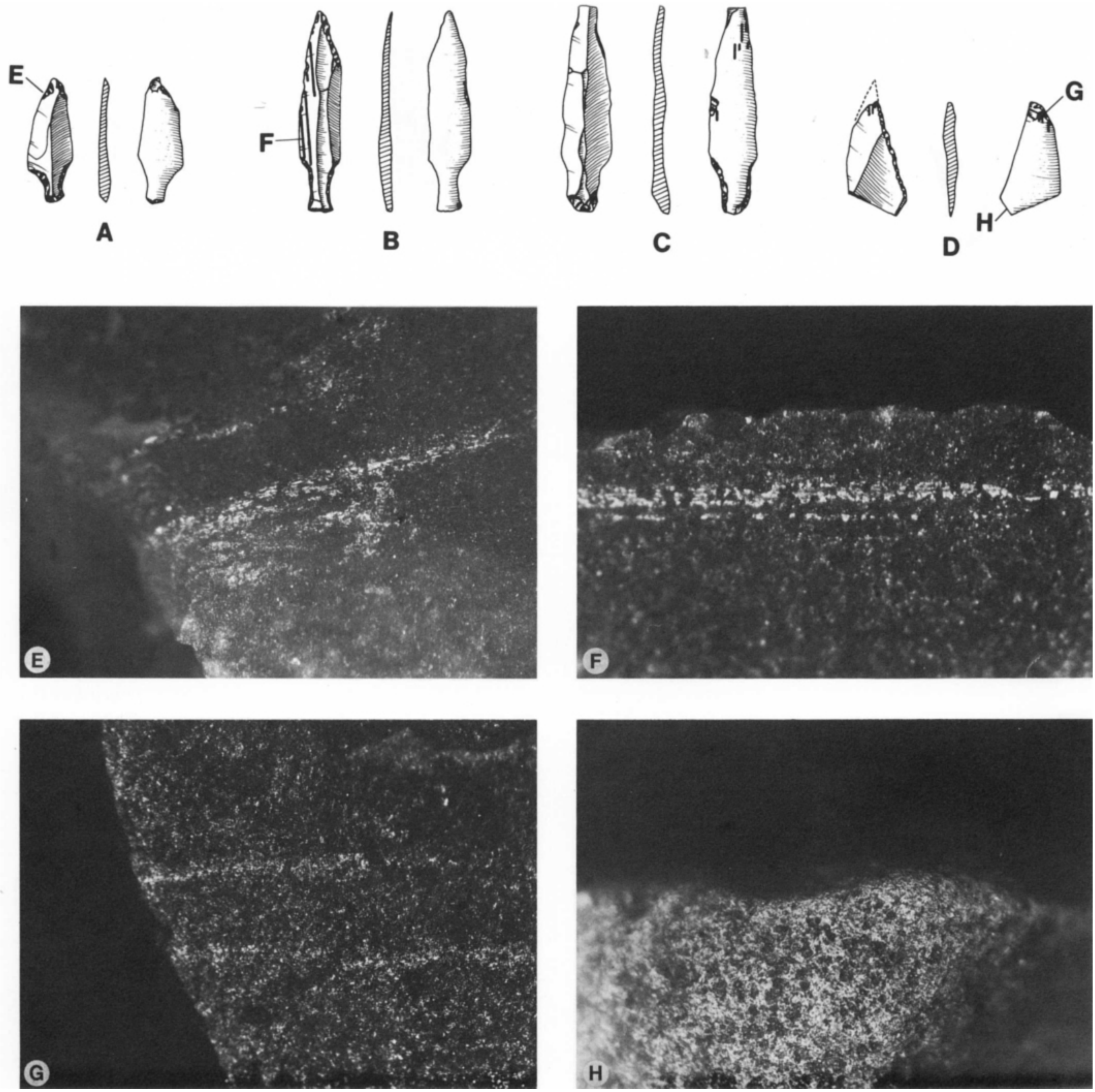


Fig. 25. Examples of flint points from the upper layer at Stellmoor, with indications of macro and micro wear traces. A–C: tanged points, D : Zonhoven point. 2:3. – A: The dorsal side of the tip shows a small step terminating bending fracture from which several unifacial spin-offs initiate on the ventral side. Along the distal part of the edges are several cone fractures. – B: Several cone fractures are seen along the edges. – C: The tip shows a snap fracture from which several unifacial spin-offs initiate. One of these is 13 mm long and runs along the edge, resembling a burin blow. Along the edges, several cone fractures are seen. – D: The tip shows two step terminating bending fractures. From these, a unifacial spin-off, less than 1 mm long, initiates on the dorsal side. A small cone fracture is seen on the dorsal side of the base. – E: Photomicrograph of linear polish with striations at the bottom of a small fracture. The micro wear is oriented parallel to the longitudinal axis of the point (cf. A). 1:83. – F: Photomicrograph of linear polish with striations running along the edge of the point (cf. B). 1:83. – G: Photomicrograph of linear polish at the tip of the Zonhoven point (cf. D). 1:83. – H: Photomicrograph of an abrasion at the proximal end of the Zonhoven point. This abrasion may be a result of friction between the point and the shaft (cf. D). 1:167.

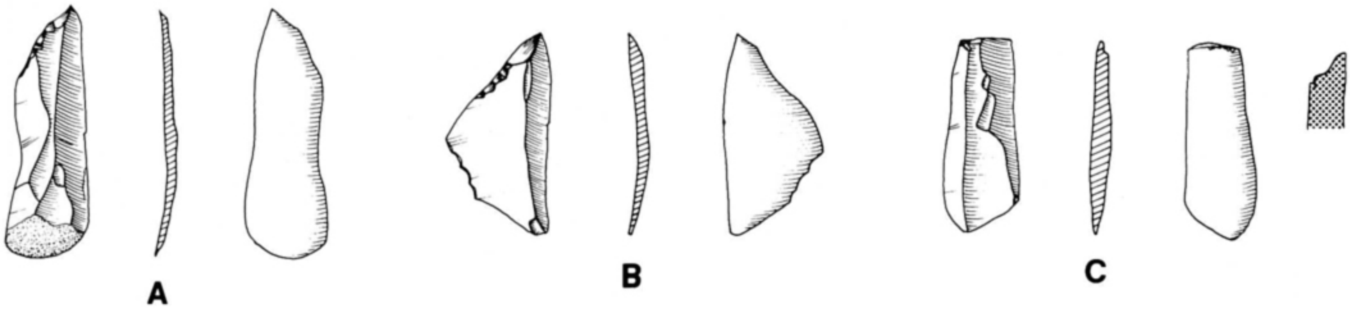


Fig. 26. The three microliths from the aurochs from Vig. 2:3. – A: No wear traces are seen. – B: The proximal end shows several small snap fractures. – C: The tip shows a bending fracture which, in places, is step terminating. From this fracture several spin-offs, less than 1 mm long, initiate on the ventral side.

and 12 unifacial spin-offs of a length of more than 1 mm (Fig. 25 A, C and D). (As the points are relatively small, spin-offs with a length of more than 1 mm are considered diagnostic).

23 of the points were examined for micro wear traces. Of these, 13 showed no wear traces. 4 had wear traces which could – subject to reservations – be considered projectile diagnosticating, and 8 (6 tanged points and 2 Zonhoven points) showed clear, projectile diagnosticating micro wear traces (Fig. 25).

The frequency of diagnostic macro and micro wear traces is relatively high in this assemblage. Moreover, all discovered points show non-diagnostic fractures and wear traces which may well have arisen from their use as projectile tips. Therefore, it is likely that all flint points from the upper layer at Stellmoor represent used arrowheads.

The Aurochs from Vig

A complete and well-preserved skeleton of an aurochs found during peat digging in a small bog at Vig in the north-west of Zealand (Hartz & Winge 1906). The animal was dated to pollen zone IV, the preboreal period (Degerbøl & Fredskild 1970: 188–189).

Two ribs on the right side of the aurochs show lesions with embedded flint chips. The one lesion was healed, but the other was completely fresh at the death of the animal (Hartz & Winge 1906: 232–233). Holes through both shoulder blades may also be attributable to hunting weapons (Noe-Nygaard 1973 and 1974, see however Møhl 1980).

During excavation of the skeleton, three flint points which must have been shot into the animal were found around the chest. They are all lancet microliths with oblique retouch at the tips (Fig. 26). One of them shows projectile diagnosticating macro fractures (Fig. 26 C), i.e. a step terminating bending fracture perpendicular to the length. From this unifacial spin-offs, less than 1 mm in length, initiate.

The calcareous gyttja, in which the flint points were embedded, decalcified their surfaces so they are unsuitable for micro wear trace analysis.

The Aurochs from Prejlerup

A whole and well-preserved skeleton of an aurochs, excavated in a small bog at Prejlerup in the north-west of Zealand (Aaris-Sørensen 1984). It was dated by C-14 analysis to 6460 ± 90 b.c. (K-3130), and by pollen analysis to the boreal period, pollen zone V.

During the careful excavation, 12 more or less fragmented lancet microliths, 3 triangular microliths and 1 fragment of a presumed arrowshaft were found directly in connection with the skeleton. Projectile diagnosticating macro fractures are seen on 6 of the points (all lancets). But it has not been possible to demonstrate micro wear traces, which must be attributed to the fact that the surfaces of most of the points were more or less

Fig. 27. Oblique arrowhead embedded in the proximal epiphysis of the left humerus of a red deer, found at Kongemose (*locus classicus*). Photo: Nanna Noe-Nygaard.

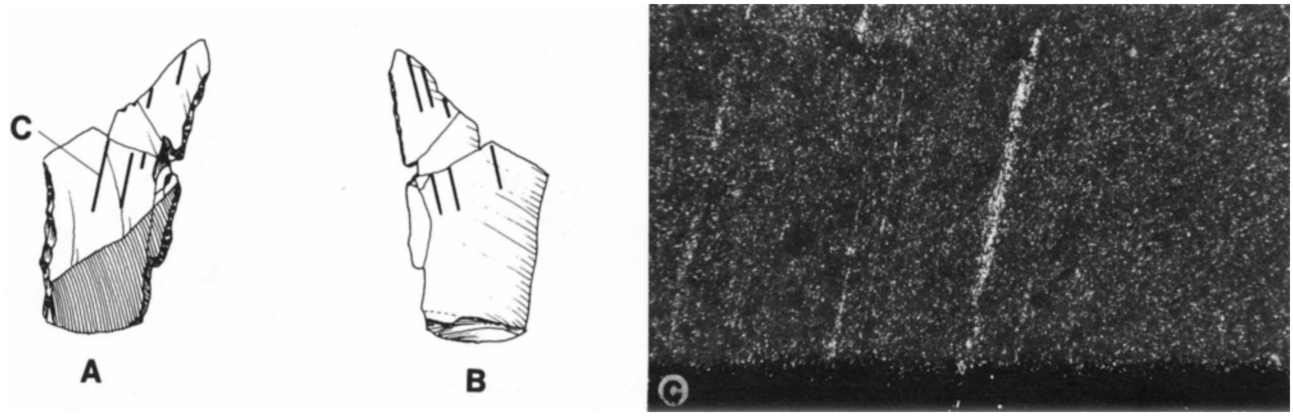


Fig. 28. The same arrowhead as shown on fig. 27 with indications of macro and micro wear traces (redrawn after Noe-Nygaard 1974). – A + B: The arrowhead consists of 6 fragments, showing several step terminating bending fractures at its tip and base. From one of the bending fractures of the tip, spin-offs initiate, running down one of the retouched sides. 1:1,3. – C: Photomicrograph of linear polish with striations. 1:42.

decalcified by the calcareous sediments. The diagnostic macro fractures include 6 step terminating bending fractures, 3 unifacial spin-offs with a length of more than 1 mm and 1 bifacial spin-off (Fischer 1984).

Red Deer Bone with an Embedded Oblique Arrowhead from the Kongemose Settlement

Limb bone of red deer with an oblique arrowhead embedded in an unhealed lesion (Fig. 27), found at the Kongemose settlement in western Zealand (Noe-Nygaard 1974: 224–225). C-14 analyses date the settlement to approx. 5600 to 5350 b.c. (Tauber 1971: 127 and 131), and by pollen analysis it is referred to the early atlantic period, pollen zone VI (Jørgensen 1956: 37, 1961: 445).

On collision with the bone, the flint point was heavily damaged (Fig. 28 A-B). The tip end shows two step terminating bending fractures from which spin-offs of up to approx. 1 cm initiate. The proximal end is missing. It was broken off by a step terminating bending fracture perpendicular to the length. Apart from these macro fractures, there are a number of well-developed projectile diagnosticating micro wear traces (Fig. 28 C).

Vejlebro, Layers 8 and 9

Settlement from the Ertebølle culture, excavated in the northeast of Zealand (Malmros 1975). Both layers are, on the basis of a series of C-14 analyses, dated to approx. 3525 b.c. (Malmros 1975: 113).

The flint inventory of both layers includes transverse arrowheads in all stages of production. If the undisputably unfinished specimens are excluded, there are 24 more or less successful arrowheads from layer 8 and 42 from layer 9. Of these, 5 and 2 respectively show projectile diagnosticating macro fractures. The material has not been examined for micro wear traces.

Præstelyng

Excavated settlement from the final part of the Ertebølle culture, situated in the Åmose in western Zealand. By means of C-14 analyses the settlement is dated to approx. 3200 b.c., and by pollen analyses it is referred to the late part of pollen zone VII (Troels-Smith 1981: 110, note 4, Noe-Nygaard 1971: 18–19 and 1981: 110–111).

The existing material comprises 57 finished and usable transverse arrowheads, a considerable number of pre-forms and, moreover, quite a few specimens which were in principle finished by the flint knapper but the retouch was so unsuccessful that they must be considered failures. Projectile diagnostic macro or micro wear traces have not been observed on the unfinished or unsuccessful specimens. Of the usable transverse arrowheads, 8 show projectile diagnosticating macro fractures. There are 7 step terminating bending fractures perpendicular to the length, 2 unifacial spin-offs longer than 1 mm and 1 bifacial spin-off.

Four of the finished and usable transverse arrowheads proved unsuitable for micro analyses because of decalcification and crazing by fire. Of the remaining 53 specimens, 2 show diagnostic micro wear traces.

Red Deer Bone with Embedded Transverse Arrowhead from Maglelyng

Red deer rib with a transverse arrowhead embedded in a healed lesion, found in the Maglelyng complex of the Åmose in western Zealand (Noe-Nygaard 1974: 227–229). Detailed information about the original context of the bone is not available. But, on the basis of a pollen analysis, it is dated to the subboreal period, pollen zone VIII.

Through collision with the rib, several cone fractures occurred on the edge of the arrowhead, and the longest are more than 3 mm long. Moreover, the entire proximal end was broken off – partly by a hinge terminating bending fracture and partly by a series of cone fractures.

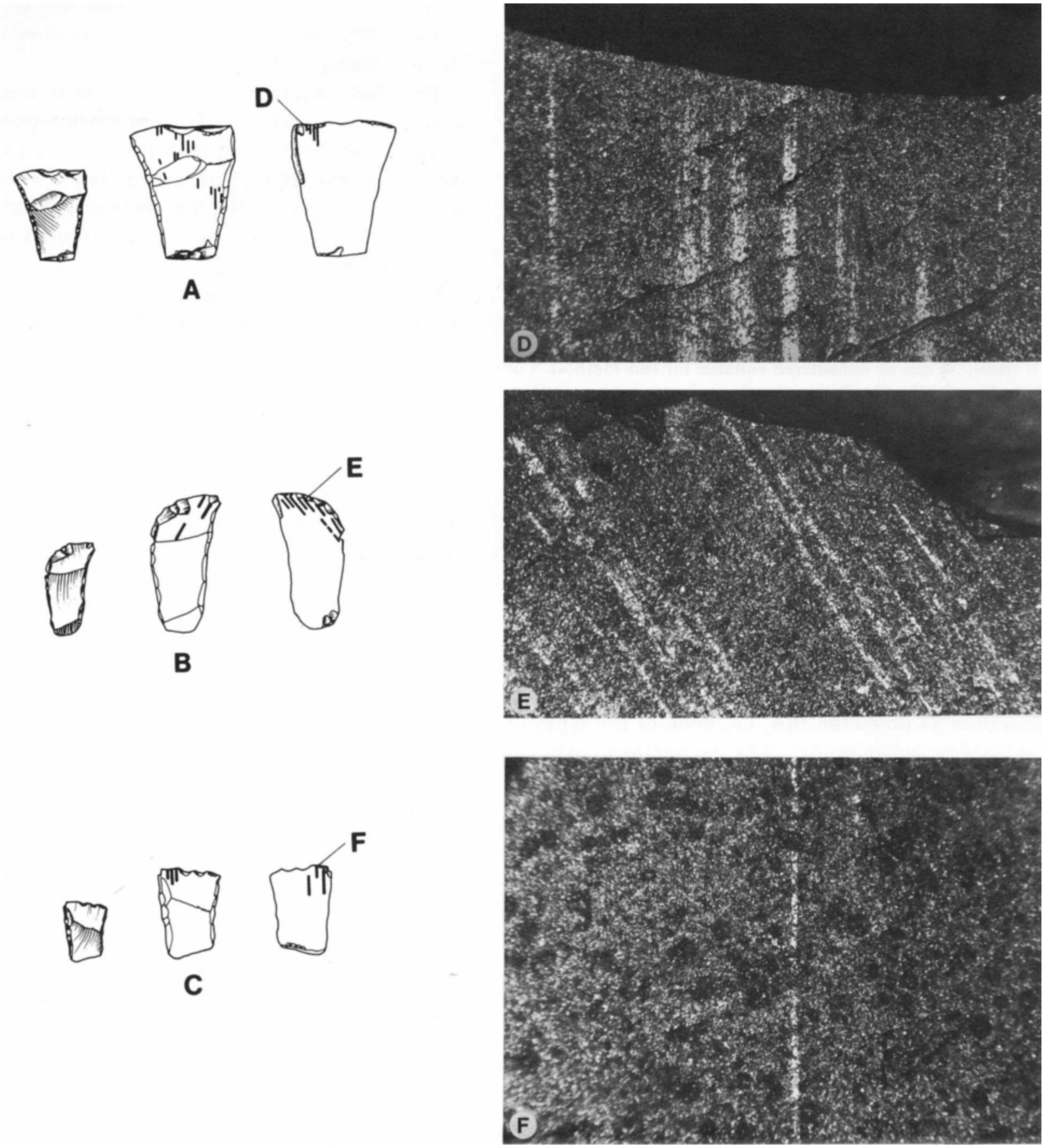


Fig. 29. Three transverse arrowheads from the Muldbjerg site with macro and micro wear traces, each specimen shown first on scale 2:3 and then twice on scale. 1:1. – A: The edge shows several small cone fractures and two small bending fractures. From the bending fractures, several spin-offs initiate along the ventral as well as the dorsal side. A spin-off, 8 mm long, runs – like a burin blow – along one of the retouched sides. The proximal end shows a step terminating bending fracture from which bifacial spin-offs initiate. – B: The edge shows several bending fractures on the ventral side and on one of the retouched sides. From these, spin-offs along the dorsal side initiate, their maximum length being 3 mm. The ventral side of the proximal end shows several small cone fractures. – C: The edge shows several small cone and bending fractures – none of which are diagnostic. The proximal end shows a snap fracture from which unifacial spin-offs, less than 1 mm long, initiate. – D: Photomicrograph of linear polishes, oriented at right angles to the edge. 1:42. – E: Photomicrograph of linear polishes oriented at acute angles to the edge. This orientation indicates that the point was forced in another direction than the original (cf. Fig. 16). 1:42. – F: Photomicrograph of linear polish oriented at a right angle to the edge. 1:42.

Muldbjerg
Excavated settlement from the early Funnel Beaker Culture, situated in the Åmose in western Zealand. The settlement is dated to approx. 2800 b.c., pollen zone VIII (Troels-Smith 1954, 1960 a, 1960 b and 1967).

The material comprises 34 transverse arrowheads. Of these, 30 can be characterized as finished and usable, whereas 4 seem to have been failures and hardly usable as arrowheads.

Even though a few of the transverse arrowheads were damaged by fire, they are all usable for macro analysis. An examination of them showed that 9 have projectile diagnosticating macro fractures. There are 13 step terminating bending fractures, 6 unifacial spin-offs with a length of more than 1 mm and 3 bifacial spin-offs (Fig. 29).

Micro wear analysis was made of 34 transverse arrowheads. Of these, 30 can be considered suitable for this method. 4 of them have projectile diagnosticating micro wear traces (Fig. 29).

The analysis of 397 flint points of different age and morphology shows that the defined macroscopic and microscopic characteristics of the projectile point function are present on the prehistoric material. This not only applies to the two point types with which we primarily experimented (Brommian points and transverse arrowheads), but also to the other point types. Moreover, none of the points show traces from other uses than as projectile tips, i.e. none of the types of microscopic polish produced by the treatment of meat, hide, bones, plants or wood were demonstrated. Further, we can demonstrate that several of the prehistoric points with projectile diagnostic macro and/or micro wear traces were used as projectile tips. The analyses shows that the characteristics of projectile points, isolated on the basis of experiments, are very numerous on Stone Age flint points and that these characteristics are connected with the very projectile point function.

The frequency of projectile point diagnosticating wear traces on the analysed, prehistoric points are summed up in table 4. It appears from the table that the frequency of diagnostic macrofractures is almost the same for all points shot into largish animals. The 18 points of which we know for certain that they were shot into aurochses are – taken as a whole – showing a frequency of 39%. Moreover, the 45 points which were in all probability shot into reindeer show a frequency of 42%. The examination of the prehistoric finds has not yielded any results which contradict the assumption: that the chance of the occurrence of diagnostic macro fractures on projectile points shot into largish animals is about 40%, irrespective of the species of animal and the morphology of the points.

The conditions of preservation for micro wear traces were generally poor in the finds where flint points were found in connection with animal skeletons. Therefore, the existing material affords no possibility of evaluating the advanced assumption that there is a 60% chance of diagnostic micro wear traces if the point is shot into largish animals.

Several of the sites enumerated in table 4 must be considered proper settlements. This applies to Bromme, Vejlebro, layers 8 & 9, Præstelyng and Muldbjerg. These sites all contain a comprehensive artefact inventory, comprising among other things large amounts of flint waste and "constructions" such as fireplaces. This does not apply to Ommelshoved which is more likely a "special activity site". The two water-deposited find layers at Stellmoor cannot be grouped with any of these categories. More likely, Stellmoor was a refuse area and a storage place for meat and raw materials for the tool production.

On the basis of the settlements and the special activity site enumerated in table 4, it appears that the corrected frequencies of diagnostic macro and micro wear traces are between 4% and 30%. These frequencies are considerably lower than the approx. 40% and 60% respectively which, according to the experiments, occur through shooting into largish animals. They are in most cases even lower than what may be expected from arrows which missed the target by accident (cf. tables 2 and 3). On the basis of the above, we can conclude that a considerable part of the points found at the settlements and special activity site were hardly used for hunting largish animals. They must have been used for other purposes or not at all. As previously mentioned (pages 19 and 42), there is no positive evidence for any other functions of these point types than as projectile points. Therefore, it seems most likely that relatively many of the finished and apparently usable points in the examined inventories were never used. If we assume that in a population of used projectile points the frequency of diagnostic macro and micro wear traces will be 40% and 60% respectively, then approx. 25% to 90% of the points of the examined settlements and special activity site must be considered unused. This situation calls for an explanation. It is worth noticing that an arrowhead can be made within a few minutes while the

NAME OF SITE	SCIENTIFIC DATING: Pollen zone	SCIENTIFIC DATING: C-14 age b.c.	Number of available points	RESULT OF MACRO ANALYSIS: Number of analysed points	Number of points unsuitable for macro analysis	Number of points with projectile diagnostic macro fractures	Frequency of points with projectile diagnostic macro fractures	Corrected frequency of points with projectile diagnostic macro fractures	RESULT OF MICRO ANALYSIS: Number of analysed points	Number of points unsuitable for micro analysis	Number of points with projectile diagnostic micro fractures	Frequency of points with projectile diagnostic micro fractures	Corrected frequency of points with projectile diagnostic micro fractures
Stellmoor, lower level	I	10,500	4	4	0	2	50%	50%					
Ommelshoved			110	110	22	11	10%	13%	15	14	1		
Bromme	II		65	65	18	3	5%	6%	61	61			
Stellmoor, upper level	III		45	45	0	19	42%	42%	23	0	8	35%	35%
Vig, aurochs	IV		3	3	0	1	33%	33%	3	3			
Prejlerup, aurochs	V	6,500	15	15	0	6	40%	40%	15	8	0	0%	0%
Kongemose, oblique point in a bone	VI	5,500	1	1	0	1	100%	100%	1	0	1	100%	100%
Vejlebro, level 8		3,525	24	24	0	5	21%	21%					
Vejlebro, level 9		3,525	42	42	0	2	5%	5%					
Præstelyng	VII	3,200	57	57	1	8	14%	14%	57	4	2	4%	4%
Maglelyng, transverse arrowhead in a bone	VIII		1	1	0	0	0%	0%	1	1			
Muldbjerg	VIII	2,800	30	30	0	9	30%	30%	30	5	4	13%	16%
Σ			397	397	41				206	96			

Table 4. The results of the application of the macro and micro methods on prehistoric points. The various sites are mentioned chronologically. The frequency of projectile diagnosticating wear are stated partly in relation to the total number of analysed points and partly in relation to the points, the condition of preservation which makes them suitable for the analysis method in question.

production of an arrowshaft demands much more time. An obvious explanation may thus be that Stone Age flint knappers generally produced series of points to make sure always to have some on stock from which the hunters could pick out the ones most suited for the shafts at hand and the hunt ahead.

SUMMARY AND CONCLUSION

By means of practical experiments, we have demonstrated and defined two types of wear traces which are diagnostic for the projectile point function. The one type can be studied with the naked eye (the macro method), the other type requires a microscope (the micro method). Both types are found on all types of projectile points used in the experiments. They have furthermore been found on a large number of prehistoric flint points of very different age, size and shape. We therefore expect that the defined macro- and microscopic characteristics of the projectile function are universal for points of flint and related stone – irrespective of the morphology and mounting method of the points.

Diagnostic macro and micro wear traces were observed on approx. 40% and 60% respectively of the fired points. Similar frequencies of macro and micro wear traces were observed on prehistoric flint points which were for certain or in all probability shot into aurochses, red deer and reindeer. We have consequently put forth the assumption that these percentages are universal for points shot into largish animals.

A total of 85 of the projectile points used in the experiments were analysed by means of the macro and the micro method. In each case, distinction was made between diagnostic and non-diagnostic wear traces and no wear traces at all.

The result of the two analyses is that the macro method diagnosticated the projectile function on 36% of the fired points (12), whereas the micro method reached a total of 53%. However, the micro method does not make the macro method superfluous. By using both methods, it is possible to diagnosticate as much as 61% of all cases – and this increase is obtained by a relatively modest extra effort: the time used for each object is very limited in the case of the macro method, whereas it is rather time-consuming to examine a flint object for micro wear traces. Moreover, the macro methods requires no special equipment and is far more tolerant to the texture, colour and surface disintegration of the flint.

So, we must conclude that the macro and micro methods can be used independently, that their strength is found in different fields, and that, especially in combination, they are efficient means of establishing whether a flint object served as a projectile tip.

The results presented here are based on examinations of 448 flint objects used in the experiments and 397 prehistoric flint points. Had we made more experiments, and had we included even more prehistoric objects in our analyses, we would undoubtedly have been able to present considerably more exact statements than now. Nevertheless, we expect that the methods developed will be helpful in the numerous attempts at functional and behavioural interpretations of lithic assemblages which are increasingly occupying archaeologists all over the world.

Anders Fischer, The National Agency for the Protection of Nature, Monuments and Sites, *Fredningsstyrelsen*, Amaliegade 13, DK-1256 Copenhagen K.

Peter Vemming Hansen, Institute of Prehistoric Archaeology, University of Copenhagen, Vandkunsten 5, DK-1467 Copenhagen K.

Peter Rasmussen, The National Museum, Dept. of Natural Science, Ny Vestergade 11, DK-1471 Copenhagen K.

Acknowledgements
The experiments forming the basis of this article were started at the end of 1981 at the Institute of Prehistoric Archaeology, University of Copenhagen. Further experiments in 1982 and 1983 were carried out at Lejre Research Centre which kindly provided us with space and resources. We would like to thank the Committee of the Research Centre for their generous economic support. We would also express our gratitude for all practical help given by the people working at the Centre, in particular Ole Malling, Bjarne Bang Jensen, Henrik Andersen and Dorthe Nielsen. Much valuable assistance was rendered by Bo Madsen, Institute of prehistoric Archaeology, Aarhus, who produced many of the flint points. We could not have carried out the experiments without the assistance of the members of the Danish Society of Bowhunters. In particular, we are indebted to Jan Jensen who with unerring precision fired the majority of the flint points. Thanks are also due to Carsten and Ulrik Henriques, Claus Hjelm Jensen, Andreas Nielsen, Jan Reinhold Nielsen, Lars Thorup and Niels Tuxen, all members of the Danish Society of Bowhunters, for valuable help and good company. Furthermore, we are most grateful to Jørgen Troels-Smith and Claus Malmros, both of the National Museum and Kim Aaris-Sørensen, the Zoological Museum, for placing unpublished material at our disposal. Finally, we express our grattitude to Lisbeth Pedersen, Kalundborg Museum, Kjeld Christensen and Claus Malmros, both of the National Museum, for critical reading of the manuscript.

NOTES

1. A piece of flint resembling a transverse arrowhead and found embedded in a swan bone at Bøgebakken in Vedbæk (Møhl 1979: 68–69) has turned out to have been made in more recent times and cannot therefore be regarded as evidence for interpretations of the function of prehistoric transverse arrowheads.
2. The points were made of socalled senonian flint from the island of Falster (Hansen og Madsen 1983: 48) and were manufactured in accordance with the size, weight and general morphology of the prehistoric ones.
3. We would like to thank Harm Paulsen, Schleswig-Holsteinisches Landesmuseum für Vor- und Frühgeschichte, and Søren Moses, Søllerød Museum, for informations about their work in connection with reconstructions of prehistoric bows.
4. It is to be expected that tools used for chopping and stabbing will be exposed to forces similar to those of the projectile points – i.e. parallel to the length. Therefore, other flint tools, such as axes, may show related fractures.
5. The proximal end of many Brommian points show bending fractures of the types defined as diagnostic in this article. Whether these fractures occurred in the moment of detachment or later during use of the finished points is usually easy to ascertain from the order in which the retouching of the tang and the fractures have occurred.
6. The micro wear analysis was done by Peter Rasmussen.
7. We would like to thank Nanna Noe-Nygård, Institute of Historical Geology and Palaeontology, Univ. of Copenhagen, for her help with the SEM photographs. These were taken by Stig Hansen, Institute of Geology, Univ. of Copenhagen.
8. As to the terms diagnostic and non-diagnostic the wear traces named diagnostic are so clear and well-developed that to all appearances similar traces can be found on prehistoric projectile points. The wear traces called non-diagnostic are so faintly developed that it is douptful whether they could be seen on prehistoric points. Obviously, this division of wear traces is purely subjective, but it enables us to present a more realistic picture of the experiments in relation to the archaeological material.
9. The work in connection with the experimental points with fish polishes gavè rise to important observation because it turned out that it is possible to remove the polish by cleaning the flint in HCl.
10. The examination was carried out on a X-ray monitor plant at the *Schleswig-Holsteinisches Landesmuseum für Vor- und Frühgeschichte*. We are indebted to Hans-Otto Nielsen for making the examination.
11. According to the *Schleswig-Holsteinisches Landesmuseum für Vor- und Frühgeschichte*, the bows and arrows from Stellmoor were lost during

a fire in 1944. The same seems to apply to the two proximal ends of tanged points.

12. The macro analysis included a total of 148 experimental projectile points shot into different materials, excl. water. The method diagnosticated the projectile point function in 41% of these cases.

REFERENCES

ANDERSEN S.H. 1975: Ringkloster, en jysk indlandsboplads med Ertebøllekultur. *Kuml*, 1973–74.

1980: Tybrind Vig. Foreløbig meddelelse om en undersøisk stenalderboplads ved Lillebælt. *Antikvariske Studier*, Bd. 4. (København).

1981: *Danmarkshistorien, Stenalderen 1, Jægerstenalderen.* (København).

BARTON, R.N.E. & C.A. BERGMAN 1982: Hunters at Hengistbury. Some evidence from experimental archaeology. *World Archaeology*, Vol. 14, No. 2.

BECKER, C.J. 1945: En 8000-aarig Stenalderboplads i Holmegaards Mose. Foreløbig Meddelelse. *Fra Nationalmuseets Arbejdsmark*, 1945. (København).

1971: Late Palaeolithic Finds from Denmark. *Proceedings of the Prehistoric Society*, Vol. XXXVII. (Cambridge).

BERGMAN, C.A. & M.H. NEWCOMER 1983: Flint Arrowhead Breakage: Examples from Kasar Akil, Lebanon. *Journal of Field Archaeology*, Vol. 10.

COTTERELL, B. & J. KAMMINGA 1979: The Mechanics of Flaking. HAYDEN (ed.): *Lithic Use-Wear Analysis.* (New York).

CRABTREE, D.E. 1966: A Stone Workers Approach to Analyzing and Replicating the Lindenmeier Folsom. *Tebiwa, Journal of the Idaho State University Museum*, Vol. 9. (Idaho).

DEGERBØL, M. & B. FREDSKILD 1970: *The Urus and Neolithic Domesticated Cattle in Denmark.* Det Kongelige Danske Videnskabernes Selskab, Biologiske Skrifter, Bd. 17.1. (København).

FISCHER, A. 1978: På sporet af overgangen mellem palæoliticum og mesoliticum i Sydskandinavien. *Hikuin*, Vol. 4. (Højbjerg).

1984: Prejlerup-spidserne som facitliste for arkæologer. In AARIS-SØRENSEN, K. (ed.): *Uroksen fra Prejlerup. Et arkæo-zoologisk fund.* (København).

HANSEN, P.V. & B. MADSEN 1983: Flint Axe Manufacture in the Neolithic. *Journal of Danish Archaeology*, Vol. 2. (København).

HARTZ, N. & H. WINGE 1906: Om Uroxen fra Vig, saaret og dræbt med Flintvaaben. *Aarbøger for nordisk Oldkyndighed og Historie.* (København).

HESTER, T.R. & R.F. HEIZER 1973: Arrow Points or Knives? Comments on the proposed Function of "Stockton Points". *American Antiquity*, Vol. 38, No. 2.

HOLM, J. 1973: Istidsjægere på Ærø. *Fynske Minder*, 1972. (Odense).

HO HO COMMITTEE 1979: The Ho Ho Classification and Nomenclature Committee Report. HAYDEN, B. (ed.): *Lithic Use-Wear Analysis.* (New York).

IVERSEN, J. 1947: Geologisk datering af en senglacial boplads ved Bromme. *Aarbøger for nordisk Oldkyndighed og Historie*, 1946. København.

JØRGENSEN, S. 1956: Kongemosen. Endnu en Aamose-boplads fra ældre stenalder. *Kuml*, 1956. (Århus).

1961: Zur Frage der ältesten Küstenkultur in Dänemark. *Ber. über den V. Intern. Kongress für Vor- und Frühgeschichte, Hamburg 1958.* (Berlin).

KEELEY, L.H. 1980: *Experimental Determination of Stone Tool Uses.* The University of Chicago Press. (Chicago).

KEELEY, L.H. & M.H. NEWCOMER 1977: Microwear Analysis of Experimental Flint Tools: A Test Case. *Journal of Archaeological Science*, Vol. 4.

LARSSON, L. 1982: *Skateholmsprojectet – En utställningskatalog om et fångstsamhälle för 7000 år sedan.* Lunds Universitets Historiska Museum, Report Series, Vol. 13. (Lund).

LAWRENCE, R.A. 1979: Experimental Evidence for the Significance of Attributes used in Edge-Damage Analysis. HAYDEN, B. (ed.): *Lithic Use-Wear Analysis.* (New York).

MALMER, M.P. 1969: Die Mikrolithen in dem Pfeil-fund von Loshult. *Meddelanden från Lunds Universitets Historiska Museum*, 1966–1968 (Lund).

MALMROS C. 1975: Vejlebro – en stenalderboplads ved Arrefjorden. *Nationalmuseets Arbejdsmark*, 1975. (København).

MADSEN, A.P. 1868: *Afbildninger fra Stenalderen.* (København).

MATHIASSEN, T. 1947: En senglacial boplads ved Bromme. *Aarbøger for nordisk Oldkyndighed og Historie*, 1946. (København).

1948: *Danske Oldsager*, Bd. I, *Ældre Stenalder.* (København).

MOSS, E.H. & M.H. NEWCOMER 1982: Reconstruction of Tool use at Pincevent: Microwear and Experiments. CAHEN, D. (ed.): *Tailler! Pour quoi faire: Prehistoire et technologie lithique II. Recent progres in microwear studies.* Studia Praehistorica Belgica. (Tervuren).

MØHL, U. 1979: Aggersund-bopladsen zoologisk belyst. Svanejagt som årsag til bosættelse? *Kuml*, 1978.

1980: Elsdyrskeletterne fra Skottemarke og Favrbo. *Aarbøger for nordisk Oldkyndighed og Historie*, 1978. (København).

MÖLLER, C. 1975: Ein Reintierwirbel mit eingeschossener Feuersteinspitze aus der Ahrensburger Kulturschicht von Stellmoor. *Hammaburg*, N.F. 2, 1975.

NOE-NYGAARD, N. 1971: Spur dog spines from prehistoric and early Historic Denmark. *Bulletin of the Geological Society of Denmark*, Vol. 21. (København).

1973: The Vig Bull. New information on the final hunt. *Meddelelser fra Danmarks geologiske Forening*, Bd. 22, Hæfte 3. (København).

1974: Mesolithic Hunting in Denmark Illustrated by Bone Injuries Caused by Human Weapons. *Journal of Archaeological Science*, Vol. 1. (Cambridge).

1981: Problems in quantification of archaeozoological material caused by differences in butchering and marrow fracturing techniques. KUBASIEWICZ, M. (ed.): *Archaeozoological Studies* III. (London).

ODELL, G.H. 1978: Preliminaires d'une analyse functionelle des pointes microlithiques de Bergumermeer (Pay-Bas). *Bulletin de la Societe Prehistorique Francaise*, Tome 75/2.

PAULSEN, H. 1975: Oberflachenretuschierte Pfeilspitzen in Schleswig-Holstein. *Die Heimat*, nr. 4–5. (Schleswig).

PETERSEN, P.V. 1979: Træ til jægernes redskaber. *Søllerødbogen*, 1979. (Søllerød).

RUST, A. 1943: *Die Alt- und mittelsteinzeitlichen Funde von Stellmoor*. (Neumünster).

SCHÜTRUMPF, R. 1943: Die pollenanalytische Untersuchungen der Reintierjägerfundstätte Stellmoor in Holstein. In RUST, A.: *Die Alt- und Mittelsteinzeitlischen Funde von Stellmoor*. (Neumünster).

TAUBER, H. 1971: Danske kulstof 14-dateringer af arkæologiske prøver III. *Aarbøger for nordisk Oldkyndighed og Historie*, 1970. (København).

TROELS-SMITH, J. 1954: Ertebøllekultur – bondekultur. Resultater af de sidste 10 aars undersøgelser i Aamosen, Vestsjælland. *Aarbøger for nordisk Oldkyndighed og Historie*, 1953. (København).

1960a: En elmetræs-bue fra Aamosen og andre træsager fra tidlig neolitisk tid. En foreløbig meddelelse. *Aarbøger for nordisk Oldkyndighed og Historie*, 1959. (København).

1960b: The Muldbjerg Dwelling Place: An Early Neolithic Archaeological Site in Aamosen Bog, West-Zealand, Denmark. *The Smithsonian Report for 1959*. (Washington).

1967: The Ertebølle Culture and its Background. *Palaeohistoria*, Vol. 12. (Groningen).

1981: Naturwissenschaftliche Beiträge zur Pfalbauforschung. *Archaologie der Schweiz*, 4. 1981. 3. (Basel).

TSIRK, A. 1979: Regarding Fracture Initiations. HAYDEN, B. (ed.): *Lithic Use-Wear Analysis*. (New York).

USINGER, H. 1975: Pollenanalytische und stratigraphische Untersuchungen an zwei Spätglacial-Vorkommen in Schleswig-Holstein. *Mitteilungen der Arbeitsgemeinschaft Geobotanik in Schleswig-Holstein und Hamburg*, Heft 25. (Kiel).

AARIS-SØRENSEN, K. 1984: Uroksen fra Prejlerup. *Alle tiders Odsherred*, 1984. (Høve).

Journal of Danish Archaeology vol. 3, 1984, pp. 47–62

Flint Axe Manufacture in the Neolithic: Experiments with Grinding and Polishing of Thin-Butted Flint Axes

by BO MADSEN

This article presents observations made during the experimental polishing of replicas of neolithic flint axes. The investigations are not yet complete, but some preliminary results are described which will later be supplemented by further experiments.

The experiments are part of a project which has been running for several years, concerned with neolithic flint axe manufacture, carried out by Jacques Pelegrin and the author. The preliminary experiments dealing with the flaking process have been described in an earlier number of the Journal (vol. 2, 1983). The polishing experiments took place in 1983 at the Lejre Research Centre in Denmark, which is the sponsor of the project (1).

ASSUMPTIONS AND HYPOTHESES

Societies using simple technology have used ground stone over much of the world at various times, in some places even into the twentieth century. Like other basic lithic techniques, grinding has been developed and used independently in a number of widely separate areas. Ground stone tools, especially axes, have played an important part in the material culture of many semi-agricultural and agricultural societies, and have also been used by a few hunter-gatherer groups.

Many ideas have been put forward about the time involved in the "difficult" grinding process. "The grinding of hard stone is not just a fatiguing process that demands persistence, time and some working knowledge, but a method that gives very little external result in a given time" (Semenov 1964, 68). This author also pointed out that the grinding of a flint axe takes twice as much time as the grinding of a stone (diorite) axe.

The experiments that are described here were carried out to test and add to earlier observations. They were also tests of potential alternatives to the "traditional" method: grinding using great pressure, and involving co-operation between several people. The experiments were designed:

1) to provide a precise measurement of the time budget (in man-hours) involved in the grinding of several replica thin butted axes with proportions and sizes near the average for the originals;
2) to show whether the grinding method had any influence on the type and extent of the striations and polishing;
3) to measure the efficiency of various grinding methods, by recording the weight loss of the axe in grams per man-hour;
4) to measure the effect of grinding on the proportions of the axe (the change from stages 4 to 5).

EARLIER EXPERIMENTS

N. F. B. Sehested, the pioneer of experimental archaeology, carried out and described the first experiments with the grinding of flint axes. The results were published 100 years ago, in a lavish volume (Sehested 1884, 14–21). A number of larger and smaller experiments were described, including the erection of a log house made of timbers shaped with flint tools. Sehested also carried out a total of 6 experiments in the grinding of original flint axes. The most complete is that described as the "Fourth Experiment" (pp. 17–20), in which a thin-butted flint axe, "ready for grinding" and 18 cm long and 6.7 cm wide, was polished. The narrow sides were 2.6 cm broad. Grinding was carried out on a flat piece of granite, 73 cm long and 40–50 cm wide.

On the original axes Sehested had seen three types of grinding: "The coarse grinding, the fine grinding, and the sharpening". Experimental grinding is described on p. 19:

"The coarse grinding was carried out using sharp gravel and water. The gravel was often renewed, because it was quickly crushed into small particles. The axe was moved back and forth lengthwise, pressed down as strongly as the maker was able using two hands.

While the broad faces and the edge areas were being worked, a somewhat rocking movement was imparted to the grinding action – the lengthwise motion being kept up, however – to give the sides and edge areas the rounded form they have, and which the flaking indicates.

During the grinding of the narrow side the same rocking movement was used, but to a much lesser extent, because the narrow sides of the axes are only slightly rounded.

By using the rocking action, one avoids the larger or smaller flat surfaces that would be produced by a more rigid movement.

The edge areas were then ground more finely. It seemed best to use a stone of the same type as the fine old grindstones, sandstone or quartzite, so a fine, flat piece of sandstone was used, which was kept wet.

This grinding was done using movements in all directions, during which the edge area became completely smooth, as on the old axes.

The sharpening of the edge itself was done using a whetstone of slate.

The axe quickly becomes thicker away from the edge, just as the old ones do, which is necessary because of the structure of flint. It is completely smooth as the old axes were, and so sharp that it can be used for all the woodworking tasks involved in the building of the abovementioned log house, and indeed so fine that one could cut ones finger nails with it.«

One of the broad faces was not ground, so that work time was calculated from Sehested's experience from the other surfaces. He calculated that the work would take about 36 hours. "*With this method, a man working for 6 hours per day can grind an axe in less than a week*".

References to grinding, and particularly to the experimental grinding of flint, have since appeared sporadically as short, undocumented notes. Twentieth century experimenters with flint working have carefully avoided grinding experiments, or have used modern grinding methods (Kragh 1964, 39). Descriptions of axe manufacture and grinding in the New Guinea Highlands are, however, important ethnographic sources (Vial 1940, Chappel and Strathern 1966, Højlund 1981).

In connection with the second lithic seminar at the Lejre Research Centre (Wickham-Jones 1982), experimental grinding was once more brought to the attention of archaeologists through some preliminary work. One of the participants, the flint worker Ivan Andersen from Jutland, had already had several years' experience with the grinding of flint axes (2). One of the participating archaeologists has since used his observations in a recent publication (Olausson 1983).

TYPES OF POLISHED FLINT AXE IN THE SOUTH SCANDINAVIAN NEOLITHIC

During the last ten years there have been several studies of neolithic flint axes (Becker 1973, Højlund 1975). The largest piece of work carried out involved the analysis of nearly 1200 pointed butted and thin butted axes, and some 700 thick butted axes (Nielsen 1977, 1979). Ground lenticular stone axes start being used in the south Scandinavian mesolithic during the later Maglemose Culture. The grinding of flint axes was first introduced in the early Funnel Beaker Culture, about 4,000 BC. Ground flint axes were in use for more than 2000 years, until the earliest bronze age. The typological sequence runs from pointed- and thin-butted types to thick-butted axes which come into use shortly before 3000 BC. A selection of the characteristic types is shown in fig. 1. The most frequent are the thin-butted type, particulary types III and VI (Nielsen 1977), which are the longest lived forms (Fig. 1C, 1D).

Thin-butted axes are generally heavy, with convex, rounded cross section, and lenticular section through the long axis. The typologically later form, type VI, has a flatter blade, and has morphological traits pointing forward in time towards the earliest thick-butted forms.

The thick-butted axes are relatively lighter, and have a regular rectangular or square cross-section at the butt end. The edge is narrower and less curved than in thin-butted types.

Grinding of thin-butted axes is generally total, so that both the broad and the narrow surfaces are ground over all. Thick-butted axes are ground only on the broad surfaces, except for many fully ground axes of medium bladed form (Becker 1973, Nielsen 1979). In general terms, Sehested's description of the various types of grinding is widely applicable. But if one takes a closer look at the thin-butted axes, particularly the large ones which may be over 30 cm in length, groups of straight and parallel grinding striations may be seen

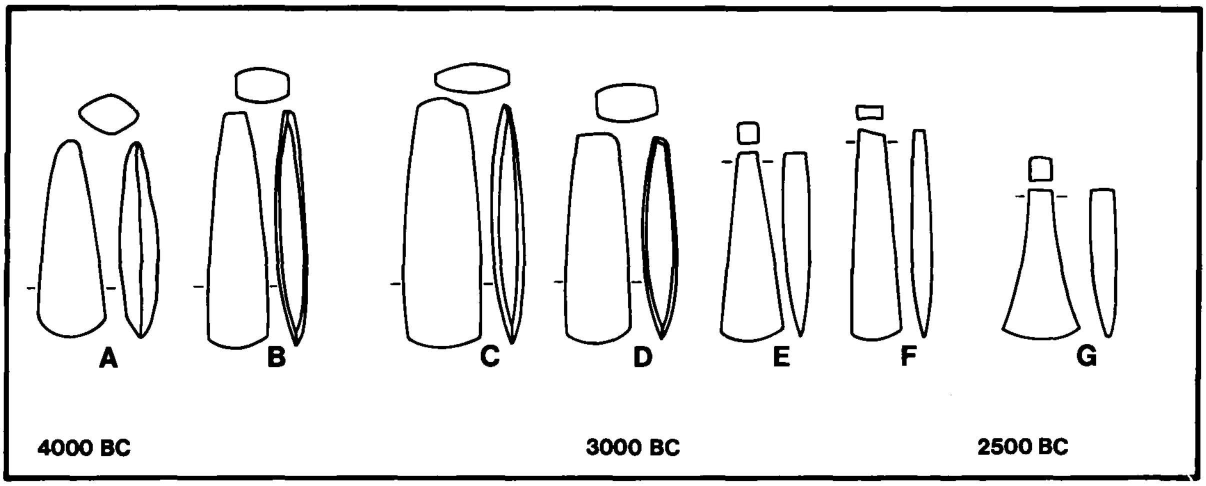


Fig. 1. The axe types of southern Scandinavia: outline of the main types.

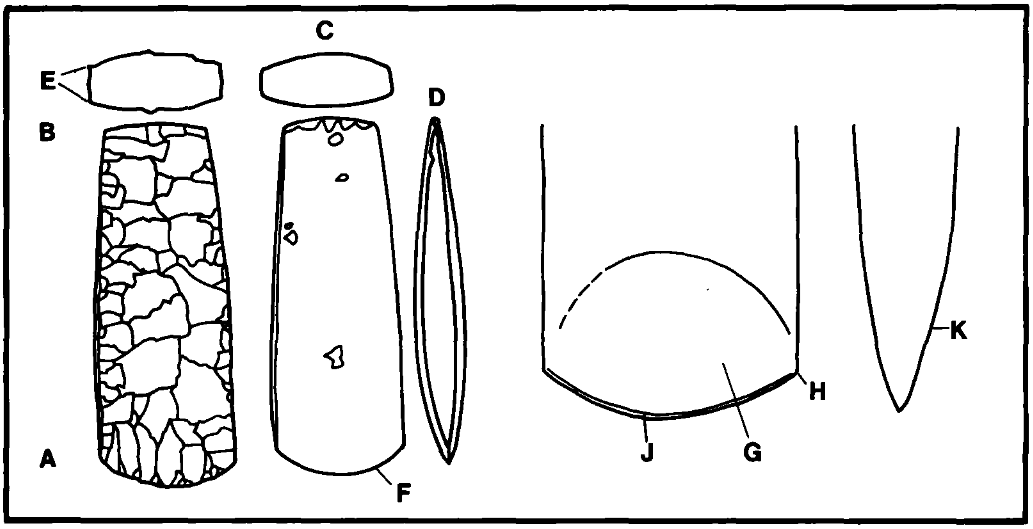


Fig. 2. Some of the qualitative aspects of thin-butted axes. A: edge. B: butt. C: face. D: side. E: seams. F: edge rim. G: edge area. H: edge corner. J: edge facet (sharpening). K: possible grinding facets in the edge area.

which are longer than is usual on other axe types. These axes have often been made relatively flat by straight, longitudinal grinding. The striations are often accompanied by powerful crushing marks at particular points (fig. 13).

TERMINOLOGY

The typological attributes of neolithic flint axes have already been described in detail (Nielsen 1977, 1979). The attributes of interest for the experiments are shown in fig. 2. The edge area (fig. 2B) is regarded as the area stretching from the broad face to the edge rim, being steeper, and marked with one or more grinding facets (fig. 2K); the transition is, however, diffuse.

Grinding is the process which leaves macroscopic traces in the form of striations or crushing spots. This process produces the definitive shape of the axe through removal of material.

Polishing is a process which does not leave macroscopic striations, but primarily changes the micro-

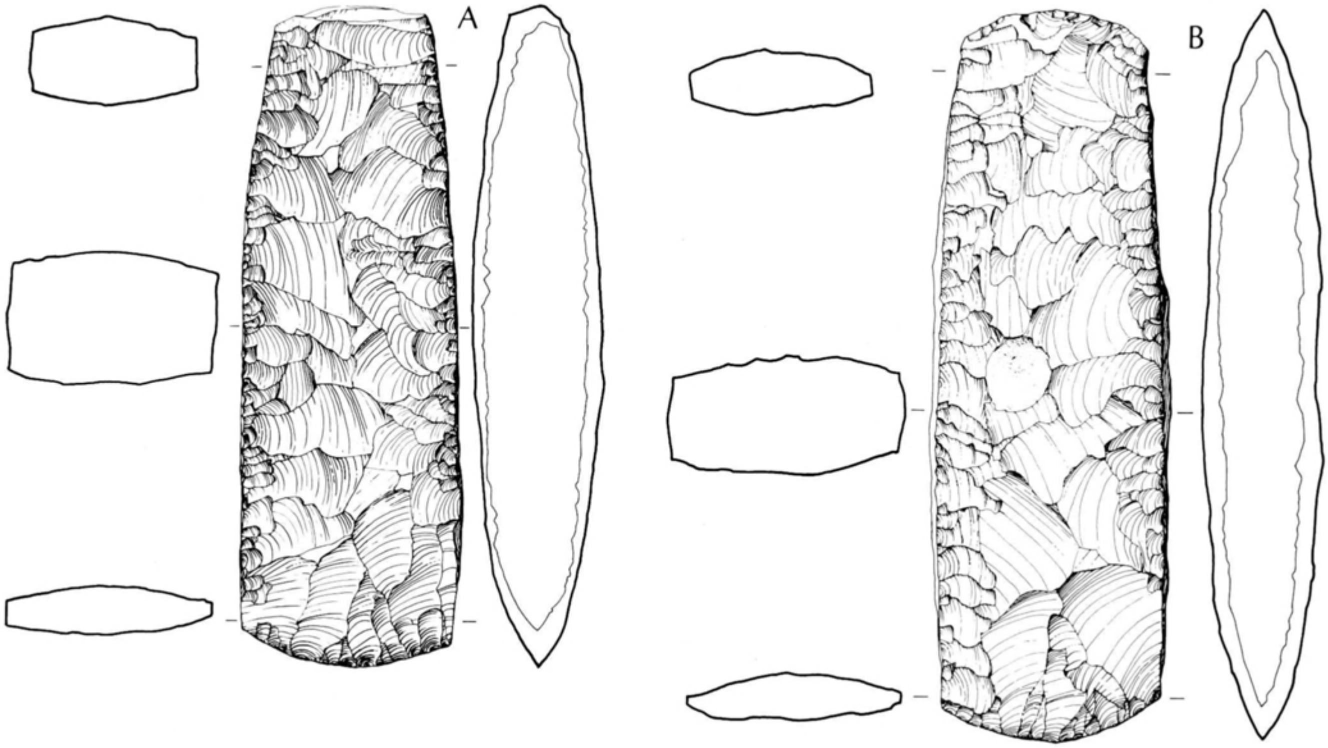


Fig. 3. A: the axe ground in experiment I. B: the axe ground in experiment II. BM *del.* 2:5.

scopic nature of the surface. Liquid film does not change the lustre of the flint after this process.

EXPERIMENTAL PROCEDURE

The production of a thin-butted ground axe involves three different activities: procurement of the raw material, flaking to shape, and grinding. The flaking falls into 4 stages (Hansen and Madsen 1983, Madsen 1984).

All the grinding experiments were done on a piece of Nexø sandstone 110 cm long, 75 cm broad and about 10 cm thick. With regard to many neolithic grindstones, this piece must be described as medium hard, perceptibly grained, and without concoidal fracture.

The most regular of the two cloven surfaces was used so that grinding took place along its longest axis (fig. 7). During the experiments, the grindstone was placed horizontally on some treestumps, in a firm position 60 cm above the ground. The experiments took place on a lake shore in the shade of an oak tree.

Even during the first experiment, a cigar-shaped grinding groove was produced, about 80 cm in length. During later experiments it became necessary to start on a parallel groove. Various positions were adopted during the longitudinal grinding of the axes. When the faces were ground, the axes were often rotated, so that grinding extended out over the seams (fig. 2E, fig. 5). During grinding of the butt area and particularly of the edge area, the axes were held at various acute angles to the grindstone. A rocking motion was often used in this longitudinal grinding.

During the grinding of the edge area, the axes were sometimes moved slightly diagonally in relation to the grinding groove, to attain maximum contact with the grindstone. The intention was not to produce a flatly ground surface, but to grind the axes all over following their rounded convex shape. Three methods were employed during the experimental grinding:

Area grinding: a smaller grindstone was hand-held and used on the axe, or vice versa. Careful strokes a few cm long were used. This was used to round off the seams and edge, and to complete the sharpening of the edge.

Hand grinding: The axe was held in both hands, and rubbed against the grindstone by one person, using regular controlled movements. The strokes were either

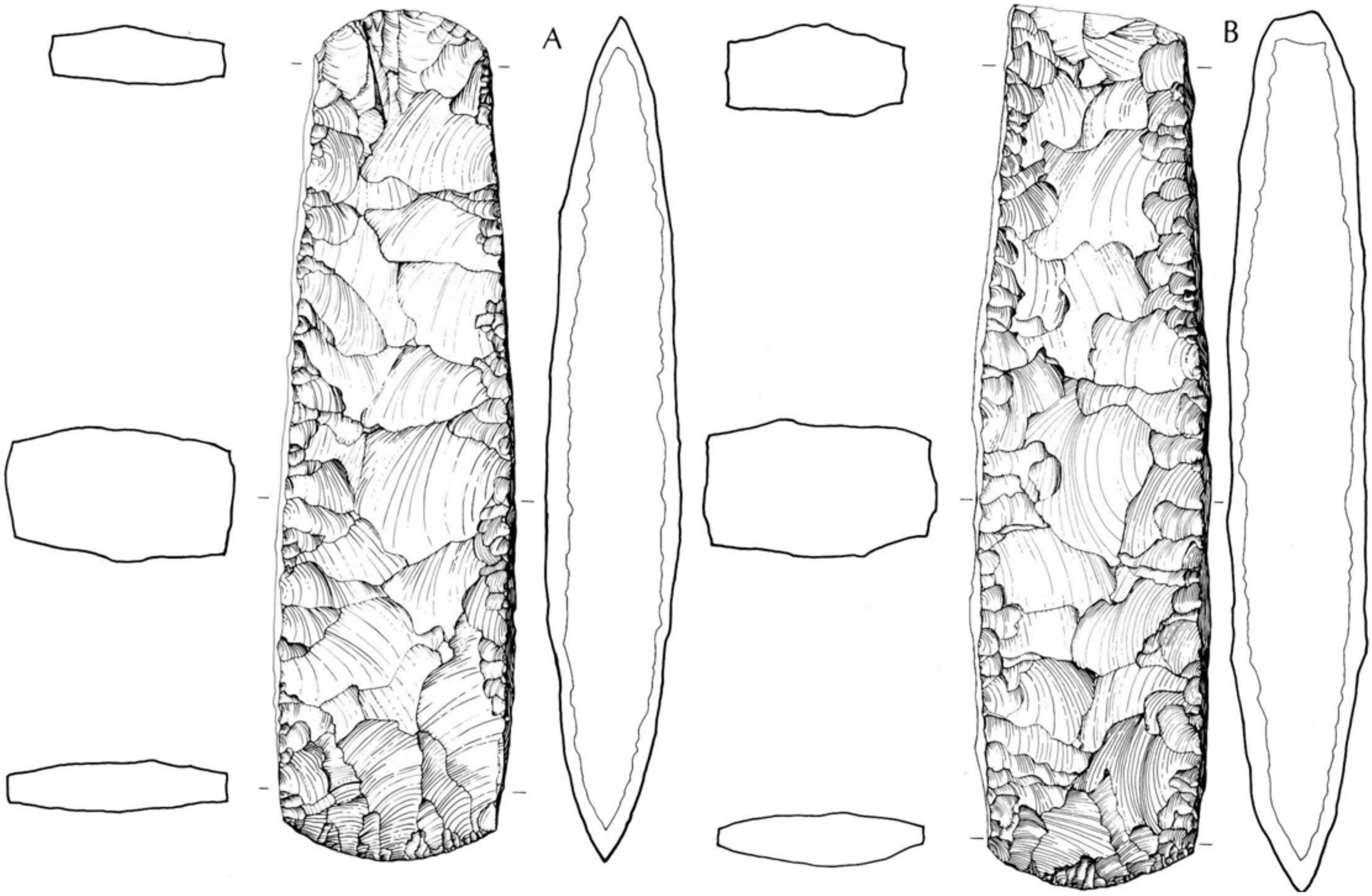


Fig. 4. A: the axe ground in experiment III. B: the axe ground in experiment IV. BM *del.* 2:5.

long and powerful (15–25 kg), or short, light and precise, 10–15 cm in length (during edge grinding). During this heavy manual grinding, the weight and strength of the body was only used when the axe was pushed forwards. When the axe was pulled back, it only rested lightly on the grindstone. The movement and the standing position are analogous to those of a carpenter, planing a piece of wood on a workbench. During axe grinding, the position is more bent, and the motion slower and heavier.

Grinding with extra weight: In this method the axe is held in a vice, which increases the pressure on the axe. This "system" is based on "the principle of least cost", using a technology known in the neolithic. The vice consists of a branch of ash about 4 m long and 15 cm in diameter, partially split so that the axe is held in position by the tension of the wood. The branch is easily split with a couple of wooden wedges, the axe is placed in position, the wedges are removed, and the axe is held firmly in position.

Vertically above the vice is placed a forked branch (fig. 6). Each fork rests in a hollow on top of the vice. On top of the fork is a heavy piece of flat sandstone. This creates a balanced but heavy weight applying the greatest possible pressure to the axe, without the 80 cm grinding motion being disturbed.

During experiment II and part of experiment III, the whole system was used to apply a total of 80.5 kg to the axe. For practical reasons this was later reduced to 52 kg. To operate the system takes *three people*. One person holds each end of the vice, alternately pulling and pushing. The third person was in the centre, helping with the movement and also checking the exact position of the axe on the grindstone.

For grinding those areas where excessive pressure could cause damage (the sides, seams and edge areas), the split branch alone is used, which applied a pressure of 32 kg to the axe. In these cases the system was operated by *two people.*

During the experiment, no grinding agent like sand or gravel was used, except for a short time during experiment II. Water was, however, freely used to wash away the fine fragments produced during grinding. The basic grinding strategy was:

1) Rounding off the sharp seams and edge corners by area grinding, and rounding off the sharp, bifacially flaked edge by transverse area grinding. This makes the edge slightly flattened (fig. 9B), a precondition for its final sharpening.

2) Grinding the faces and sides of the axe.

3) Grinding the edge area.

4) Sharpening the edge by establishing a slight edge facet (fig. 2J). This is done with diagonal and/or transverse area grinding using finer sandstone or slate. This grinding is so fine that it cannot really be distinguished from polishing.

A detailed log book was kept for all the experiments (3). In this was recorded the net grinding time in terms of how long the axe was moved on the grindstone. Also recorded was the total work time, including pauses and adjustments. In practice, 100 grinding strokes were carried out at a time. The length of the utilised grinding surface was carefully recorded. For experiments I and II, the gradual expansion of the ground area on the axe was recorded at the short interval of every 400 strokes (fig. 8). All axe replicas were precisely measured and weighed before and after grinding (4). The axe replicas' sides were numbered, so that the extent and type of grinding could be recorded for each side.

Four experiments will be briefly described below. The quantitative data are tabulated in fig. 10.

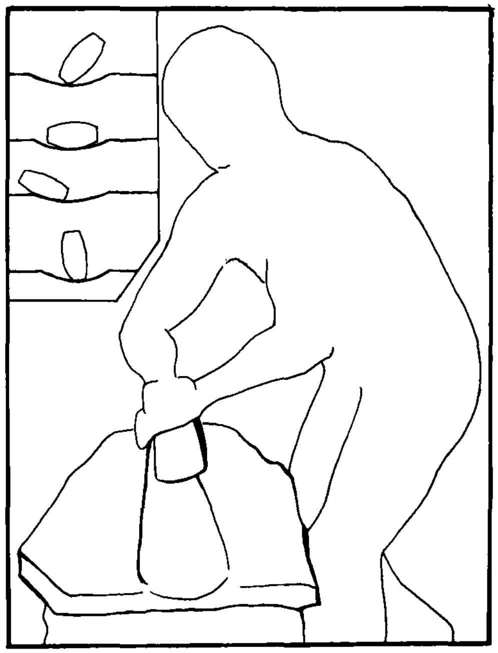


Fig. 5. Hand grinding.

EXPERIMENT I – HAND GRINDING

A replica thin-butted axe of type VI was chosen for this experiment, made by JP from medium to good quality flint from Falster. This quality of Senonian flint has a black to bluish grey colour. The flaked axe must be described as most regular, with beautifully worked seams and edge, although the cross-section twists slightly in relation to the medial plane.

The axe was relatively thick and short, with a weight of 1174.4 g, a length of 22 cm and a thickness of about 4.5 cm (fig. 3A). Only the faces of the axe were ground, in the outer part of the edge area, and it has still not been finally sharpened. The axe was ground while the grindstone was still uneven and before grinding grooves had developed. There were 11,800 grinding strokes in all, mainly around 50–60 cm in length; for some periods, however, stroke length was 70 cm, and the edge area was ground with short strokes of 15–25 cm. In all, the axe moved 6650 m on the grindstone, over a period of 5 hours and 30 minutes (table 10). The sharpening (which was not carried out) would have taken an estimated 15 to 25 minutes. The ground surfaces showed light to medium grinding striations. Slight facets could be made out along the seams, and one face (side 3) showed a grinding facet in the edge area (fig. 12). The grinding removed about 0.3 cm from the maximum thickness.

EXPERIMENT II – GRINDING WITH EXTRA WEIGHT

A thin butted axe replica of type III A (fig. 1C) was used, made by BM from medium quality Senonian flint from the coast of Djursland, eastern Jutland. The typical axe had very regular lines with medium fine seams, which were, as with all the replicas, shaped with the "turned edge" method. During the flaking of side 3, two hinge fractures occurred in an attempt to make the angle of the edge sharper. The axe was relatively broad and flat, with a weight of 1127.2 g, a length of 24 cm, a breadth of 8 cm and a thickness of 4.1 cm (fig. 3B).

All four surfaces were ground. The two narrow sides were done first, with a combination of hand grinding and grinding with extra weight (32 kg) with the axe fixed in the split ash branch. This was carried out quickly, the sides taking 30 and 21 minutes.

In this work the grinding groove was unintentionally deepened. (This could have been prevented if the grinding had been spread out more across the groove.) It was therefore necessary to establish a new grinding groove.

As mentioned earlier, sand was used for a short period (8 minutes) during this experiment. This was not intended as a grinding agent, but to stabilise the movements of the axe on the still uneven surface of the grindstone.

After the seams, edge corners and edge rim were ground with area grinding and hand grinding respectively, the faces were ground with extended use of the maximum weight of 80.5 kg. The friction was so great that during the grinding of face 3 it was noted in the log book that the axe was warmer than blood heat! Length of grinding stroke was 80 cm. The axe moved a total of 6810 m over the grindstone, taking 10,600 strokes in 4 hours 30 minutes, and was by then fully ground as far as the outer edge area on side 3 (fig. 14).

On all four surfaces, powerful, long and parallel striations were visible, which partially ran over into the most powerful type of grinding trace: crush marks at certain

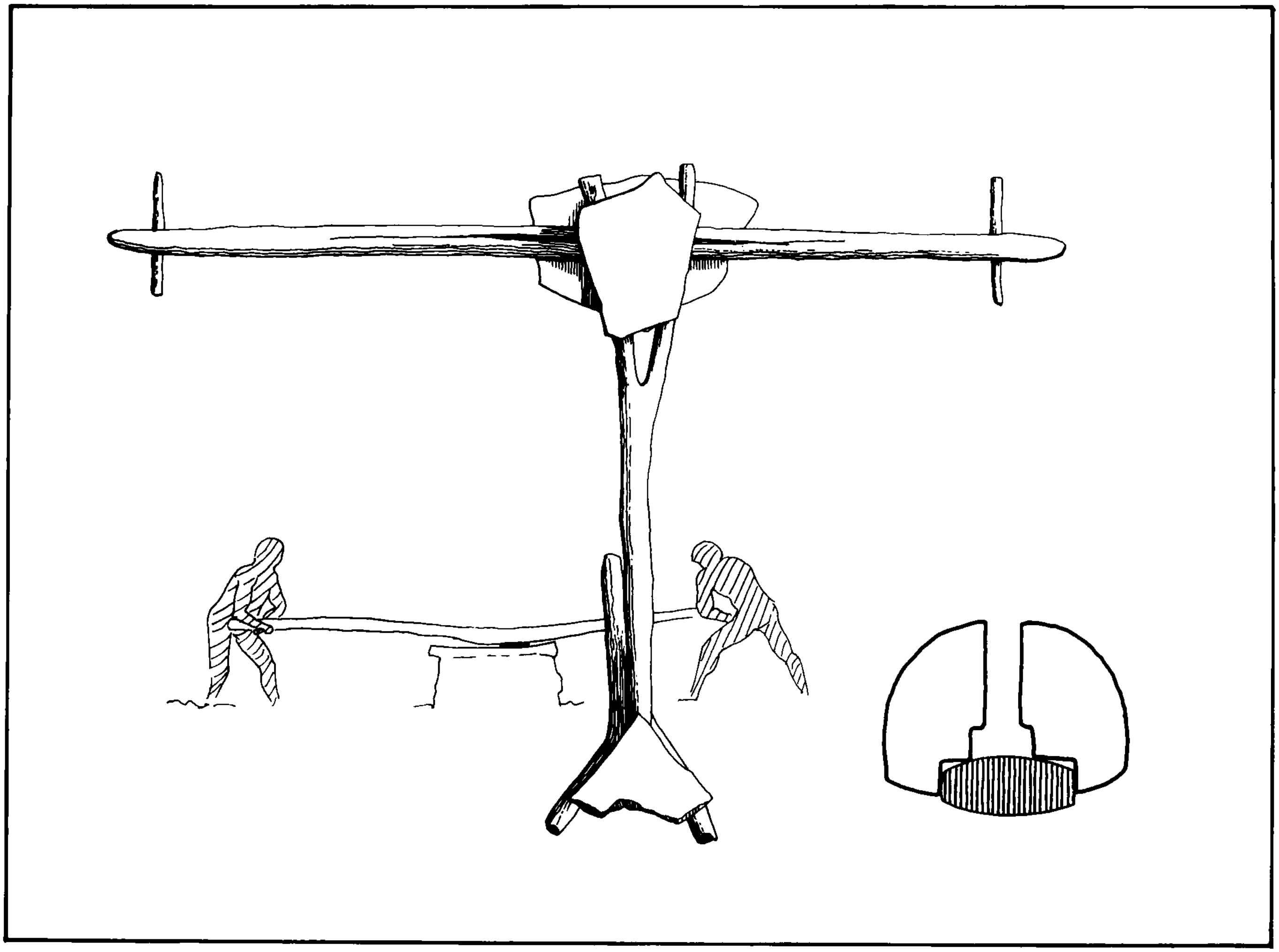


Fig. 6. The system used for grinding with extra weight. BM *del.*

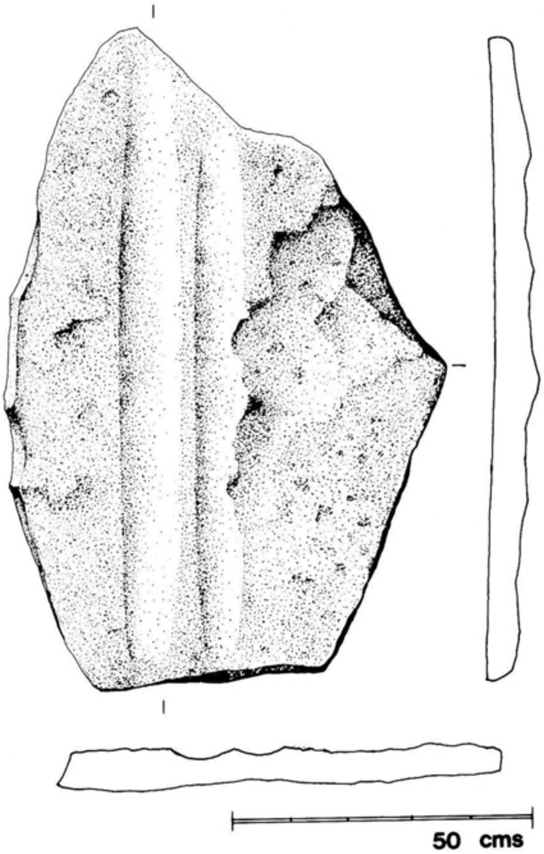


Fig. 7. The experimental grindstone. BM *del.*

points. Clear grinding facets occurred in both edge areas (fig. 2K). Grinding reduced the maximum width by 0.35 cm, and the maximum thickness by 0.77 cm.

EXPERIMENT III – GRINDING WITH EXTRA WEIGHT

A thin-butted axe of type III was ground, made by JP from light greyish blue Senonian flint from Falster. This variety was decidedly porous. The large replica was of typical shape. It was the most regularly flaked of those used in the experiments, regarding both surface working and cross-section through the long axis and general outline. The edge area was perfectly flaked. This axe blade was slightly twisted, as are many original thin-butted axes. Length was 29.2 cm, greatest breadth 8.3 cm and greatest thickness 4.7 cm (fig. 4A). It weighed 1671 g.

This axe was the most completely ground of all the experimental examples. The edge was so well ground that light transverse sharpening for 5 to 10 minutes was all that was necessary. Edge grinding was done on the large grindstone, which now had a smooth, suitable grinding groove. A rounding of the sharp edge (fig. 9B) by area grinding meant that hand grinding could be taken right out to the edge without risk of damage – a wellknown technique in lapidary technology (Scarfe 1970).

The heavy grinding was carried out as described for experiment II, except that the maximum weight of 80.5 kg was reduced to 52 kg during experiment III. This led to better control over the movement of the axe in the groove. The axe travelled a total of 12,340 m in 16,350 grinding strokes, in a time of 6 hours 38 minutes. There was a grinding facet in the edge area on side 1, which also had powerful striations and crush marks similar to those noted in experiment II. Greatest breadth was reduced by 0.4 cm, greatest thickness by 0.5 cm.

EXPERIMENT IV – GRINDING WITH EXTRA WEIGHT

The last axe to be polished in this series of experiments was a large thin-butted replica of type V, made by BM from plain, dark Senonian flint of the best quality from Falster. The axe had lines typical of a piece of lesser quality. Surface flaking was irregular, with several concave hinge fractures, which would need much grinding down. Length was 30.3 cm, greatest breadth was 8.3 cm and greatest thickness was 4.8 cm (fig. 4B). The axe weighed 2013.4 g.

Grinding followed the same procedure as in experiments II and III. Maximum extra weight was 52 kg. With this weight, grinding was carried out from the faces out over the seams. This resulted in partial pressure damage along these in the form of negative flake scars 0.5 – 2 mm in size, with a truncated form as seen in the so-called "split cone" fracture. The axe travelled 15,830 m over the grindstone, taking 21,650 strokes over 9 hours. The edge was not sharpened. Grinding striations and crush marks were marked on all surfaces. Maximum width and thickness were both reduced by 0.4 cm.

EXPERIMENTAL RESULTS AND OBSERVATIONS

Work time. In the table (fig. 10), net grinding times are given, varying from 4.5 to 9 hours. These are expressed as the number of man hours taken in the four experi-

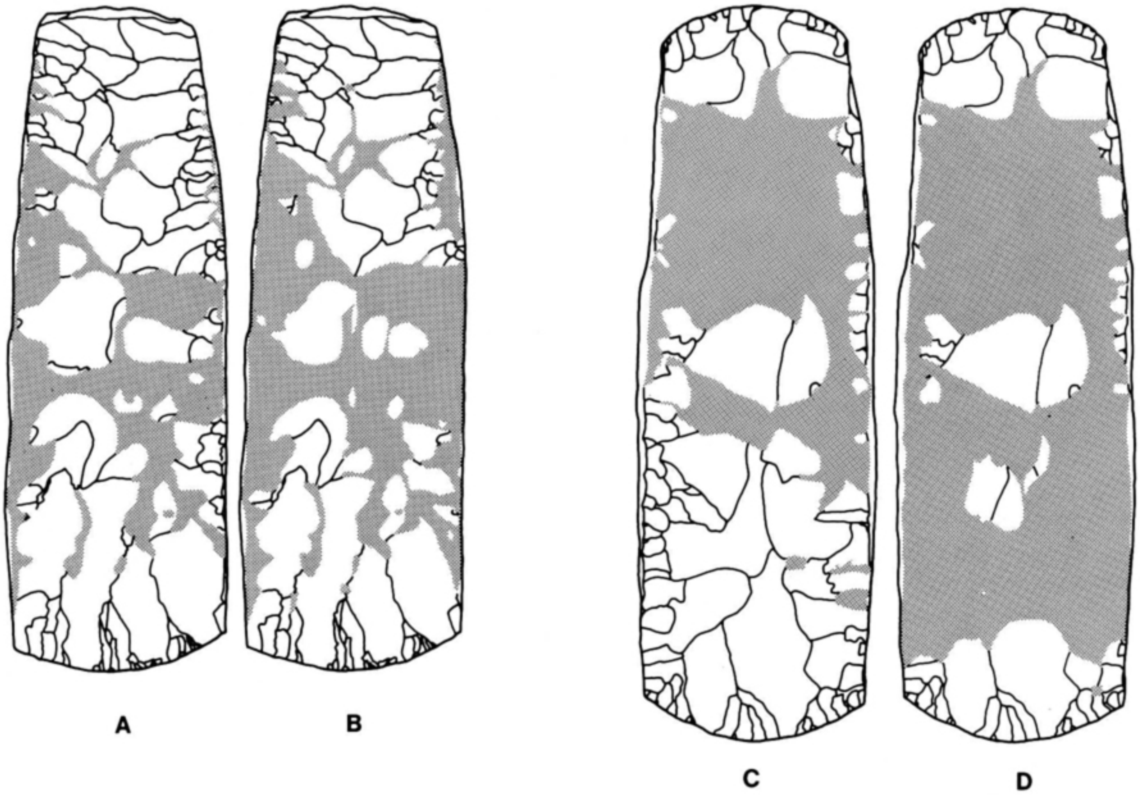


Fig. 8. The extension of ground areas.
Experiment I, side 1: A. After 400 grinding strokes (200 m).
B. After 800 grinding strokes (400 m).
Experiment II, side 1: C. After 400 grinding strokes (300 m).
D. After 800 grinding strokes (600 m).

ments. Anyone who has tried polishing a flint axe must agree that it is monotonous physical labour, which cannot be carried out non-stop. During the experiments, the ratio between net grinding time and total work time varied from 2:3 to 1:3, when the work was slowest. The ratios, which show the practical side of grinding, are to some extent a factor of the workers' physical condition and weight, but are also strongly conditioned by experience, skill and work rhythm. But even if a realistic estimate is 1:2, it still means that a medium sized thin-butted axe can be ground in one day's work.

Earlier experiments have related the total ground area to the time taken to produce it. Sehested gives 0.1 to 0.12 cm^2 per minute. Andersen (Olausson 1983, 32) seems to be able to grind about 2 cm^2 per minute. (For the experiments described here, such a calculation gives from 0.5 to 10 cm^2 per minute). This method of presentation is entirely subjective, however. Fig. 8 clearly shows that increased friction (experiment II) drastically increases the area ground per unit of time.

Weight loss. The above quote from Semenov is contradicted by the experiments, which show that quite a lot of weight can be lost during grinding – from 6% to 15% of the unground weight of the axe in stage 4 of its manufacture. In experiment IV, about 300 g flint was removed in grinding. This corresponds to the weight of a small flint axe. It can be added that use of extra weight and several people made the grinding more economical in terms of time and energy. The figures in the table (fig. 10) show that there seems to be a weightloss increase of several grams per man-hour if extra weight is used.

Quality of flaking. The surface topography of the axe is clearly of great importance. A comparison between experiments III and IV is a useful example of this. It took 9 man-hours more to grind the axe with the worst flaking. One of the conclusions from experiment IV was that it would be easier to rough out a new axe (which takes about 2 hours) than to grind for a whole extra day

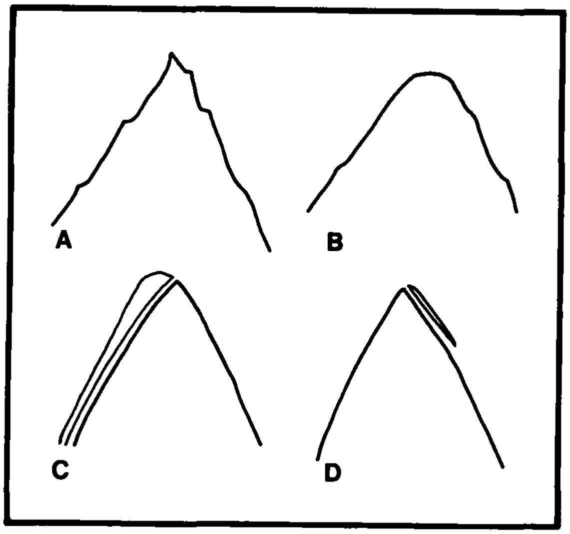


Fig. 9. Grinding of edge rim and edge area. A: the sharp, bifacially flaked edge before grinding. B: rounding off the edge. C: grinding the edge area on both faces. D: sharpening the edge rim. Grethe Rasmussen *del.*

– always assuming there is plenty of available flint.

The axe ground in experiment III had the greatest weight loss relatively to working time. Several factors were probably at work here, which two possible ones are: the axe was made from porous flint, which may have been easier to grind; more important, however, is the fact that a well-flaked axe, with close and regular spacing of the negative flake scars and characterised by many small projections and many facets, can be ground quicker than a more crudely worked axe. A crude axe has larger projections and fewer facets. During grinding, crumbling or crushing of the sharp points of the projections is constantly taking place, and it seems that larger fragments of flint are broken off with conical fractures. This process increases the amount of flint removed by the sharp grains in the grindstone.

Type consistency. Measuring the diminishing of the axe sizes showed that, although there was a clear drop in thickness, and to some degree of width and length, the grinding process did not affect the typological traits of the axe. It is, therefore, justifiable to use the same type descriptions for both ground and unground prehistoric axes – so long as one makes the same reservations as Becker (1973), who presents detailed examples of reworking of ground thin-butted axes. This seems to involve repairs to thin-butted axes damaged during use (Becker 1973, figs. 10 and 11). There is also one example of an axe altered entirely by grinding, from a thin-butted axe to a hollow-ground adze (Becker 1973 fig. 16). A partial reworking of a ground stone axe which still preserves the original type (as described by Becker), is, however, not possible (Becker 1973, 133). The illustrated examples of these are in fact unfinished thin-butted axes, with greater or lesser partial grinding (Becker 1973 figs. 8 and 9).

Macrostriations. One of the aims is to examine whether there is a connection between grinding method and appearance (nature and extent of striations and polishing). Figures 11A and 11B show photographs of side-lit silicon rubber impressions of the ground faces of two different axes (5), from experiment III (grinding with extra weight) and experiment I (hand grinding) respectively. The striations in fig. 11A are clear, deep and parallel. They are also longer than in fig. 11B, and are accompanied by areas of crush marks, which are irregular and pit-like. The surface of fig. 11B has more transverse striations, fewer crush marks and much greater areas of of polishing. These striations, formed by grinding on the quartz sandstone, are very similar to the striation type illustrated by Meeks, Sieveking, Tite and Cook (1982, 327). Figs. 13 and 14 compare an early neolithic axe of type IV, ground all over, with one of the experimentally ground axes from experiment II. The hypothetical connection between grinding method and appearance seems at present to be quite likely correct; more investigations must be carried out, however, to provide more thorough documentation and quantification.

Traces of use. Becker (1973, 130) mentions the difficulties in distinguishing these from deliberate polishing. The experiments confirm that this is the case. Polishing resembling gloss appeared in the edge area itself, even though considerable pressure was used in grinding.

If use traces are to be demonstrated, they must be in the form of microscopic polishing from wood in the edge area, not arbitrary polishings or macrodamage like the small "feather terminated scars" illustrated by Olausson (1983, fig. 25).

EXPERIMENT No.	I	II	III	IV
3 men at work pressure 80,5 kgs	-	1^h 48' 50"	63'	5^h 22'
3 men at work pressure 52 kgs	-	-	58'	-
2 men at work pressure 32 kgs	-	1^h 34' 55"	1^h 28'	1^h 46'
1 man at work "handgrinding"	5^h 31' 25"	1^h 3' 35"	3^h 9' 30"	1^h 48'
Total net time	5^h 31' 25"	4^h 27' 20"	6^h 38' 30"	8^h 56'
No of grinding strokes	11800	10600	16350	21650
Meters	6650	6810	12340	15830
Weight reduction	74,5 g	147,3 g	197,0 g	300,1 g
Man/hours	5,5236	9,6666	12,1417	21,4333
Grs. removed per man/hour	13,4875	15,2389	16,2250	14,0015

Fig. 10. Quantitative data from the experiments.

COMPARISON WITH OTHER GRINDING EXPERIMENTS

A comparison of the experiments at Lejre in 1983 with those of Sehested calls for some comment on the long grinding time used in 1881. This long time can be explained by the fact that Sehested used granite as a grindstone and added gravel as a grinding agent. Compared to sandstone and water, this method produces far less friction, creating a sort of ball-bearing effect. Furthermore, we know nothing of the quality of the flaking of the axe Sehested used. Finally, it is likely that Sehested's times are inclusive of a number of rests. The Lejre experiments agree much more closely with the experimental grinding of 3 flint axes described by Olausson (1983, 23). One thin-butted and two thick-butted axes were ground by Ivan Andersen in 2 hours 5 minutes, 4 hours 5 minutes and 4 hours 10 minutes respectively. The edge area of the thin-butted axe was ground on carborundum for 20 minutes, the rest of the grinding being on sandstone. Grinding time for the thin-butted axe seems very short. Th explanation is, to judge from the illustration, that the axe is not fully ground.

AXE GRINDING IN NEW GUINEA

Stone axes were manufactured in several regions of east new Guinea until the 1940's (Vial 1940). Mining, flaking into shape and grinding are all described. The raw material was layered, siliceous slate or more uniform rock types, characterised by partial or complete conchoidal breaks. The three types manufactured were working axes with lenticular and rectangular cross sections, and large, thick axes for bridewealth, together with ceremonial axes, which were the best prepared. The last named have flat, rectangular cross-sections, and the blades are ground all over and are up to 30 cm in length. These ceremonial axes are not without a certain similarity to our own medium bladed, thick-butted axes (Becker 1973, fig. 27) and axes of late neolithic type (fig. 1G).

In the 1960's the original character of the axe production in the Highlands was replaced by the manufacture of axes from softer stone, used among other things to sell to the tourists (Chappel and Strathern 1966). Originally the axes were bifacially flaked by direct percussion, using an ovoidal hammer stone. The thick, lenti-

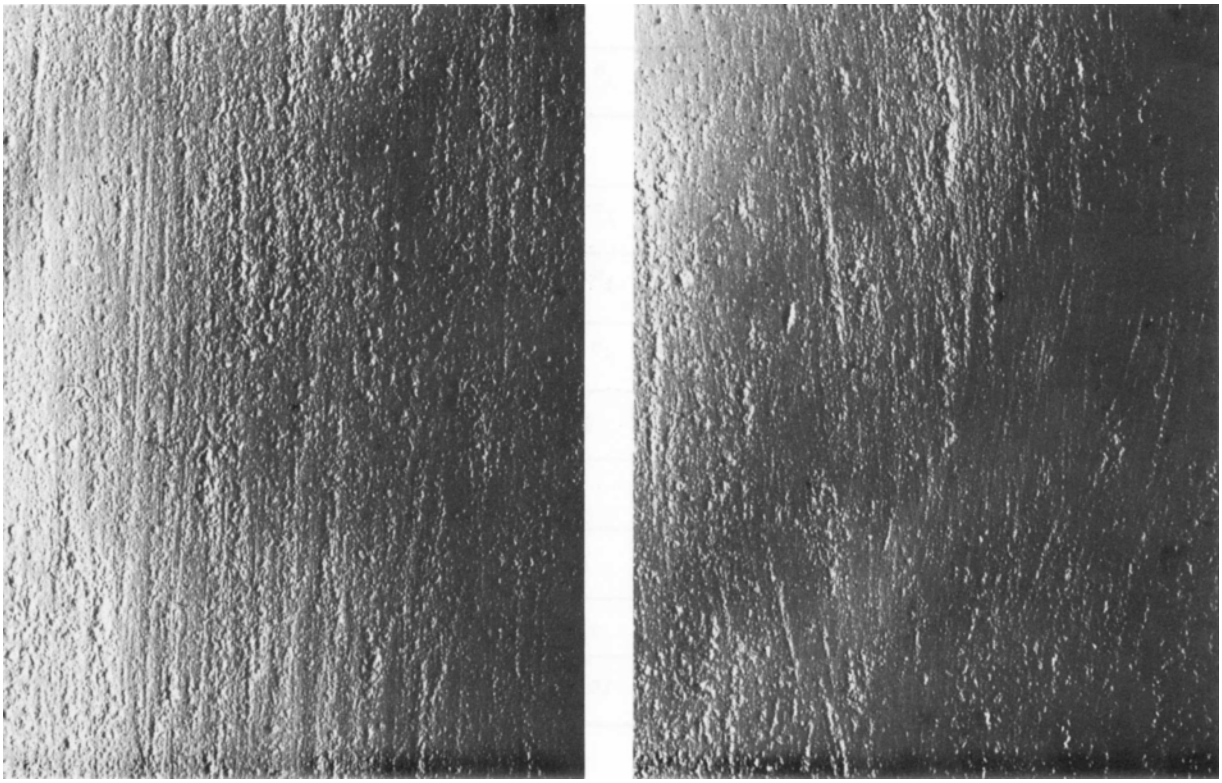


Fig. 11. Silicon rubber impressions of traces of grinding, lit from the side, taken with an Optica reprocamera. The dark shadows are due to the concave surface of the impression. A: Experiment III, side 3. B: Experiment I, side 1. Photo: E. Benner Larsen. 2,2:1.

cular cross-section was squared off by grinding – a process demanding a lot of grinding.

Vial (1940, 160) states that it took about three days to grind a ceremonial axe, and gives the following description of the work (see also Højlund 1979, 35):

"All the villages and hamlets have their polishing 'factories', the essentials of which are water and blocks of sandstone and a shady place to sit. Sometimes men worked by themselves beside a hole in the ground filled with rain water, sometimes six or eight men worked side by side on the banks of a small stream. Two races were noticed in the forest between villages, and the local natives with us said these carried water for axe polishing.

A number of men were seen at work polishing blades. The man sat beside his water-supply with blocks of sandstone propped up on the ground before him, and dipping the stone blank in the water, held it in both hands and rubbed it backwards and forwards on the sandstone, stopping now and then to examine it and wet it again. In addition to the large pieces of sandstone there were some smaller pieces lying nearby which were apparently used for the final touches, though I did not see this.«

In northeast Irian Jaya (west New Guinea) stone axes are still being produced. The work involves flaking with direct percussion using a hammerstone, pecking and grinding on quartzite using water, and finally polishing on palm leaves containing silicon. A French gemologist visited the village of Ormu Wari in 1982, where axes are made for the other villages around Lake Sentani (Gonthier 1982). These axes, which are polished "as smooth as water", are used according to the author for ceremonies and bridewealth.

DISCUSSION

We now see examples of modern flint workers being used as informants. The observing archaeologist can find himself in a situation almost parallel that of travellers in the early days of ethnography, who received almost whatever answers they wanted from the friendly informant (Olausson 1983, 34).

Fig. 12. The experimentally ground axes.

In this work, Olausson undertakes an examination of raw material availability, production process and use of flint and stone axes in the neolithic of Scania. Basing her comments on the comments of the informant, she argues that flint axe manufacture was an unspecialised task, which could be learnt by most people very quickly. Olausson believes that at least one member of each family would have been able to manufacture flint axes.

When Strathern inquired about the grinding of ceremonial axes at Maegmul in the New Guinea Highlands in the 1960's, he was told that the work took a good three weeks. This was very different from the account of Patrol Officer Vial from 25 years earlier (Chappel and Strathern 1966, 98). The flaking process could still be demonstrated with the help of a steel axe, but at Maegmul people were no longer acquainted with the details of the grinding process.

In neither the ethnographic nor the experimental archaeological situation can observations about material culture be made without understanding the informant's background. Olausson's informant (6) is beyond any doubt very skilful at producing four-sided flint axes with a copper fabricator. But the fact that he taught himself this in a short time is no justification for extrapolations to be made about the entire neolithic axe production of Scania. It can be stated with at least

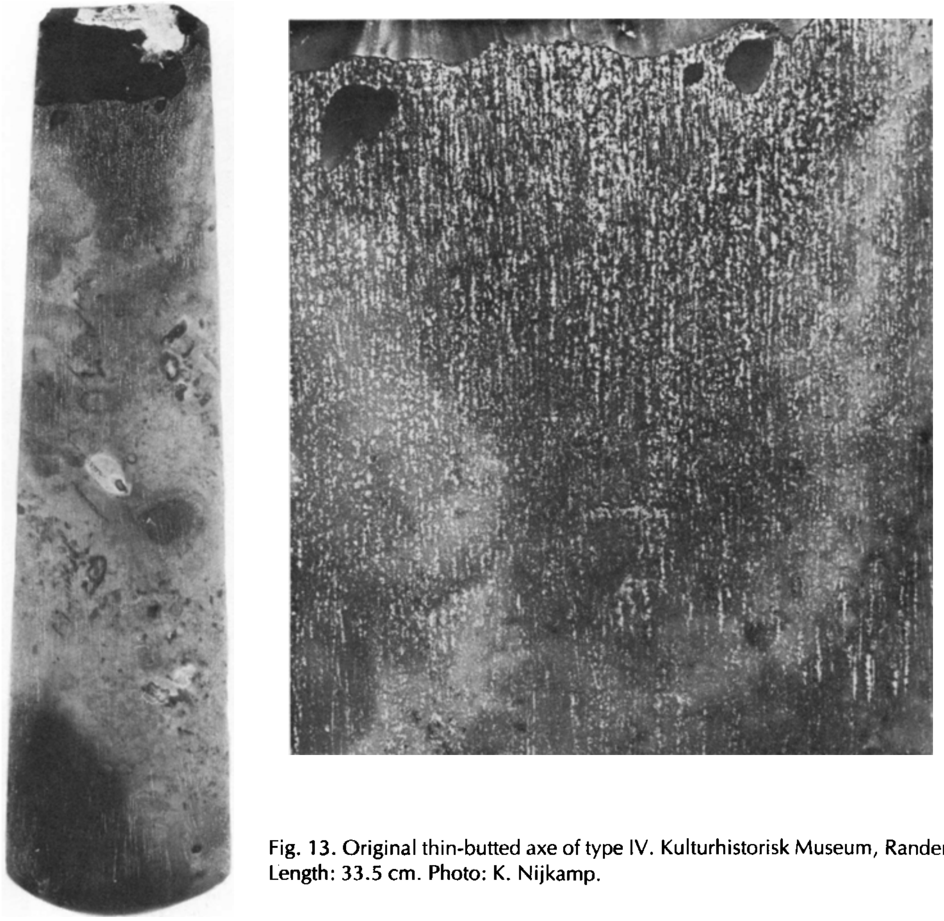


Fig. 13. Original thin-butted axe of type IV. Kulturhistorisk Museum, Randers, no. 1662. Length: 33.5 cm. Photo: K. Nijkamp.

as much force that the experimental results, arrived at through flaking at a replicative level, show that the flaking of four-sided axes with antler fabricators is a process which takes several years to learn. Merely to maintain that the second stage of axe manufacture, the shaping of a four-sided flint blank by direct percussion, can easily be learnt by anyone, would correspond to a claim that the middle palaeolithic Levallois flaking system was straightforward.

There appear to be no great differences between the experimental results and the descriptions from New Guinea, either as regards grinding methods or the time involved. In New Guinea it is clear that stone axes are exchanged and utilised in areas far beyond the place of manufacture. The distributions of some axe types of the south Scandinavian neolithic are also much greater than the areas where production took place. The flaking into shape of these flint axes is regarded as work that from a regional perspective would be collectively specialised. Flaking was carried out by groups in the areas most rich in the raw material (Hansen and Madsen 1983). As in New Guinea, local production of axes with inferior flaking would also have taken place in areas poor in raw materials. The range of axes from the Jutland Single Grave Culture includes many types with badly executed flaking (in the coarser Danian flint), and also well flaked uniform axes made of better flint, not of local origin. This shows that it was the completed object, not the raw material, that was traded.

As regards grinding, it seems likely that all users would have been able to grind an axe already flaked to shape, or to sharpen one. The question is whether the grinding process went through a technological development at any time in the early neolithic. One can envisage that better grinding methods might have been used by the specialist groups who shaped and distribut-

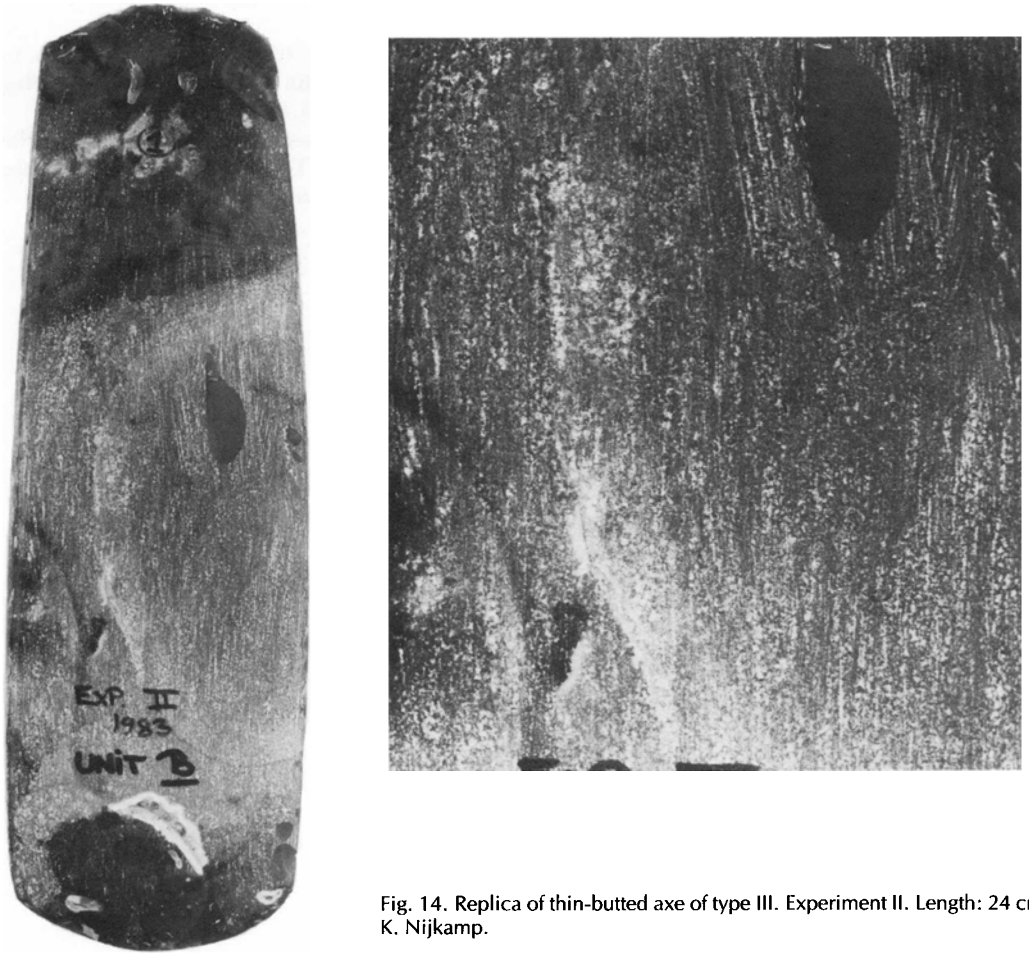


Fig. 14. Replica of thin-butted axe of type III. Experiment II. Length: 24 cm. Photo: K. Nijkamp.

ed the axes. In the archaeological material there is a geographical agreement between areas rich in flint, areas with evidence of production (workshops, flint pits and mines, blank production), and concentrations of the longest and most completely ground axes, such as type IV (Nielsen 1977, fig. 16A).

How these hypothetical grinding systems were actually carried out is an unanswered question. The "system" used at Lejre in 1983 was only one imaginative possibility out of many, and should be followed up by further experiments, for example using a method of grinding with extra weight which can be operated by a single person.

Experimental archaeology attains results through the interplay between experience and experiment, and in this way moves from the possible towards the plausible – although often slowly. The researching of lithic technology is still characterised by single experiments, or series of very few experiments. It is hoped that the experiments described here will help to reduce this lack.

Translated by Peter Rowley-Conwy

Bo Madsen, Kulturhistorisk Museum, DK-8900 Randers.

NOTES

1. Thanks are due to Hans Ole Hansen (Director) and Dorthe Hubert Nielsen (Area Administrator), of the Historical-Archaeological Research Centre, Lejre, for all their assistance. Thanks also to Martin Appelt and Simon Drost who added both finesse and strength to the closing stage of the experiments. Peter Kelterborn of Switzerland took part in some of the experiments; thanks to him for his constructive energy, enthusiastic participation and sound advice.
2. Ivan Andersen has worked for several years on the hand grinding of flint axes made by himself (with an iron fabricator). He has con-

vincingly reconstructed the grinding process, works in a standing position and grinds on quartz sandstone. Andersen describes among other things grinding a 420 g thin-butted axe in 5 hours 15 minutes – information from a privately printed manuscript 1981 (Olausson 1983, 32).

3. In connection with the log book, some of the experiments were recorded on video by the Lejre Centre's media workshop. (Malling, O. and Madsen, B. 1983: Experimental Grinding of Neolithic Flint Axes).
4. Thanks to B. Skytte Jensen and P. Boe, of the Chemical Laboratory, Risø Nuclear Research Station, for their willing help and interest.
5. This documentation and analysis was carried out by E. Benner Larsen of the School of Conservation in Copenhagen. The work is part of a project examining tool marks on prehistoric tools.
6. Thor Bjørn Petersen made the axes. It is the experience of the author that most present-day flint workers have been influenced by others. Petersen's methods imitate those of the German flint worker Harm Paulsen, who however only uses antler (Olausson 1983, figs. 5 and 6).

REFERENCES

BECKER, C. J. 1973: Studien zu Neolitischen Flintbeilen. *Acta Archaeologica*, vol. XLIV. Copenhagen.

CHAPPEL, J. and STRATHERN, M. 1966: Stone Axe Factories in the Highlands of East New Guinea. *Proceedings of the Prehistoric Society*, N. S. no 32. Cambridge.

GONTHIER, E. 1982: Les outils de Nouvelle-Guinée. *Revue Gemmologie AFG*, no 73. Paris.

HANSEN, P. V. and MADSEN, B. 1983: Axe Manufacture In The Neolithic: An Experimental Investigation of an Axe Manufacture Site at Hastrup Vænget, East Zealand. *Journal of Danish Archaeology*, vol. 2. Odense.

HØJLUND, F. 1975: Axes and Chisels of Flint in the Battle-Axe Culture. *Kuml* 1973–74. Aarhus.

– 1979: Stenøkser i Ny Guineas højland. *Hikuin* vol. 5, Aarhus.

– 1981: The Function of Prestige Weapons in the Reproduction of New Guinea Highlands Tribal Societies. *Oral History* vol. IX, no 3. *Institute of Papua New Guinea Studies.*

KRAGH, A. and MELDGÅRD, J. 1964: *Mand og Flint.* Copenhagen.

MADSEN, B. 1984: Et forsøg med tilhugning af Kristianstad-flint. *Fjölnir* vol. 3, no. 1. Uppsala.

MEEKS, N. D. *et al.* 1982: Gloss and Use-wear Traces on Flint Sickles and Similar Phenomena. *Journal of Archaeological Science* vol. 9, no 4. London.

NIELSEN, P. O. 1977: Die Flintbeile der frühen Trichterbecker-kultur in Dänemark. *Acta Arch.* vol 48. Copenhagen.

– 1979: De tyknakkede flintøksers kronologi (Zur Cronologie der dicknackigen Flintbeile). *Aarbøger for nordisk Oldkyndighed og Historie* (1977). Copenhagen.

OLAUSSON, D. S. 1983: *Flint and Groundstone Axes in the Scanian neolithic.* Scripta Minora 1982–1983: 2, Lund.

– 1984: Lithic Technological Analysis of the Thin-Butted Axe. *Acta Arch.* vol. 53. Copenhagen.

SCARFE, H. 1970: *Collecting and Polishing Stones.* London.

SEHESTED, N. F. B. 1884: *Archaeologiske Undersøgelser 1878–1881.* Copenhagen.

SEMENOV, S. A. 1964: *Prehistoric Technology.* London.

VIAL, L. G. 1940: Stone Axes of Mount Hagen, New Guinea. *Oceania* XI (2). Sidney.

WICKHAM-JONES, C. R. 1982: The Second International Seminar in Lithic Technology. *Scottish Archaeological Review*, vol. 1, no. 2. Edinburgh.

Journal of Danish Archaeology vol. 3, 1984, pp. 63–82

Hanstedgård

A Settlement Site from the Funnel Beaker Culture

by PALLE ERIKSEN and TORSTEN MADSEN

The settlement site dealt with in this essay should be viewed in relation to a settlement archaeological program currently being carried out in Eastern Jutland. The program is concerned with the organization and development of TBK society (Madsen 1982). The excavation of the Hanstedgård site revealed undisputable traces of a hut, even if its D-shaped form may seem odd. Distributional differences between tool-types on the site are also noted, and their significance in terms of site organization is discussed in the essay. Also a survey of house claims in the Nordic TBK is included, with a critical assesment of these claims.

SITE DESCRIPTION

The settlement site of Hanstedgård is situated immediately north of the town of Horsens in eastern Jutland in a tunnel valley. For the greater part of the Atlantic and Subboreal periods the valley contained an eight kilometer long inlet of the Horsens Fjord to which it was connected by a very narrow sound (Fig. 1).

The settlement was situated on a 300 by 170 m. large and 6 m. high hillock surrounded by water on three sides and low marshy areas on the fourth side, in effect making it an island (Fig. 1). The subsoil of this island consisted of gravel and sand.

Most of the hilllock was removed and used for road construction during the seventies, leaving only the edges of the island partly undisturbed. It was here along the northern edge of the island that the excavation was carried out during the spring of 1983 as part of a rescue program in connection with the laying down of gas pipelines. The excavation was directed by Palle Eriksen from Vejle Kulturhistoriske Museum and carried out in cooperation with Institute of Archaeology, University of Århus. Erik Dalby, Frank Grønning and Chr. Åbo Jørgensen participated in the excavation. The finds are kept at Vejle Kulturhistoriske Museum (J.nr. VKH M998).

An area of 750 sq. m. was stripped by machine, revealing various pits, some modern disturbances and a 42 m. long and 4–10 m. wide depression filled with a grey-black, humus-rich material (Figs. 2; 3). Approximately one third of this depression was excavated, revealing further pits, some ard furrows and traces of a hut. Apart from one piece of pressure flaked flint from the top of the depression, all datable material from all features can be attributed to MN I. In general, the pottery suggests that we are dealing with an early level of the MN I with a mixture of MN Ia and MN Ib traits in the individual features.

The depression

Although rather deep in some places, the depression was a natural formation, and evidently it was fully open at the time of the settlement. Along its bottom a 15–30 cm. thick, grey-black, humus-rich soil (buried Ah horizon) was found (Fig. 4), containing fair amounts of settlement debris evenly distributed from top to bottom. The average density of worked flint was 32 pieces per sq. m. and of pottery 200 g. per sq. m., measured in those areas where the deposit was completely preserved. Above this Ah horizon was a 10 cm. thick deposit of light grey-brown sand (Fig. 4), partly sealing off the lower deposit from the modern plow soil. The formation of this deposit was probably the result of agricultural activities higher up on the hillock. We are not so fortunate as to be able to date this activity, but it may well have happened in prehistoric times in connection with the initial ploughing evidenced by the ard furrows.

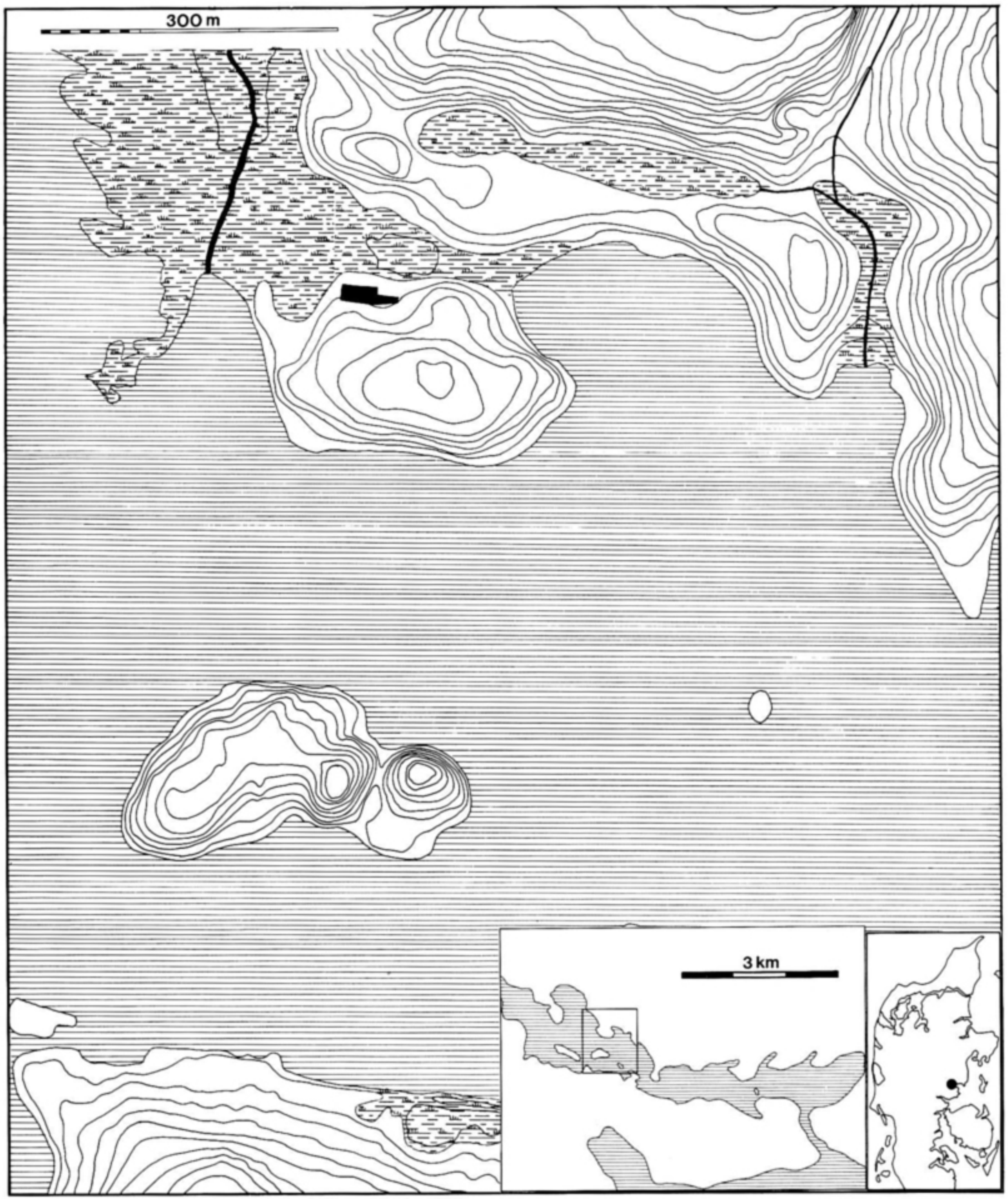


Fig. 1. Map showing location of the Hanstedgård site. Contour lines are at one meter intervals. The excavation area is shown as a black polygon.

Ard furrows

Ard furrows were uncovered in a 3 m wide trench in the middle of the depression (Fig. 3), and in the eastern end in the area of the hut. The main direction of the furrows was east-west, along the axis of the depression, but a few earlier, non-parallel, generally north-south directed furrows were also seen. The explanation for this pattern seems to be that some initial haphazard ploughing took place to rip up the roots on the cleared land before a systematic ploughing was carried out with parallel, 5–15 cm. wide furrows placed with an average density of 4 per m. The ard furrows definitely postdate the hut and thus probably the settlement as a whole. However, it is not possible to say how much later, and this phase of cultivation may date to any period later than the MN I.

Fig. 2. The excavation area seen from the west.

Pits

Twenty-three datable pits were excavated. They are of two very different types.

Type 1 (14 examples) is round-bottomed with a width between 50 and 110 cm. (average: 82 cm.) and a depth between 5 and 34 cm. (average: 19 cm.). The fill is in most cases homogeneous with a grey-black colour. The amount of cultural debris in the pits of this type is moderate, with an average of 40 pieces of worked flint and 800 g. of pottery.

Type 2 (nine examples) is flatbottomed with vertical sides (figs. 5; 6). The width lies between 64 and 180 cm. (average: 102 cm.) and the depth between 47 and 100 cm. (average: 64 cm.). The fill in this type of pit follows a very distinct pattern. At the bottom is a 10–20 cm. thick deposit of charcoal-coloured, black sand. It goes from one side of the pit to the other and covers the bottom completely, leaving no doubt that it is a primary deposit related to the function of the pit. Very often, the sides of the pits have slumped in immediately after the primary deposition, and mostly it is impossible to separate this slumped material from the subsoil. The result of this is a queer, strangulated appearance of the pits when seen in section. The primary deposits and the slumped subsoil were subsequently covered by a grey or grey-black layer. In a couple of the deeper pits a new, black, charcoal-coloured, primary deposit was formed before the final filling, which in all the pits takes the form of a grey-black, humus-rich soil of the same general appearance as the buried Ah horizon in the depression. The pits contained large amounts of debris, with 160 pieces of worked flint and 2600 g. of pottery as an average.

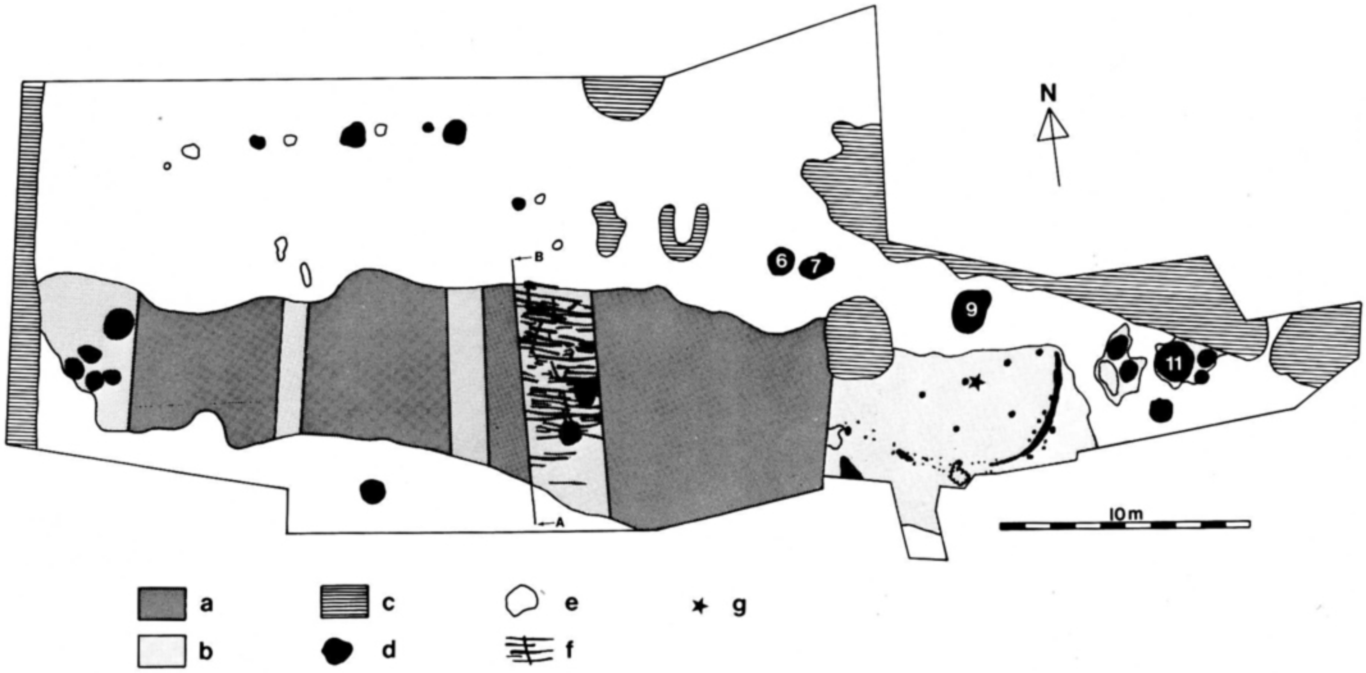


Fig. 3. General plan of the excavated area. Legend: a: unexcavated parts of the depression. b: Excavated parts of the depression. c: Disturbed areas. d: Dated pits. e: Undated pits. f: Ard furrows. g: Fireplace in hut. A and B refer to endpoints in the section fig 4.

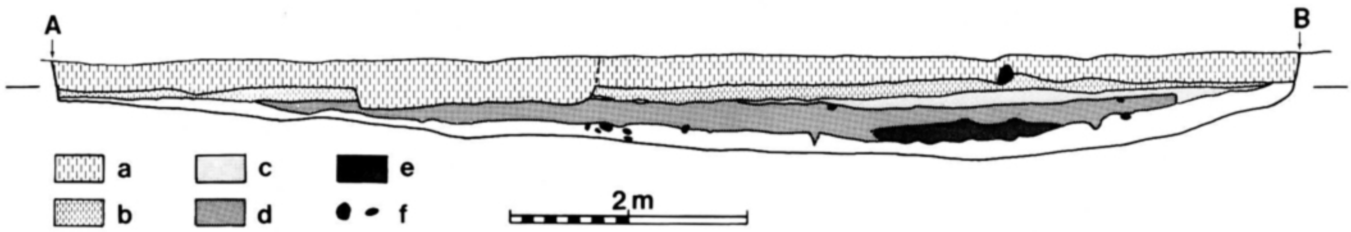


Fig. 4. Section through the depression. a: Modern plough-soil and disturbances. b: Plough-soil of older date. c: Light, grey-brown sand. d, e: Humus-coloured, grey-black sand (Ah horizon). f: Stones. Endpoints A and B refer to plan fig 3.

The two types of pits are differently distributed within the excavated area (Fig. 15). Most of the type 1 pits are found to the west, while the type 2 pits are concentrated to the east, around the hut. The morphological differences between these two types must be related to functional differences. The dark, charcoal-coloured layer at the bottom of type 2 pits shows the use of fire in connection with these pits. Although it does not seem possible to attribute a precise function at the moment, it seems reasonable to suggest that they had something to do with food handling, whether roasting, other types of food preparation, or some sort of food preservation like smoking. There is no clue to the function of type 1 pits.

The hut

In the eastern, flat bottomed part of the depression, the traces of a hut were uncovered (Fig. 7). They showed up in the yellow subsoil after the removal of 6–22 cm. of buried soil. Ard furrows appeared as the covering soil

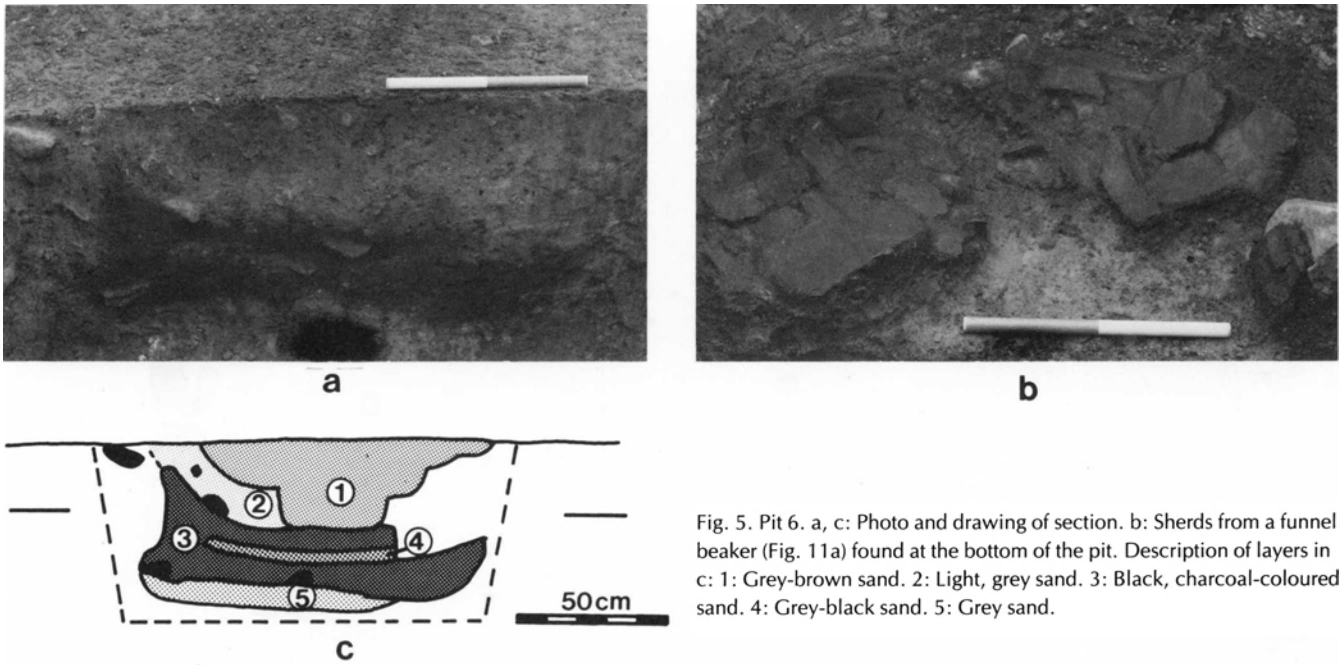


Fig. 5. Pit 6. a, c: Photo and drawing of section. b: Sherds from a funnel beaker (Fig. 11a) found at the bottom of the pit. Description of layers in c: 1: Grey-brown sand. 2: Light, grey sand. 3: Black, charcoal-coloured sand. 4: Grey-black sand. 5: Grey sand.

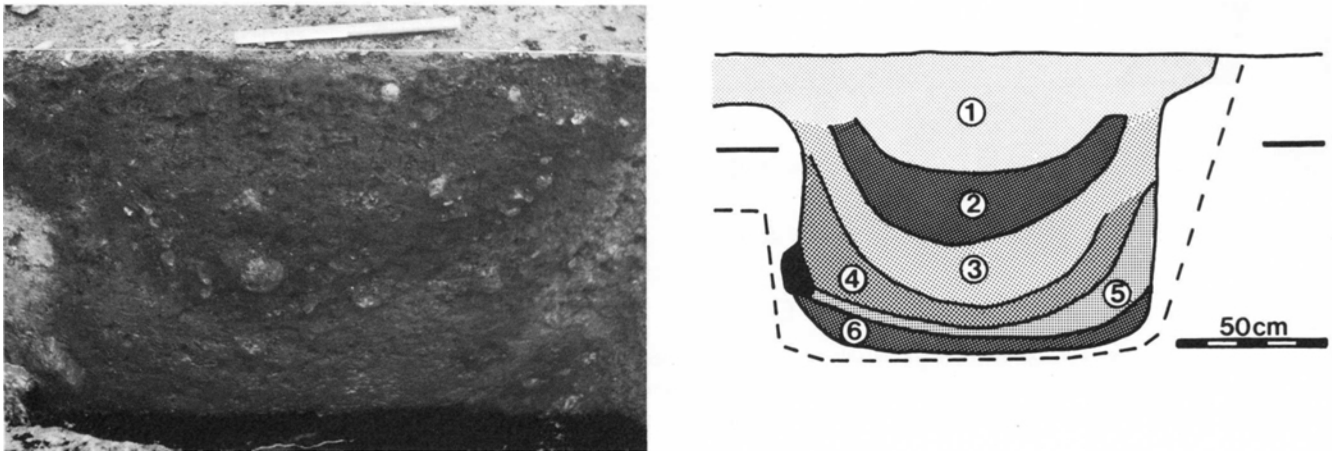


Fig. 6. Pit 11. Photo and drawing of section. Description of layers: 1: Grey-black, humus-coloured sand. 2: Black, charcoal-coloured sand. 3: Dark, grey sand. 4: Grey-black sand. 5: Grey sand. 6: Black charcoal-coloured sand.

was removed, and it was noted that they were definitely later than the traces of the hut.

The plan of the hut was D-shaped, measuring 9 by 5 m. with the straight side wall facing north. This wall showed up as a line of 4–5 regular post holes. Two holes suggesting the existence of roof-carrying posts were located in the interior, and another four post holes were found in the semicircular wall. One of the latter stood in line with the posts of the northern wall, two formed a line together with the roof-carrying posts in the interior, parallel to the northern wall, and the fourth was situated just outside the semicircular wall to the south.

The semicircular wall consisted on the west of two parallel rows of stakes and, on the east, of a shallow foundation trench, in the bottom of which were a few stake holes. On both sides of this foundation trench were rows of shallow post holes parallel to the wall.

The entrance to the hut seems to have been from the

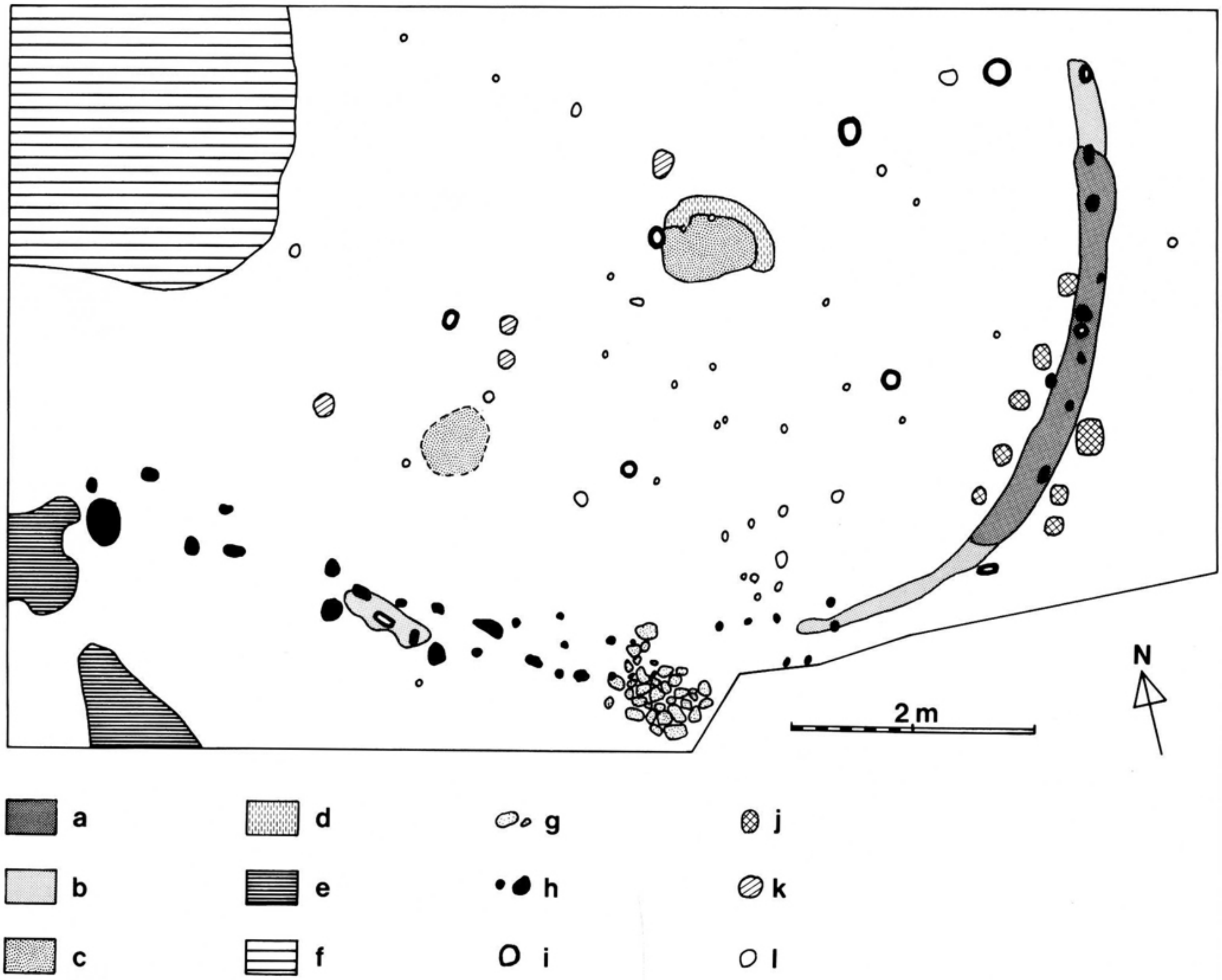


Fig. 7. Plan of the Hut. a: Foundation trench of grey-black colour. b: Foundation trench of grey colour. c: Red-brown sand (fireplace). d: Dark, grey-brown sand. e: Pits. f: Modern disturbances. g: Entrance paving. h: Stake holes in semicircular wall. i: Postholes > 30 cm. deep. j: Shallow postholes adjacent to foundation trench. k: Postholes < 30 cm. deep. l: Various stakeholes.

south, where a stone paving marks a break in the wall. A fireplace was situated adjacent to the northern wall, and the presence of another was indicated in the western part of the hut. The original floor level was at least 2 cm. above the level of the subsoil, to judge from fireplace and entrance paving. In the following detailed description of the constructional features all measures of depth are given from this conservative estimate of the original floor level.

The semicircular wall. This wall was 12.2 m. long and consisted to the east of a 5.8 m. long shallow foundation trench which was 10–30 cm. wide and 5–10 cm. deep, with a rounded bottom (Figs. 7a, b; 8a). The fill of the trench was grey-black in the middle but became lighter towards both ends. The three regular post holes associated with the trench were 33, 37 and 57 cm. deep. The eight stake holes found beneath the dark area in the middle of the trench had an average depth (below floor level) of 15.9 cm. A row of five possible post holes (13, 13, 15, 16 and 21 cm. deep) was seen along the inner edge of the trench, and a row of three possible post holes (17, 16 and 13 cm. deep) was seen along the outer edge of the trench (Fig. 7j). To the west of the founda-

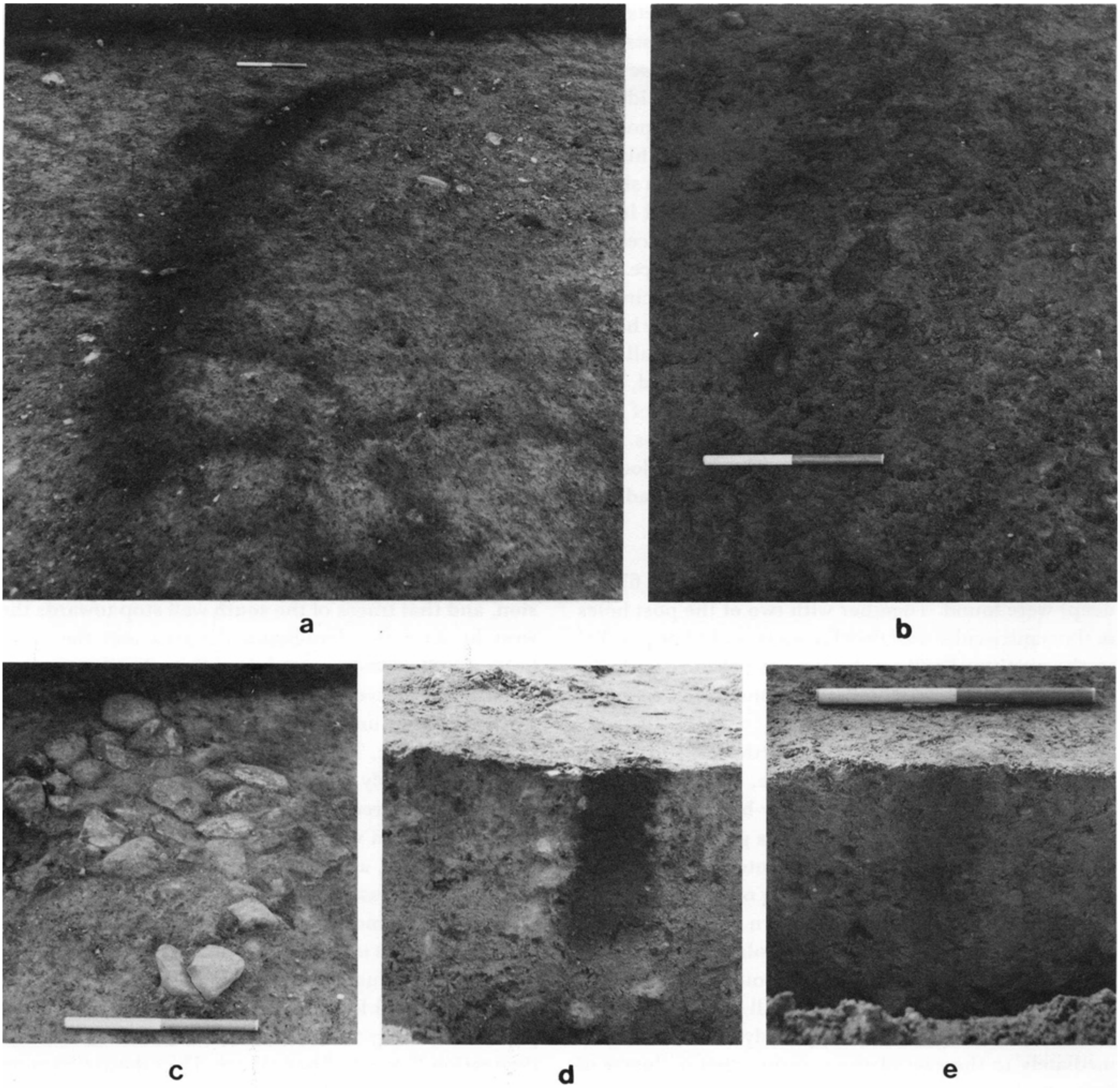


Fig. 8. Photos showing details of hut. a: Foundation trench seen from north. b: Stakeholes in western part of semicircular wall seen from west. c: Entrance paving seen from north. d: Posthole adjacent to fireplace, 33 cm deep. e: Posthole 1.7 m west of fireplace, 33 cm deep.

tion trench came 6.4 m. of wall constructed with two parallel rows of stakes irregularly placed some 30–40 cm. apart (Figs. 7h; 8b). A total of 30 stake holes were recognized. They had an average depth of 14.5 cm. The one regular posthole in this part of the semicircular wall was 32 cm. deep. A 90 cm. break in the double line of stakes was partly filled out by a paving of fist-sized stones, that undoubtedly marks the entrance to the hut (Figs. 7g; 8c).

The north wall. Four evenly spaced post holes (46, 46, 33 and 33 cm. deep, Fig. 8d, e) and a shallow assumed post hole (20 cm. deep) form a straight line that meets both ends of the semicircular wall. This line of posts presumably indicates the north wall of the hut. However, a 29 cm. deep posthole found half a meter outside the middle of the wall may indicate a replacement post for the one standing at the edge of the fireplace. This one certainly must have been scorched by the fire as shown by the heavy, black, charcoal-colour of the fill in the post hole (Fig. 8d, compare with 8e). The replacement must have given the wall an angular appearance. The junction between the north wall and the semicircular wall is well defined at the east corner, where we have a regular posthole at the end of the semicircular wall. The junction at the western corner, on the other hand, lacks constructional evidence. A reconstruction of this corner would certainly be somewhat ambiguous. Two possible post holes (20 and 19 cm. deep) were located just inside the wall, but it is uncertain if they had anything to do with the wall.

The interior. In the interior two post holes (34 and 67 cm. deep) were found. Together with two of the post holes in the semicircular wall they form a straight line parallel to the north wall. These four posts together with the posts of the north wall, definitely constitute a basis for the roof construction.

The fireplace adjacent to the north wall showed up very clearly as a 55 by 80 cm. large, oval spot of red-brown sand with a band of dark, grey-brown sand partly enclosing it. The fireplace itself was gone, but the red colouring that continued 8–10 cm into the subsoil was clear evidence of an intense heating of the soil. Traces of another fireplace in the western part of the hut showed up as a weaker, red-brown colouring extending only a few centimeters into the subsoil.

There was a general scatter of small stake holes in the interior of the hut, but it was only in an area immediately to the east of the entrance that a cluster of holes gave the impression of a deliberate pattern. No function, however, could be attached to these stake holes.

Reconstruction. Even though the traces of the hut at Hanstedgård represent the least ambiguous evidence so far for a dwelling in the Nordic TBK (for detailed discussion see below) a reconstruction is not self-evident.

The most likely suggestion for a reconstruction is based on the apparent D-shape of the traces revealed, and, as the above description has already shown, this is the way we have decided to look at the evidence. We would suggest that the D-shaped hut had a roof construction based on two straight rows of posts. Each of these must have carried a beam on which the roof rested. The semicircular wall was probably a quite low wattle and daub wall woven between the two rows of stakes. The straight north wall, on the other hand, must have been comparatively more solid and probably higher, making the roof slope towards the semicircular wall. The actual construction of the wall is more in doubt, but it may also have been a wattle and daub construction.

Another possibility for a reconstruction is to view the foundation trench as representing an end wall in a rectangular house of which the stretch of wall marked by the double row of stakes constituted a part of the south wall, while the opposite wall is missing. In this proposed reconstruction, one would have to assume that all traces of this missing wall had been destroyed because it was outside the protecting layers of the depression, and that traces of the south wall stop towards the west because the depression deepens and the stake holes therefore do not reach into the subsoil.

This alternative explanation has two serious flaws. First, it is very unlikely that all traces of a north wall could disappear. The eastern end of the depression is very flat, and only a very few centimeters of subsoil can have been removed by ploughing where the wall should be. The junction with the end wall, especially, should have left traces, as it was actually under the covering soil of the depression.

Second, the most serious flaw relates to the roof-carrying posts. It is not possible to fit these into a logical pattern if we assume a rectangular house, whereas they fit the D-shaped form. Furthermore, the roof-carrying posts are so deep that they would be visible outside the depression if they had been there. Thus the assumption of a rectangular house goes against the evidence, and a D-shaped hut is clearly the most acceptable suggestion for a reconstruction.

FIND MATERIAL

Flints

A total of 2436 pieces of waste flint, 78 cores and 327 tools were uncovered during excavation.

Waste. The waste material consists mainly of rough, irregular flakes of varying size, often with cortex preserved. Regular blades are very rare.

Cores. All but five of the cores were irregular pieces with alternating striking directions from mostly unprepared, and, as it seems, randomly chosen platforms. Only four cores had a single, well defined, prepared platform suitable for the production of blades or bladelike flakes. The last core was a complete blank for a thin-butted axe.

Axes. There are seven fragments of axes and 49 pieces of waste flint showing traces of grinding. In all cases where the type of axe can be determined it is of the thin-butted type (Fig. 10).

Scrapers. There are 203 scrapers, or 62% of all tools (Fig. 9m–q). They are mostly wide flake scrapers, with the scraping retouch on the distal end. Only occasionally does the scraping retouch extend to the lateral edges. Most of the scrapers have a heavy, steep scraping edge, but there are also quite a few scrapers with very thin and flat scraping edges. It has not been investigated whether this difference implies a difference in function for wood and hide scraping respectively, as has been demonstrated through wear analysis on scrapers from Sarup (Jeppesen 1984). Only a very few scrapers can be termed blade scrapers and there is no clearcut dividing line between these and the flake scrapers.

Knives. Seventy knives have been identified amounting to 21% of the total tool assemblage (Fig. 9g, i–l). The identification of knives is based on the presence of retouch on the back and/or distal end, but it is known from wear analysis that suitable unmodified flakes quite often were used as knives. In the present material it is possible to observe wear with the naked eye on many such flakes, but unless a regular use-wear analysis is performed it is impossible to make a uniform separation of this type of knife from the waste material in general. Therefore, only morphological identification is used here.

Twenty-seven of the knives have a backing retouch, but no modification of the distal end. Twenty-nine knives have the distal end retouched transversely (10 pieces), obliquely (14 pieces), or in an arc (5 pieces), but have no backing. Fourteen

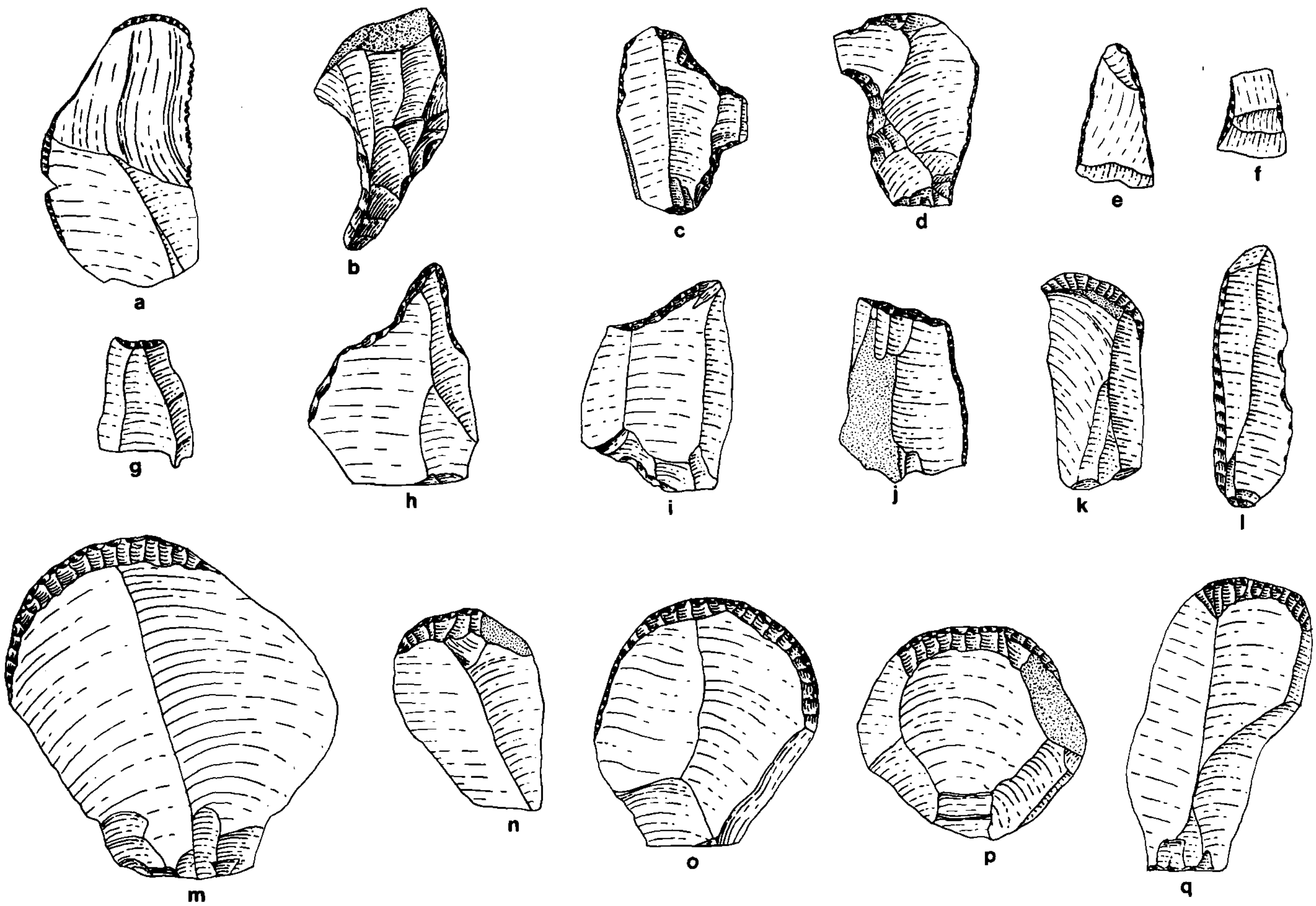


Fig. 9. Flint tools 1:2. a: Denticulate. c, d: "Skiveknive". g, i–l: Knives. e, f: Transverse arrowheads. b: Core drill. h: Flake drill. m–q: Scrapers.

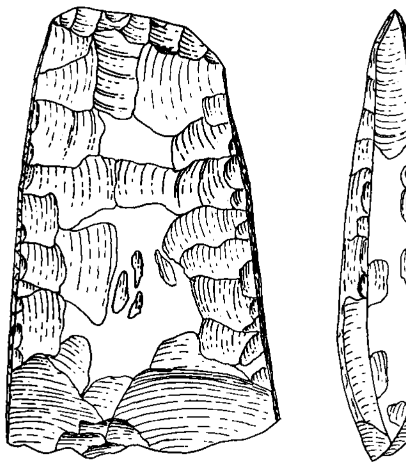


Fig. 10. Thin-butted axe of flint, 1:2.

knives have a combination of backing retouch and modification of the distal, end, either transversely (5 pieces), obliquely (8 pieces) or in an arc (1 piece).

One of the knives with backing retouch is obviously a sickle, as a heavy gloss can be observed on both the dorsal and ventral sides, extending well back from the edge.

Denticulates. Only two denticulates were found (Fig. 9a). The type is characterized by its very fine notching on a mainly concave lateral edge, while the back and the distal end may or may not be modified. On the Early Neolithic site of Mosegården the type made up no less than 22% of the tool assemblage (Madsen and Jensen 1984: 73, Madsen and Petersen 1984: 80). On the Fuchsberg site of Toftum from the transition between the Early and the Middle Neolithic their relative frequency is 9% (Madsen 1978: 173), and on the present site from MN I it is reduced to less than 1%. The type is so far not known from later TBK sites.

It was originally assumed that the denticulates were used as sickles, because of a very pronounced gloss that is often observed at the very edge of the blade (Madsen 1978: 173, Skaarup 1975: 63 and 138). However, wear analyses have shown that this gloss very likely has been produced by secondary processing of plant material and that it cannot be the result of the denticulates being used as sickles (Madsen and Jensen 1984: 76).

Transverse arrowheads. Seven transverse arrowheads were found. They are all rather large and generally have straight, converging lateral edges (Fig. 9e, f).

»Skiveknive«. Ten pieces were found of a peculiar type of tool traditionally termed »skivekniv« in Danish (= diskknife) (Fig. 9c, d). Neither in English nor in Danish is this an illuminating name. The type is characterized by approximately 1 cm. of sharp flake edge that is left between two concave retouchings. However, the function of this short piece of sharp edge as a knife has not been established. We need some wear analyses to determine the true function of this type of tool. The dating of »skiveknive« seems to be exclusively MN I, where we find them in great numbers at Troldebjerg (Winther 1935: 28). At Toftum from the Fuchsberg phase not one example is known among the many thousand tools (Madsen 1978), and they have not been reported from MN II contexts either.

Flake drills. Six drills produced on flakes were found (Fig. 9h). The drill point itself on this type is made by two concave retouchings. One of the drills has two drill points.

Core drills. Three heavy drills made from cores with long, three-sided drill points were present among the tools (Fig. 9b).

Various pieces. Twenty-six flakes had retouch on various edges, but could not be placed in any regular tool category.

Pottery

Some 3400 sherds or 39 kg. of pottery were uncovered during the excavation. Approximately two-thirds of the sherds were undecorated, while the rest bore some form of decoration.

Most of the pottery is very fragmentary, but from sherds in the pits a couple of pots have been restored completely, and large parts of others have been put together. The inventory is completely dominated by funnel beakers, which make up at least 90% of the pots. The only other forms present in some number are band-decorated bowls, pedestalled bowls and clay disks. A few undecorated semispherical bowls, a clay spoon and a shouldered vessel (Fig. 14r) are also present.

The fragmentation of the material makes it impossible to treat the individual pots as units of observation. We have to analyse the decoration zones separately, and regard sherds carrying information about a decoration zone as units of observation for that zone.

Rim decoration. The counting of rims is as far as possible based on an estimate of the minimum number of pots. Approximately 200 pots are present to judge from the rimsherds, and 121 of these or 61% have rims that are decorated, leaving only 39% as undecorated.

The most common rim-decoration is two or more parallel, incised, horizontal, zigzag lines (Figs. 11f; 12c; 13d; 14a, c, h, i, k). Frequently they are sloppily made and look more like bundles of parallel lines placed at varying angles to each other along the rim. 28% of the decorated rims carry this ornament alone, and on another 15% it is seen in combination with other ornaments.

Two or more parallel, chisel stabbed, horizontal, zigzag lines are found on 12% of the rims (Figs. 11d; 12d; 14n). The same relative frequency applies to rims with a horizontal row of vertical incised lines (Figs. 11c; 12a, b; 14h), and to rims with a horizontal row of round pits (Figs. 13a; 14g), whereas a horizontal row of vertically placed chisel stamps occurs on only 7% of the rims (Figs. 11b; 14f, k). These various horizontal rows are also the ornaments that we find in combination with

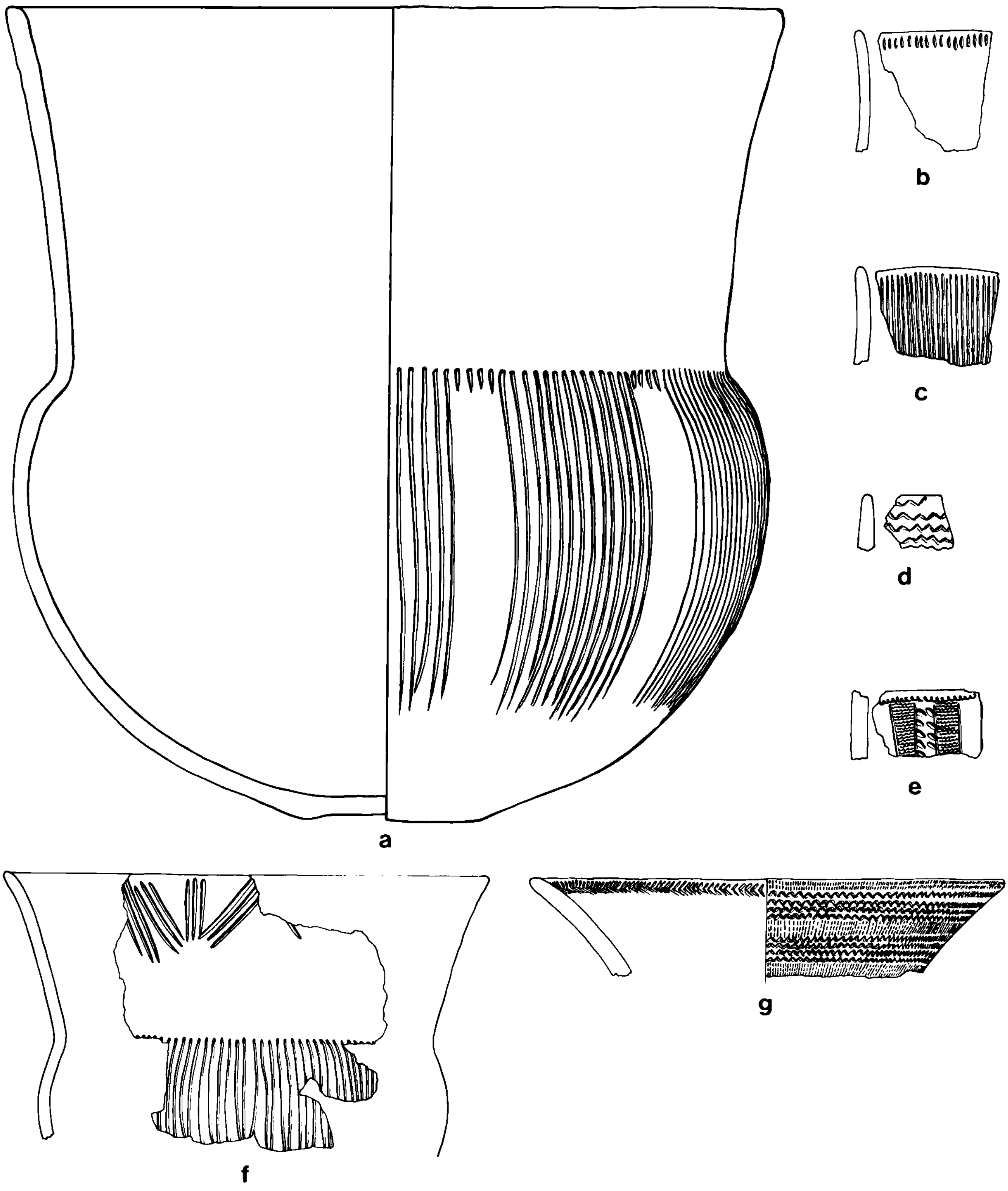


Fig. 11. Pottery from pit 6. Drawn by Elsebeth Morville. 1:3.

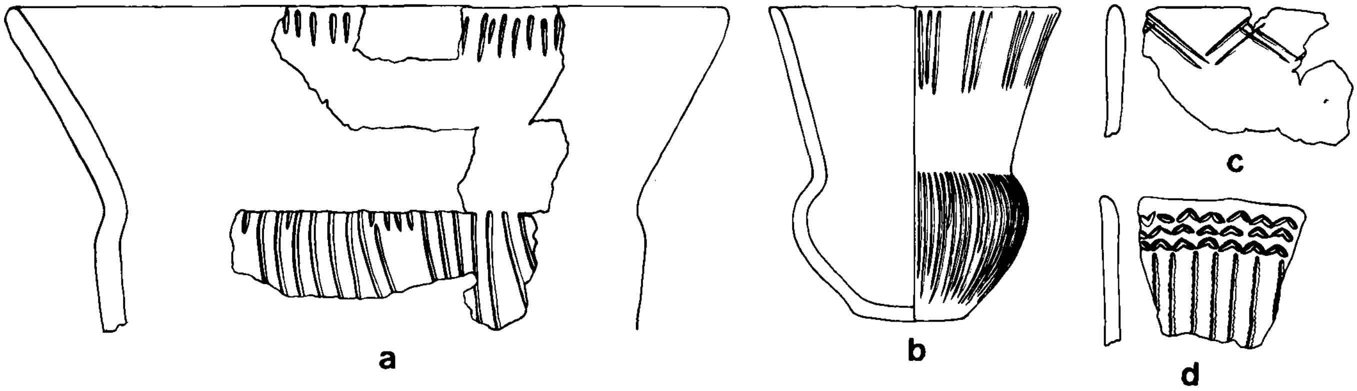


Fig. 12. Pottery from pit 7. Drawn by Elsebeth Morville. 1:3.

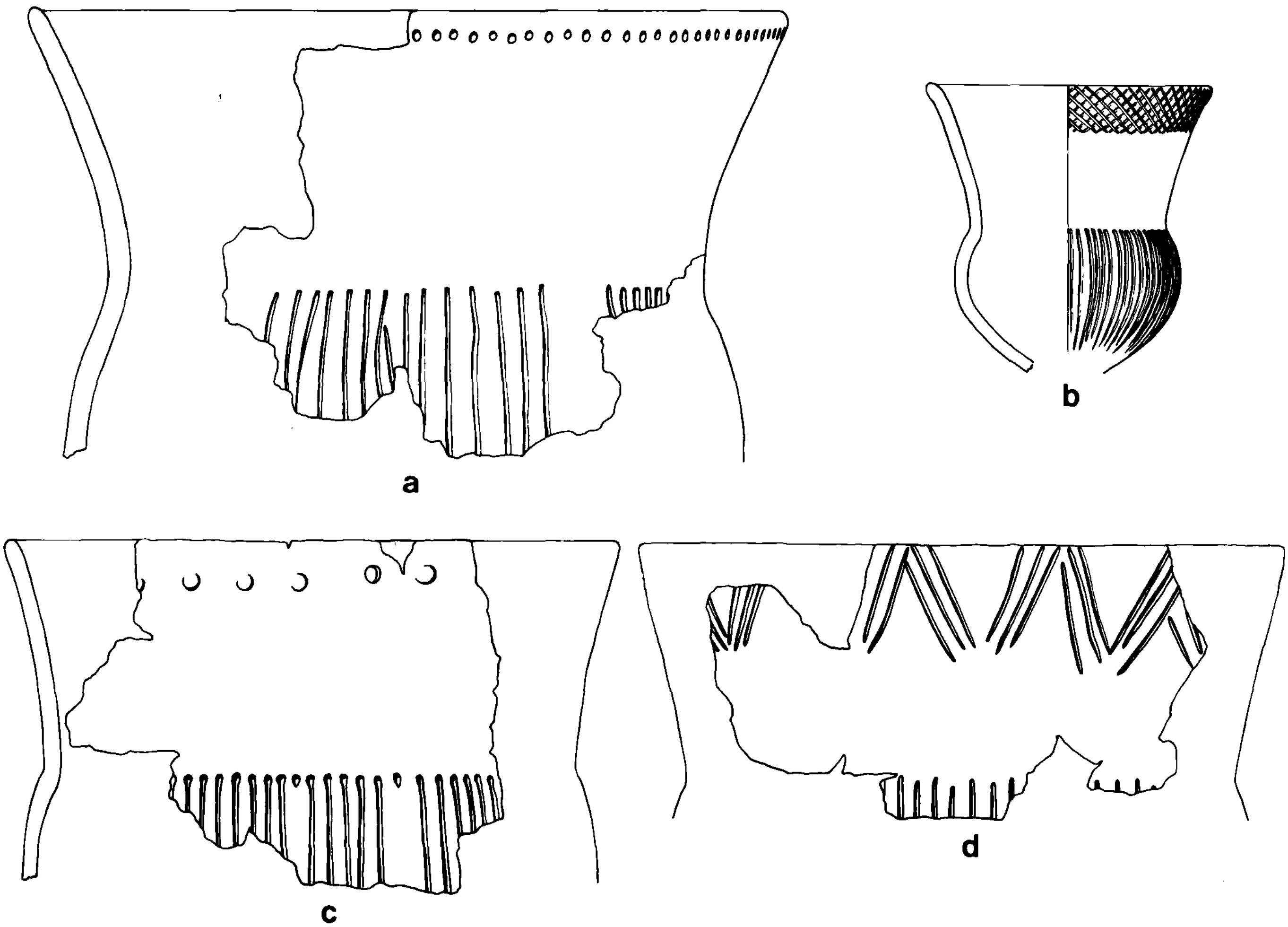


Fig. 13. Pottery from pit 9. Drawn by Elsebeth Morville. 1:3.

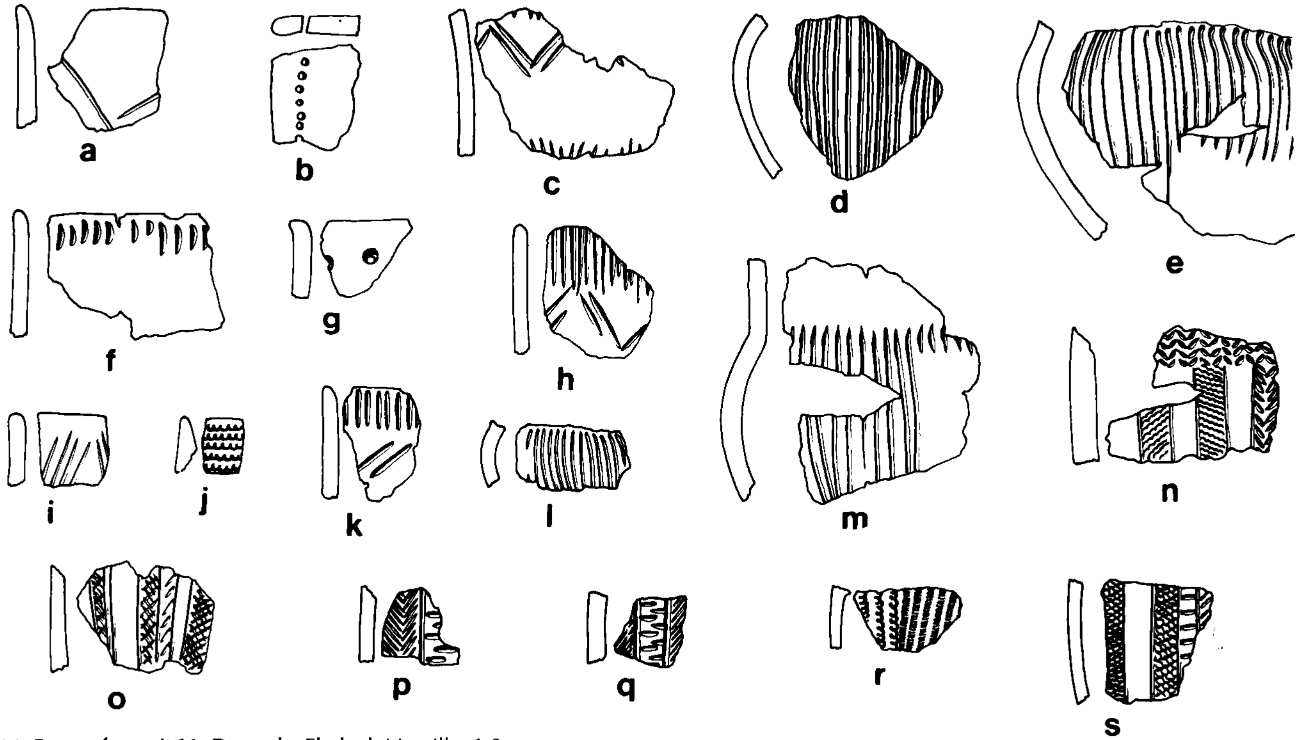


Fig. 14. Pottery from pit 11. Drawn by Elsebeth Morville. 1:3.

the incised zigzag lines, making up the above-mentioned 15% of rims.

The last group of ornaments to be mentioned is two or more horizontal arc stab lines directly beneath the rim (Figs. 11e; 14j). They occur on 7% of the rimsherds. The remainding 7% comprises rimsherds with miscellaneous ornaments (Fig. 13b, c).

Belly decoration. The most common belly decoration on the funnel beakers is long, incised, vertical lines placed continuously or in bundles (Figs. 11a, b; 12a, b; 13a–d; 14d, e, l, m). They comprise 97% of the belly decoration on this type of vessel, while 2% consists of vertical lines in whipped cord and 1% consists of various decorations like rows of stabs, ladder ornaments, or applied mouldings.

The band-decorated bowls have rather simple and narrow vertical bands, and they do not seem to have special bands beneath the lugs. 33% of the bands have a filling of horizontal or oblique hatching made by incised lines, stab-and-drag or impressions of chisel stabs, dentated stabs or cardium (Figs. 11e; 14n, o, q, s). Another 24% have cross hatching in these same techniqes (Fig. 14, s). 32% of the bands have two vertical rows of large round stabs, horizontal chisel stabs, or triangular stabs, arranged so that the stabs in the two rows alternate inside the band in a zipperlike fashion (Figs. 11e; 14p, q, s). The last 11% consist of elongated impressions (among others chisel stabs and whipped cord) filling the band with a herringbone pattern (Fig. 14n, p).

Pedestalled bowls. At least 12 pedestalled bowls are present in the material, mostly in a very fragmentary state. All but four of these are decorated with an all-over horizontal line decoration made with arc stabs. Two have a decoration alternating between horizontal zigzag lines made with chisel stabs and horizontal rows of vertical chisel stabs. One has an all-over decoration of horizontal zigzag lines made with chisel stabs, where the lines meet angle to angle forming a diamond pattern across the surface. The last bowl has a decoration alternating between three horizontal zigzag lines made with chisel stabs and a horizontal row of vertical dentated stabs (Fig. 11g).

Clay disks. Approximately 40 clay disks are present in the material. None of them have decoration on the edges, but two have an all-over decoration of imprints on both sides. The imprints are shallow finger impressions in the one case and small round stabs in the other. On a third disk a row of narrow holes pierced all the way through the disk is found along the edge (Fig. 14b).

SITE ORGANIZATION

Only a very small part of the total settlement on the island has been excavated, and, consequently, we can say very little about site organization. Nevertheless, there are obvious non-random distributional patterns

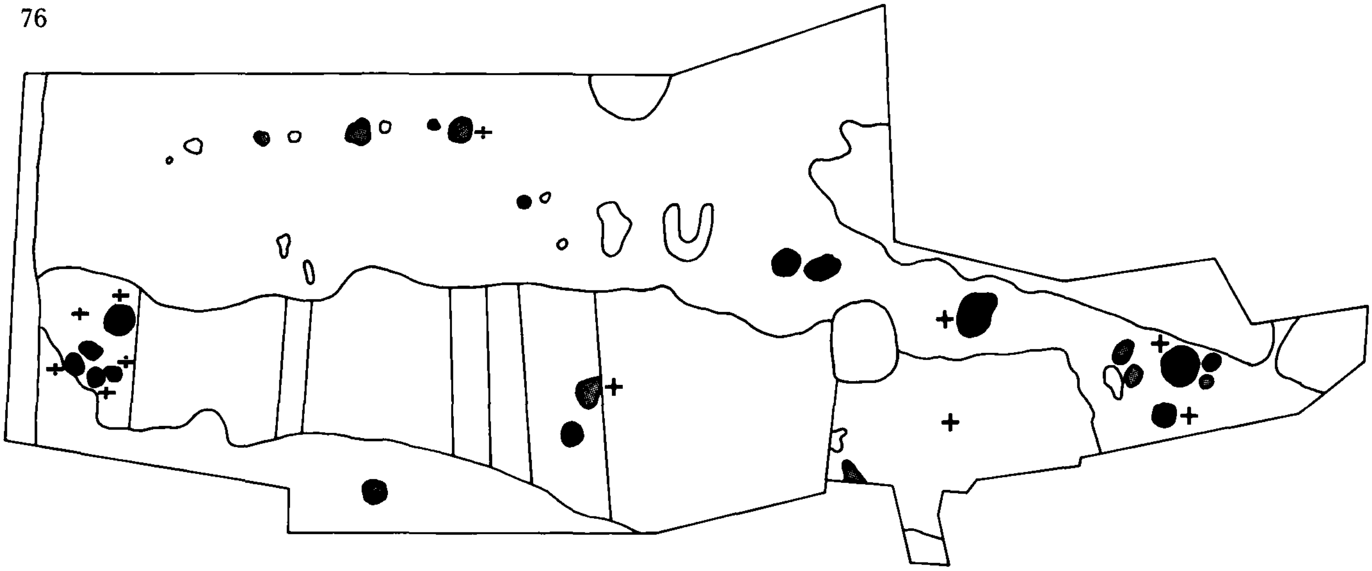


Fig. 15. Differential distribution of various features on the site. Grey spots: Type 1 pits. Black spots: Type 2 pits. +: Tool assemblages characterized by scrapers. –: Tool assemblages characterized by "skiveknive" and axe-fragments.

within the excavated area worth noting. First of all the two types of pits are differently distributed (Fig. 15). The type 2 pits are, with two exceptions, found towards the east, and it seems reasonable to believe that there is a direct relationship between the hut and this cluster of pits, as they probably have something to do with food preparation/preservation. The type 1 pits are mainly distributed towards the west, but do also occur around the hut. There are no features to which they can be correlated within the excavated area.

Looking at the tool type distributions within the excavation, we find an amazingly clear and significant difference in tool-kit composition between the western end of the excavation and the eastern end around the hut. The contents of 17 pits or layers in pits with more than five tools and of four samples of tools from the buried Ah horizon have been analysed by a correspondence analysis (Bølviken *et al.* 1982). Only the first axis of the analysis (Fig. 16) is of relevance. It shows a very clear isolation of a group of tools consisting of "skiveknive", denticulates (not significant with only two pieces present) and axe fragments including flakes with traces of grinding. Another group consisting of scrapers and transverse arrowheads in opposition to the first group is also, if less clearly, isolated. The rest of the tools have hardly any of their variation accounted for on the first axis.

The units of observation (pits, layers in pits, and samples from the Ah horizon) marked as dots along the axis (Fig. 16) do not show a similar clear separation into groups. However, if we mark out (as filled dots) those units that are more or less drawn towards the two tool groups, and mark them on the site plan with either – or + according to whether a unit is drawn towards the group of tools consisting of "skiveknive", denticulates and axe fragments, or drawn towards the group of tools consisting of scrapers and transverse arrowheads, we find a non-random pattern of distribution (Fig. 15). Those units characterized by "skiveknive" and axe fragments are found in the western part of the excavation, whereas those characterized by scrapers and to a lesser degree transverse arrowheads are found in the eastern part of the excavation around the hut.

These differences are probably an indication of different activity areas. Thus the hut and its surroundings mainly were the scene of activities in which the use of scrapers was frequent (the weak association with transverse arrowheads may be coincidential), whereas in the areas towards the west activities often occured in which "skiveknive" were in use, and where fabrication of axes occured. The other tool types are evenly distributed in the two areas. It should be stressed that the distributional differences between "skiveknive", axe fragments and scrapers, although significant, is not one of ex-

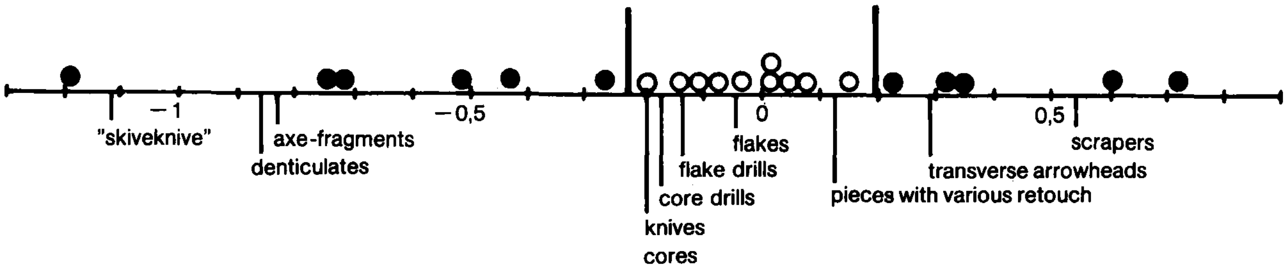


Fig. 16. Correspondence analysis of tool composition in 21 samples of tools from the excavation. Only the 1. principal axis is shown covering 36% of the total variation.

clusiveness, but one of degree. Scrapers being the most common tool are naturally also frequent towards the west, but they are by no means as common as towards the east. Indeed, if we split the excavated areas in an eastern and a western half and make a cross tabulation of the three tool types (Fig. 17) we find a highly significant difference.

An interpretation of the two activity areas is difficult as long as we have no wear analyses to support it. The difference may, however, be associated with a division by sex in activity patterns, and we would assume that the activities around the hut would be of a domestic nature.

The distribution of pottery was also submitted to analysis for variations within the settlement, but the outcome showed that there was no significant variation in types of decoration between the various units of observation (pits, layers in pits, and samples from the buried Ah horizon).

HOUSE CONSTRUCTIONS OF THE TBK

The appearence of a flimsy D-shaped house structure with a MN I date raises the question anew: What type of houses were actually used during the TBK? A series of claims for domestic TBK houses has been raised over the years, but there is a confusing variety in general type as well as in constructional details among these supposed houses. Three main forms have been suggested: longhouses of rectangular or trapezoidal shape, short rectangular houses, and small oval, round or D-shaped huts. But even within these three general forms, it is difficult to separate regular and uniform house types. Indeed, as will become apparent from the following, it is doubtful how many of the claims for houses are acceptable. Alternative interpretations of many of the features should seriously be considered.

Longhouses

The two structures from Barkær (Glob 1949) were long regarded as the finest examples of longhouses from the Neolithic in North Europe, comparable to the longhouses from the Linear Pottery cultures in Central Europe. However, recently it has become apparent that these structures must be longbarrows and not domestic houses (Glob 1975, Madsen 1979: 306). The same seems to apply to the two features from Stengade, both of which may be regarded as burial monuments placed on former settlement sites. Stengade I with its two graves is evidently a longbarrow constructed in two stages (Madsen 1979: 308), and recently David Liversage convincingly has argued that the trapezoidal Sten-

	SCRAPERS	AXES	"SKIVEKNIVE"	
EAST	obs. 40 exp. 62	obs. 37 exp. 17	obs. 6 exp. 3	83
WEST	obs. 160 exp. 138	obs. 19 exp. 39	obs. 4 exp. 7	183
	200	56	10	266

X^2 = 49.4 with 2 D.F. Significance level < 0.001

Fig. 17. Tabulation showing the difference in frequencies (obs.) of scrapers, axe-fragments and "skiveknive" between the eastern and the western part of the excavation. An x^2 test, where the expected frequences (exp.) are calculated under the assumption that the row and column frequencies are independent, show the difference to be highly significant.

gade II should also be regarded as a burial monument (1981: 149).

The famous Troldebjerg longhouse (Winther 1935) is a much more difficult claim to assess. With one row of roof-carrying posts and only one wall, the reconstruction of the house seems odd. To the front, it would be an elaborate construction with a timberwall set in a foundation trench, whereas its back side merely would be a "lean to" with the roof slanting to the ground. If it were not for the vast amount of cultural debris found during the excavation, these constructional features, would probably never have been regarded as part of a house. The palisade with the row of posts behind it would probably have been regarded as some sort of fence construction, and indeed that is presumably what it is.

From the causewayed enclosure at Büdelsdorf we have almost exactly the same constellation of a palisade with rows of posts behind it (Hingst 1971: abb. 1). There is no doubt here that we are dealing with an ordinary palisade system in connection with the enclosure. In support of this altered interpretation of the Troldebjerg "longhouse" it should be mentioned that recent excavations have revealed the existence of a shallow ditch in front of the palisade on Troldebjerg (Andersen 1981: note 46).

The most recent claim for a longhouse comes from the MN V As Vig settlement site (Davidsen 1978: 58–62). In this case the house was 38 m. long and of a sunken construction with a 2.6 m. wide floor 0.75 m. beneath the subsoil surface. The roof is supposed to have rested on a single row of heavy posts placed in an axial bedding trench in the middle of the floor, and further supported by two rows of minor posts placed along the edge of the floor. The sides of the "housepit" slope gently from the narrow floor up to the subsoil surface where the roof is supposed to have rested directly on the soil (Davidsen 1978: fig 75). The total width of the house is supposed to have been approximately 6 m.

The As Vig "house" is very badly substantiated. Only the last two meters of its north end were seen by professional archaeologists, while the rest had been destroyed by gravel taking. It is difficult, not to say impossible, to believe in this feature as a longhouse or indeed as a house at all. The suggested reconstruction is all too abnormal from almost any point of view, to be accepted on the very scrappy evidence available. We are convinced that it would be much more fruitful to think in terms of features known from causewayed enclosures when trying to interpret the As Vig evidence.

Another claim from the same period and in the same publication concerns the site of Sigersted I on Zealand (Davidsen 1978: 22–28). Two parallel rows (26 and 15 m. long) of post holes with the posts in each row closely spaced were here interpreted as indications of a longhouse. However, there is no supporting evidence for this interpretation at all. We have two palisade-like rows of posts and that is all we can say.

Short rectangular houses

The first claim for this type came from Strandegård, and was based on a rectangular setting of stones (minimum dimensions 11 by 4.5 m.) with a 4.5 by 3 m. stone paving in the middle (Broholm and Rasmussen 1931: Abb. 1). Beneath the stone paving major fragments of three Early Neolithic pots from the Virum Group were found. Cultural debris from the Ertebølle culture and the Early Neolithic Svaleklint group was found all around, as well as below and over the stone setting. Strandegård is seldom mentioned in connection with houses any more, as most scholars have realized that it must be a burial structure placed in a former settlement area.

A recent claim for a short rectangular house comes from Ø. Hassing (Johansen 1975). The 10.6 by 5.4 m. large structure, with its deep foundation trench and two inner rows of roof-carrying posts, must indeed be a house. However, the site not only contains an early Middle Neolithic settlement, but also a Pre-Roman Iron Age settlement, and the house has a very familiar Iron Age look. Despite the excavator's assurances that the house belongs to the Neolithic and not the Iron Age, we should be very cautious and not unconditionally accept the Neolithic date.

A 6–7 by 3 m. large rectangular hut has been reported from the very carefully excavated Muldbjerg settlement site dating to the early Neolithic Oxie group (Troels-Smith 1960: 597). The hut is supposed to have been of a very flimsy construction of stakes and reed. No documentation has been published.

Outside the Nordic TBK area, two reasonably certain short rectangular houses from TBK contexts in Niedersachsen should be mentioned. A 12.8 by 4.8 m. large house comes from Flögeln-Eekhöltjen, Kr. Cuxhaven (Zimmermann 1979). It had walls set in shallow foundation trenches and a double row of roof-carrying posts placed in its central axis. Three transverse inner partition walls divided the house into four compartments. Like the outer walls they were set in shallow foundation trenches, and they were placed in conjunction with the roof-carrying posts. Four C-14 dates lie in the range of 2845–2450 b.c.

The other house comes from Wittenwater, Kr. Uelzen (Voss 1965, Schirnig 1979). It measured 15.6 by 6 m. and had rounded ends. Although a few inner roof-carrying posts were present, the main constructional feature is heavyset posts in the outer walls and in two transverse, inner partition walls that must have carried a good deal of the roof's weight. The distance between the individual posts in the walls was 1–1.3 m. A centrally situated fireplace was present.

There seems no reason to dispute these two houses from Niedersachsen. However, it may be questioned how much relevance they have for the Nordic TBK. We are dealing with a different, if neighbouring, branch of the TBK and with distances of 300–500 kilometers. We cannot just assume that the same type of houses should be present in the two areas.

Oval, round or D-shaped houses

The most excessive claim for this type of house comes from Troldebjerg (Winther 1935). Here a series of cuts into the hill slope leaving semicircular flat areas was interpreted as house floors in D-shaped huts. The existence of fireplaces within and outside these areas tended to suggest that they could be huts, but a total absence of post holes made it less than likely. Continued excavations, however, suggested that there was an abundance of small post holes in connection with these features (Winther 1938). The post holes were found both along the curved back of the cuts, and in the area in front, where they in several cases tended to form straight lines. They were no more than 10–20 cm. deep and of a very flimsy nature. Winther himself assumed that he must have overlooked these post holes on earlier occasions.

The suggested huts from Troldebjerg do indeed have much in common with the contemporaneous hut from Hanstedgård, and we tend to accept the claim. However, one thing should not be forgotten. The standards of documentation on Troldebjerg, although excellent for a settlement excavation of that time, is nowhere near our demands today, and it does leave a certain amount of uneasiness that prevents a wholehearted acceptance.

A claim for four horseshoe-shaped huts preceeding the excavations at Troldebjerg and to which the Troldebjerg huts actually were compared, comes from Klein-Meinsdorf, Kr. Plön in Holstein (see for instance plans and photos in Hoika 1981: abb. 5). However, the four features from this locality with their meter-thick "outerwalls" of clay and crushed flint and their partly stone-paved floors are definitely not houses, but the foundations for dolmens, where the large stones have been removed before excavation, or are lying outside the foundations in broken, half-buried conditions (e.g. Hoika 1981: abb. 5,1). Two fully comparable examples of this kind of "hut" can be seen at Mosegården near Horsens (Madsen and Petersen 1984: 62–65). This example clearly demonstrates some of the ambiguity prevalent in archaeological interpretations.

From Ørnekul on Nexelø a claim has been raised for a round hut measuring 5 by 4.3 m. (Becker 1953), presumably belonging to the Svaleklint group of the Early Neolithic. The wall foundation was laid with stones, and in the middle of the hut was a stone-built fireplace on a clay floor. The drawn plan looks convincing, the photographs less so. The main problem is that the excavations took place in an old beach line deposit with its enormous mass of stones. Now, is it correct to separate huts from this mass of stones? Or could it be other activities by man that have created a layout of the stones to which it would be tempting to apply an interpretation of huts. Personally, we do not feel convinced that we are dealing with remnants of a dwelling. A further complication is that the site comprises not only an Early Neolithic settlement, but also an Ertebølle settlement, as well as several phases of habitation during the Middle and the Late Neolithic. This makes the dating uncertain too.

At Knardrup Galgebakke near Copenhagen on Zealand three subrectangular or D-shaped houses dating to the Early Neolithic Virum group have been claimed (Larsen 1958). They were found in a straight line with only 1–2 m. between each other, and there may have been more in the line. Each house shows as an irregular scatter of stones with a tendency to a marginal distribution. A few assumed post holes were found inside the houses, but they do not form a coherent pattern that can be interpreted in constructional terms. In each of the houses, concentrations of charcoal-coloured sand, and fire-cracked stones were found. The houses measured 6–7.5 by 3.5–5 m.

Even if the general outline of the supposed houses from Knardrup Galgebakke is very much the same as the outline of the Hanstedgård hut, we feel very reluctant to accept the features from Knardrup Galgebakke as houses. They may be houses, but the excavations were definitely not of a standard, where we can feel assured that all there was to see actually was seen (see especially Larsen 1958: fig 2 and 5).

The position of the Knardrup Galgebakke site on a very pronounced promontory surrounded by a former lake, is very characteristic of causewayed enclosures in Denmark. The row of "houses" could very well be a row of ditches, where only the top layers containing, among other things, a fill of stones were excavated. A fully comparable example is seen at Büdelsdorf in South Schleswig (Hingst 1970: Abb. 4). A 7 by 4 m dark, charcoal-coloured feature was uncovered here, with many partly fire-cracked stones in the surface. It was immediately interpreted as a house due to a row of post holes enclosing it, but was later reinterpreted as a "roofed firepit", the function of which was not understood (Hingst 1971: 194). The reason for this reinterpretation was that the dark-coloured soil and the many stones proved to cover a deep pit that could not possibly have been a house. Also, other pits of the same type had shown up, forming a row parallel to the already acknowledged ditch system of the causewayed enclosure. Today we know from comparisons with Sarup (Andersen 1981) that these "roofed firepits" are enclosed ditches in the surrounding ditch system of the enclosure.

We will thus take it as possible that the row of three "houses" on Knardrup Galgebakke in fact may be the tops of ditches in a causewayed enclosure. Although this may not be the correct interpretation, it is one that is just as likely as their interpretation as houses.

From Oldenburg-Dannau, Kr. Ostholstein, evidence of what surely must be traces of a house or hut has been published (Hoika 1983). An approximately 100 sq. m. large area of this early MN settlement was excavated in 1979 and 1980. Unfortunately, the area was excavated in small squares over the two years prohibiting a coherent picture of the structure. Furthermore, the level of documentation was obviously not as thorough in 1979 as in 1980. Stake holes in the presumed wall had thus possibly been discounted in 1979 as rodent activity (Hoika 1981: 55), and other features were not registred to the same degree as in 1980, making the composite drawing confusing to look at (Hoika 1981: abb. 3).

Nevertheless, what is there does suggest some sort of a house or hut construction. The most prominent feature is a band of red-coloured clay, including pieces of burned daub with impressions of stakes and cut timber, forming a semicircular to horseshoe-shaped outline. This outline measures 8 by 6 m. but its termination towards the north is not defined. There is a marked tendency in the 1980 squares for small post holes and stake holes to cluster along the band of red clay, and it seems likely that we are dealing with the remnants of a burnt wall. Layers of charcoal support the idea of a burnt structure, and a couple of stone-built hearths inside the red clay band supports the interpretation as a house or hut. However, the even spread of larger post holes over the excavated area is not helpful for a reconstruction, and the only section published warns of a complex situation with at least two separate phases, as also stated by the excavator (Hoika 1981: 55).

Even if there can be little doubt that we are dealing with the remnants of a dwelling or succesive dwellings, we find that one should be careful when details of a reconstruction are called for. We do not feel that the evidence carries much weight in this respect, but we note that there are features like curved walls with stake holes associated that look very familiar when viewed from a Hanstedgård point of view.

From the Mosegården site in eastern Jutland a cluster of post holes has been taken to indicate a couple of huts presumably of a round form (Madsen and Petersen 1984: 72). The site dates around 3000 b.c. and belongs to the Early Neolithic Volling group. The Mosegården site had been covered by a barrow almost immediately after it was left, and the site is thus very well preserved and free from later intrusions. This makes it rather certain that the post holes, found in a limited area of the site, do indicate the presence of huts, but the forms of these are definitely open to doubts. However, they must have been of a very light and flimsy construction, considering that almost no traces were left despite the perfect conditions of protection.

Another example very much like the Mosegården one comes from Lindebjerg on Zealand also dating around 3000 b.c. and belonging to the Early Neolithic Svaleklint group (Liversage 1981). Here a cluster of post holes on a settlement preserved beneath a barrow was taken to indicate a hut of a very light and flimsy construction. The form of this hut could not be determined.

In concluding this survey of house claims from the Nordic TBK, it must be stated that we know very little as yet concerning TBK house forms. Indeed, the survey has shown that we can place no or very little faith in the claims for longhouses and short rectangular houses. The latter seem to have been used in Niedersachsen, but this cannot be taken as an indication for the Nordic TBK. We only have the very small Muldbjerg hut to refer to as a possible example within this category.

Only within the group of small D-shaped or round huts do we find acceptable claims. Both at Troldebjerg and Oldenburg-Dannau the evidence seems convincing to a certain degree, and they do fit in with the pattern observed at Hanstedgård. A further support for small huts in the Nordic TBK comes from Mosegården and Lindebjerg, but neither of these two sites is able to give any information on form or size.

CONCLUSIONS

Through careful excavations, and with a good deal of luck, the settlement site of Hanstedgård has yielded valuable new information on dwelling constructions from the Nordic TBK. A major problem has been that those houses we find claimed in the literature are of such diverse types that it is hard to believe in their authenticity. As the survey in the preceeding pages has shown, there are good reasons to believe that most of the features believed to be houses never were houses.

Two questions immediately suggest themselves. Why have scholars been so willing to accept almost anything as houses, and if we actually hardly know any dwellings, where are they then? The settlements are definitely there, and many have been excavated. Therefore, the absence of obvious traces of house structures has lured the excavators into misinterpreting whatever they found as houses, based on a firm, but unwarranted belief that 'The people in Denmark, who were able to build thousands of magnificiently made megalithic tombs, and raise huge causewayed enclosures could hardly be expected to live in small, irregular huts' (Skaarup 1982: 45, translated from German).

The truth probably is that they did live in small irregular huts, like the one uncovered at Hanstedgård, and the reason why we do not find them in the settlements we excavate, is either that the faint traces of their walls are overlooked, or, more often, that they have been destroyed by ploughing before excavation. Indeed, if the Hanstedgård hut had not been preserved in the depression, but had been exposed to normal agricultural activities, the two short, parallel rows of post holes would have been all there was. Who would accept these as solid evidence for a dwelling especially if one were looking for impressive buildings to match the known elaborate monuments of the TBK?

Let us take Sarup on Funen as an example (Andersen 1981). This causewayed enclosure with two phases from Fuchsberg and MN I has been completely excavated, and so has the slightly later settlement within the same area. We may take it for granted that the people on the site did live in some sort of dwellings, and furthermore, that if they had lived in large well-built houses like, say, a Bronze Age or an Iron Age house, these could not have escaped the notice of the excavator. Furthermore, it is a completely excavated settlement, and, therefore, the houses cannot hide outside the excavated area. Thus, whatever kind of dwellings the people lived in, they did not leave many traces that could survive ploughing. Postholes, however, were common on the site, although they only formed straight lines of any length in a couple of cases (Andersen 1981: 88). With the experience from Hanstedgård it would be interesting to know if small clusters and short straight lines of post holes could not be separated at Sarup and at other TBK sites?

Postscript

After the manuscript had been delivered for printing, three radiocarbon dates from the site became available. They are:

K–4214. Charcoal and hazel nut shells from layer 3 in pit 6 (fig. 5): 2610±80 b.c.

K–4215. Charcoal from layer 2 in pit 11 (fig. 6): 2720±80 b.c.

K–4216. Charcoal from layer 6 in pit 11 (fig. 6): 2630±80 b.c.

Palle Eriksen, Vejle Kulturhistoriske Museum, Flegborg 18, DK-7100 Vejle

Torsten Madsen, Institut for forhistorisk Arkæologi, Moesgård, DK-8270 Højbjerg

REFERENCES

ANDERSEN, NIELS H. 1981: Sarup. Befæstede neolitiske anlæg og deres baggrund. *KUML* 1980: 63–103.

BECKER, C.J. 1953: Ørnekul på Nexelø. En sjællandsk Stenalderboplads med Hustomter. *Aarbøger for nordisk Oldkyndighed og Historie* 1952: 60–107.

BROHOLM, H.C. and RASMUSSEN, J.P. 1931: Ein Steinzeitlicher Hausgrund bei Strandegård, Ostseeland. *Acta Archaeologica* vol II 1931: 265–278.

BØLVIKEN, ERIK *et al.* 1982: Correspondence analysis: an alternative to principal components. *World Archaeology* vol 14,1. *Quantitative methods:* 41–60.

DAVIDSEN, KARSTEN 1978: *The Final TRB Culture in Denmark. A Settlement Study.* Arkæologiske Studier, volume V. København.

GLOB, P.V. 1949: Barkær, Danmarks ældste landsby. *Fra Nationalmuseets Arbejdsmark* 1949: 5–16.

– 1975: De dødes lange huse. *Skalk* nr. 6 1975: 10–16.

HINGST, HANS 1970: Eine jungsteinzeitliche Siedlung in Büdelsdorf. *Heimatkundliches Jahrbuch für den Kreis Rendsburg.* 20. Jahrgang: 55–69.

– 1971: Ein Befestigtes Dorf aus der Jungsteinzeit in Büdelsdorf (Holstein). *Archäologisches Korespondenzblatt* 1. 1971: 191–194.

HOIKA, J. 1982: Jungsteinzeitliche Siedlungsreste aus Oldenburg-Dannau, Kreis Ostholstein. *Offa.* 38 1981: 53–83.

JEPPESEN, J. 1984: Funktionsbestemmelse af flintredskaber: Slidsporsanalyse af skrabere fra Sarup. *KUML* 1982/1983.

JOHANSEN, ERIK 1975: Ø. Hassing huset. En hustomt fra yngre stenalder. *Hikuin* 2: 57–66.

LARSEN, KNUD A. 1958: Stenalderhuse på Knardrup Galgebakke. *KUML* 1957: 24–43.

LIVERSAGE, DAVID 1981: Neolithic monuments at Lindebjerg, Northwest Zealand. *Acta Archaeologica* vol. 51. 1980: 85–152.

MADSEN, TORSTEN 1978: Toftum ved Horsens. Et "befæstet" anlæg tilhørende tragtbægerkulturen. *KUML* 1977: 161–184.

– 1979: Earthen Long Barrows and Timber Structures: Aspects of the Early Neolithic Mortuary Practice in Denmark. *Proceedings of the Prehistoric Society* 45: 301–320.

– 1982 Settlement Systems of Early Agricultural Societies in East Jutland, Denmark: A Regional Study of Change. *Journal of Anthropological Archaeology 1: 197–236.*

MADSEN, TORSTEN and JENSEN, HELLE JUEL 1984: Settlement and Land use in Early Neolithic Denmark. *Analecta Praehistorica Leidensia* XV 1982: 63–86.

MADSEN, TORSTEN and PETERSEN, JENS ERIK 1984: Tidligneolitiske anlæg ved Mosegården i Østjylland: Regionale og kronologiske forskelle i tidligneolitikum. *KUML* 1982/1983.

SCHIRNIG, HEINZ 1979: Die Siedlung auf dem Schwarzen Berg bei Wittenwater, Kreis Uelzen. In *H. Schirnig* (ed.): *Grosssteingräber in Niedersachsen:* 244–246.

SKAARUP, JØRGEN 1975: *Stengade. Ein langeländischer Wohnplatz mit Hausresten aus der Frühneolitischen Zeit.* Meddelelser fra Langelands Museum, Rudkøbing.

– 1982: Siedlungs- und Wirtschaftsstrukturen der Trichterbecherkultur in Dänemark. *Offa* 39 1982: 39–52.

TROELS-SMITH, J. 1960: The Muldbjerg Dwelling Place. *Annual Report of the Board of the Smithonian Institution* 1959.

VOSS, K.L. 1965: Stratigrafische Notitzen zu einem Langhause der Trichterbecherkultur bei Wittenwater, Kr. Uelzen. *Germania* 43: 343–351.

WINTHER, JENS 1935: *Troldebjerg. En bymæssig Bebyggelse fra Danmarks Yngre Stenalder.* Rudkøbing.

– 1938: *Troldebjerg. En bymæssig Bebyggelse fra Danmarks Yngre Stenalder. Tillæg.* Rudkøbing.

ZIMMERMANN, W. HAIO 1979: Ein Hausgrundriss der Trichterbecherkultur von Flögeln – Im Örtjen, Kreis Cuxhaven. In *H. Schirnig* (ed.): *Grosssteingräber in Niedersachsen:* 247–253.

Journal of Danish Archaeology vol. 3, 1984, pp. 83–98

Kainsbakke A47:

A Settlement Structure from the Pitted Ware Culture

by LISBETH WINCENTZ RASMUSSEN

INTRODUCTION

Since the 1950s the Pitted Ware Culture has been important to research on Danish Neolithic cultures, especially with regard to the debate about the relationhips between the Funnel Beaker and Single Grave Cultures (Becker 1950 and 1954). The basis for any evaluation of the Pitted Ware Culture in Denmark has almost exclusively been the type objects, the cylindrical blade cores and the tanged points. The coastal distribution of these types, and parallels with Swedish finds, have led to the Danish Pitted Ware Culture being regarded as a pure forager culture – either a foraging facies of local farming cultures, or a "foreign" intrusion from the Swedish group of the Pitted Ware Culture (Nielsen 1979, Malmros 1979, Davidsen 1980 p. 39).

The various views of the culture are closely bound up with the unsolved chronological problems the culture presents. There are no certain finds enabling cross-dating between the Pitted Ware and Funnel Beaker Cultures, and the contacts between the Pitted Ware and Single Grave Cultures all relate to the later phases of the Pitted Ware Culture. The Funnel Beaker Culture sites that have produced Pitted Ware points of earlier types have mainly produced material from the Funnel Beaker Middle Neolithic (III) IV – V, and various ceramic

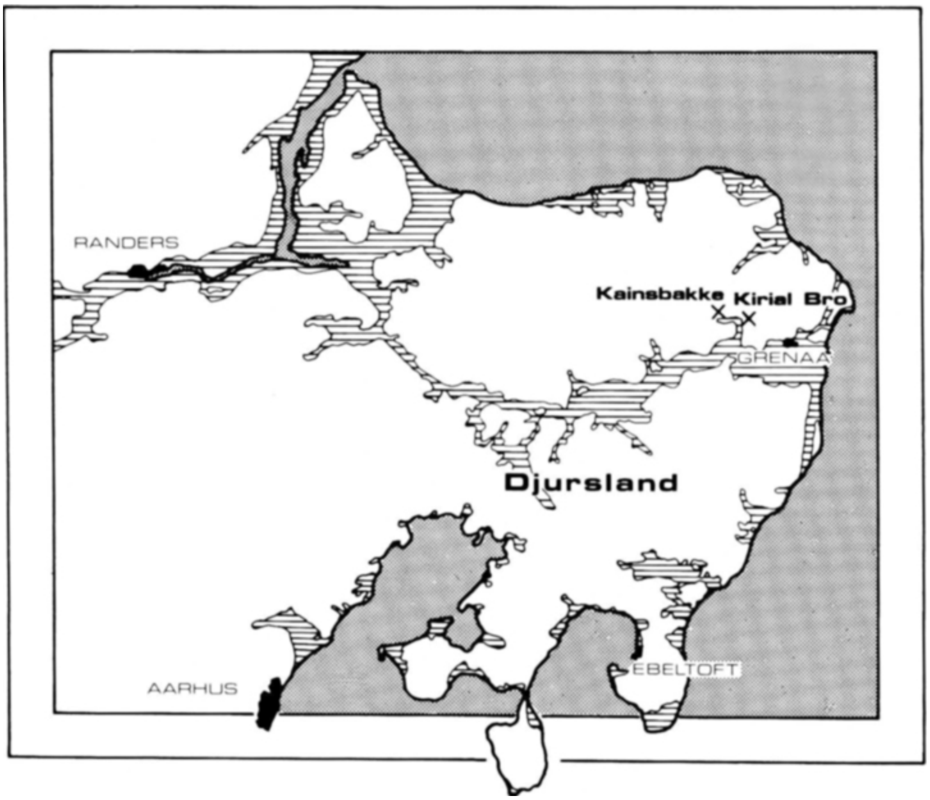


Fig. 1. The location of the sites Kainsbakke and Kirial Bro. The extent of the sea in the Stone Age is indicated by the hatching.

parallels seem to point in the same direction. The most widely held view today is that the Pitted Ware intrudes at that time, and continues until about the Ground Grave period of the Single Grave Culture (Becker 1980 fig. 6).

This view is mainly based on finds in which the Pitted Ware appears as only one element among several others from both the Funnel Beaker and Single Grave Cultures. So far, none of the finds from the earlier part of the Pitted Ware have been "pure" settlements permitting a general view of the culture, and where organic remains have been preserved it has not been possible to use them to evaluate the subsistence base of the culture. It follows that it has not been possible to obtain radiocarbon dates from material definitely belonging to the Pitted Ware Culture.

The basis for discussion and debate has thus often been uncertain and speculative, the subject being taken up from time to time without a solution being any nearer. One of the more recent contributions states that conclusive information about the Pitted Ware Culture will only be obtained from pure settlements with well preserved faunal material (Becker 1980 p. 28ff).

Such a settlement has now been discovered on the Djursland peninsula in eastern Jutland. A varied Pitted Ware assemblage has been recovered in sealed pits. The new, conclusive information available from this material will be exemplified in the following through the presentation of one of the excavated features.

THE SETTLEMENT SITE

The Kainsbakke settlement lies near Kirial town, about 5 km west of Grenå (1). It lies on a low rise about ½ km^2 in extent, which in the neolithic was partly surrounded by water, in the form of a branch of the recent Kolindsund, to the south. Besides this, waterborn access to the Kattegat would have been possible through an inlet approaching from the north east (fig. 1). Traces of settlement activity were observed from the highest point of the rise at 11 m above sea level down to the 7 m contour. Beach deposits were observed at about 4.5 m.

The settlement has been known for several years, due to the very large number of artifacts on the surface. The surface collections show no admixture of other neolithic elements, either older or younger, and 86% of the tanged points are of A types. The surface finds thus showed that the settlement must be chronologically limited to the older part of the Pitted Ware Culture.

Repeated excavations have been carried out on Kainsbakke since 1979 (2). These have been concentrated in a small area on the southeast side of the rise, because the ploughsoil here showed concentrations of cultural remains and small patches of shell (Rasmussen and Boas 1980). 526 m^2 have been excavated in all. This revealed a cultural layer, preserved in patches, 13 large and small pits, a large number of postholes, and a single fireplace. The postholes did not form any evident structure, and some of them could possibly derive from later iron age settlement on the site.

The largest pit so far found was that furthest to the south on the gently sloping ground surface. This pit (feature 47) is so far only half excavated, but has already produced a large and varied cultural material. It must be emphasised that the objects from it have only been subject to preliminary analysis. The material, in particular the large amounts of pottery, is however of such importance that the preliminary results may contribute to the continuing debate (3).

PIT NO. 47

The pit is rectangular, measuring 5.7 m east-west, 4.5 m north-south, and about 1.1 m in depth. Even on its surface, a dense scatter of finds was visible, and it could be seen that organic material was preserved because of the presence of shells.

All finds were recorded within ¼ m^2 units and measured in vertically. Artifacts, apart from the large number of scrapers, were measured in both horizontally and vertically. All the earth was wet sieved through a 1mm mesh.

The sides of the pit were cut vertically down (fig. 2). The basal layer consisted of mixed sand and soil (layer 5). Out toward the sides, this was partly covered in a symmetrical manner by a dark layer containing charcoal (Layer 8 – possibly collapsed, burnt wood). In and on this layer were several stones up to a metre across – one of these turned out to be the lower stone of a large quern. Above layer 8 and towards the sides were layers of pale material consisting in part of the subsoil material (layers 5 and 6). Layer 6, which had only a slight admixture of earth, is interpreted as collapse from the side and upper edge of the pit. Layer 5 consisted here of pale sand with a little soil. Together with the rather darker part of layer 5 (the basal layer proper) it formed one continuous layer with very few cultural remains (pottery, flint, bones, cooking stones, and a few cockles and mussels in its western part).

The primary function of the pit must be determined from the layers described here. The flat bottom, vertical sides and rectangular shape suggest that the feature may represent a sunken hut. Layers 5 and 7 must have formed in the period between collapse of the possible house and its secondary re-use as a rubbish pit. Layer 4, which like layer 6 was nearly pure sand, could be a part of the material originally dug out to make the pit; possibly this was thrown back in immediately before the final infilling, because neither humus formation nor infallen soil was observed between this layer and the shell layer above it.

The settlement material, in the form of bones, antler, shells, pottery, flint etc., was deposited above this in two compact layers with almost no soil (layers 1 and 3). This rubbish seems to have resulted from several different depositional events – which were not, however, sufficiently separeted in time for layers of fill to accumulate between the layers. In other words, deposition seems to have taken place relatively fast.

In layer 3 the shells were very dense. Mussels (*Mytilus edulis*) were concentrated in the lower part along the east and west sides, while oysters (*Ostrea edulis*) were visually predominant in the rest of the shell material. A layer of fishbones was found in the western part of the pit, in the upper part of layer 3 and in the bottom of the sand and soil layer 10; the layer was about 5 cm thick, projecting 1.5 m into the pit.

Layers 3 and 1 differed from each other only in that the earth in layer 1 was darker, and the shells here were not so densely deposited. The transition between them was formed by a 20 cm deep layer of sand and humus, with a concentration of larger bone fragments particularly towards the centre of the pit. Parts of several large storage vessels lay in the upper part of layer 1.

It is evident from the foregoing that no infilling of earth took place between the formation of layers 1 and 3 (the rubbish layers). No typological difference was observed during excavation between the finds from the top and the bottom of the pit. The bones did not seem to have been eroded before burial. The broken edges of the potsherds were sharp showing that they had not layn on the surface (where they would be subject to erosion) before deposition in the pit.

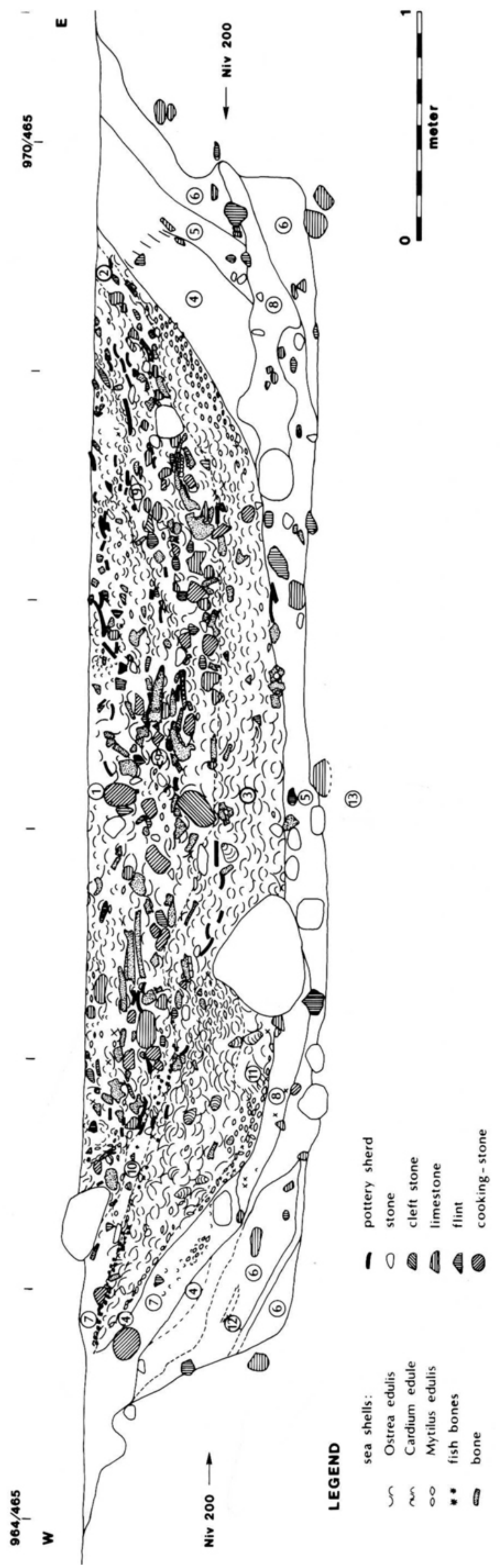


Fig. 2. Cross-section of the pit A 47. Description of layers in the text.

Everything suggests, therefore, that the pit was quickly filled, so that the finds can be regarded as a pure assemblage and the rubbish layers as closed finds.

THE FINDS

Pottery: About 5000 potsherds were recovered from the half pit. About 250 pots are represented by larger fragments or rims, 200 of them ornamented. To this must be added fragments of 3 clay discs and 2 modelled objects.

The raw material may be described as hard and compact. The surface is usually smooth, with a yellowish or reddish colour. A single sherd had a shiny, bright red surface. The tempering is crushed granite, sometimes relatively large pieces. The surface of only a few of the pots shows any trace of the tempering by e.g. being uneven. Some sherds are blackened, and several have carbonised food residues on their inner surfaces.

The rims are straight or evenly rounded. About 20 basal sherds were found over and above those in complete pots. The bases usually have a small flat or convex standing surface.

The commonest pot type has a weakly concave upper part. The transition from neck to belly may be sharp or rounded, and the diameter of the pot at this point is usually a little greater than that at the mouth. The height of the lower part is generally greater than that of the upper, and the basal standing surface is relatively small and flat or slightly convex (fig. 3–4).

At least 50 pots of this type are definitely present. They are found in sizes ranging from under 0.20 m to 0.60 m in diameter at the mouth. More than half are ornamented. Two small pots can be seen as representatives of the type with a so-called smoothed profile (Malmer 1969 p. 82, Welinder 1969–70 fig. 13) (fig. 5:6).

Apart from this pot type some examples of bowls are also present. At least 3 bowls had convex sides (fig. 5:5). One of these is ornamented (fig. 4:8). There are also a few sherds from open bowls with straight sides.

Single examples of the following pot types are also present in the material: S-profile beaker with mouth diameter greater than that of the belly (fig. 5:4); beaker with conical sides and a cordon forming a foot around the base (fig. 5:2). Both these pots are ornamented.

Ornamentation: the provisional grouping of ornament types follows Malmer's system so far as is possible (Malmer 1969).

Pits are present on sherds from at least 100 different pots, including 2 large and 1 small of which large portions are preserved. The pits may be: *Finger pits*, which occur on at least 4 different pots (fig. 3:1). They appear in single rows, double, offset horizontal rows, or in 3 rows forming inverted triangles, immediately under or a little under the rim, at the transition from neck to belly, or in combination with these as a single row on the middle of the neck. *Impressed pits* may be made by a twig, bone or snailshell, and occur on about 80 different sherds and larger sections of pots. The pits may be superficial, or up to 0.5 cm deep. They occur most commonly in double, offset horizontal rows immediately under the rim or at the transition between neck and belly. Besides this, a few sherds have single or double rows a little below the rim. The pits can also form part of complicated designs, also in combination with other forms of ornamentation, but most commonly as horizontal rows midway up the neck.

A group of 16 sherds has small impressed pits, under 0.3 cm in diameter. They form double or multiple horizontal rows, inverted triangles or other complex designs (fig. 3:4; 4:3, 9). Two of these belong to the category Malmer calls "comb stamp with two branches" (Malmer 1969 fig. 24).

Oval impressions occur on sherds from about 25 different pots. They may be short and wide or long and narrow, and sometimes set at an angle. They are arranged in offset, double horizontal rows under the rim and at the belly/neck transition. They also occur in multiple rows and forming complicated designs, as well as in multiple rows in combination with pits (fig. 4:4).

Triangle impressions occur on sherds of at least 13 different pots. They are arranged in offset, double horizontal rows immediately under the rim and around the belly/neck transition (fig. 3:3).

Crescent shaped/vertical curved impressions occur on sherds of at least 14 different pots. They are arranged in simple (at times offset) horizontal double rows immediately under the rim and around the belly/neck transition. They can be combined with rows of pits midway up the neck (fig. 4:1).

Horizontal curved impressions appear on 8 sherds. They are arranged in double rows. The impressions usually nearly join up so that the ornamentation forms wavy lines immediately under the rim. A few approach horizontal zigzag in appearance (fig. 4:4).

Horizontal zigzag appears on sherds of at least 7 different pots. They form connecting horizontal single rows immediately under the rim and at the neck/belly transition, as well as complicated horizontally and vertically arranged designs. One pot has a combination of vertical and horizontal zigzag (fig. 4:2). This ornamentation can be carried out using a *Cardium* shell.

Vertical zigzag appears on sherds of at least 30 different pots. The decoration is often divided into three, forming a reverse Z, and is applied with a *Cardium* shell. It is arranged in single or multiple horizontal rows immediately under the neck and around the belly/neck transition. A single row appears a little below the neck on a few sherds. On 3 sherds it forms a complicated design (fig. 5:3). On the pot in fig. 5:2, the cordon surrounding the base has vertical zigzag.

Other ornamental types. About 25 sherds and 2 nearly complete pots have decorations which do not immediately fit into any of the above categories. Rows of lozenges in which each alternate one is filled with oblique lines of triangle impressions, appear on one pot (fig. 5:2), where they form a surface-covering decoration, combined with vertical zigzag on the cordon surrounding the base. The pot in fig. 5:4 is decorated with horizontally arranged rectangles, placed in double rows one above the other, from immediately under the rim to somewhat below the belly/neck transition. On the pot in fig. 4:5, the individual pits midway up the neck have been embellished with arms, so

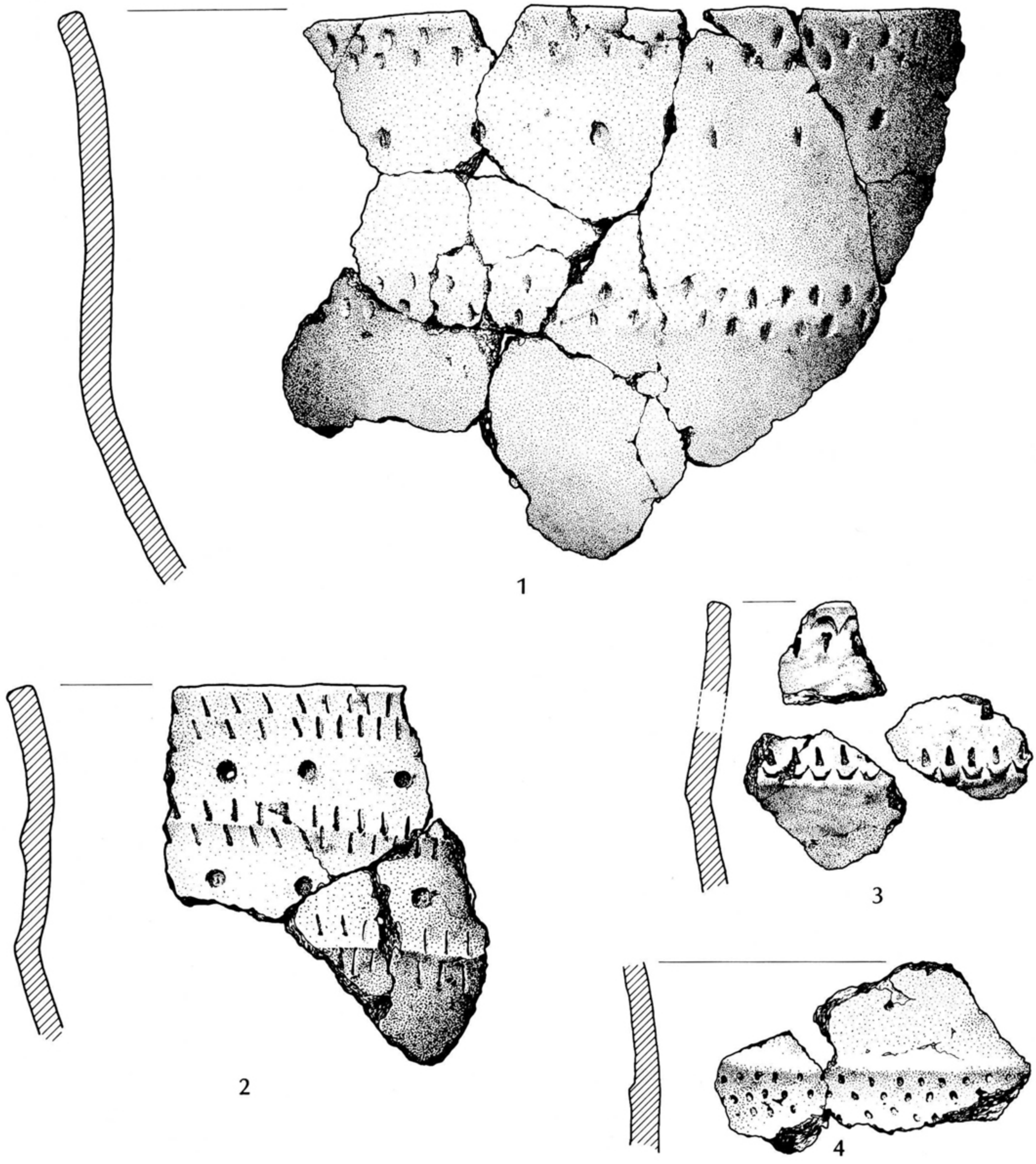


Fig. 3. Kainsbakke A 47. Pottery (drawn by Jack Bacher). 2:5.

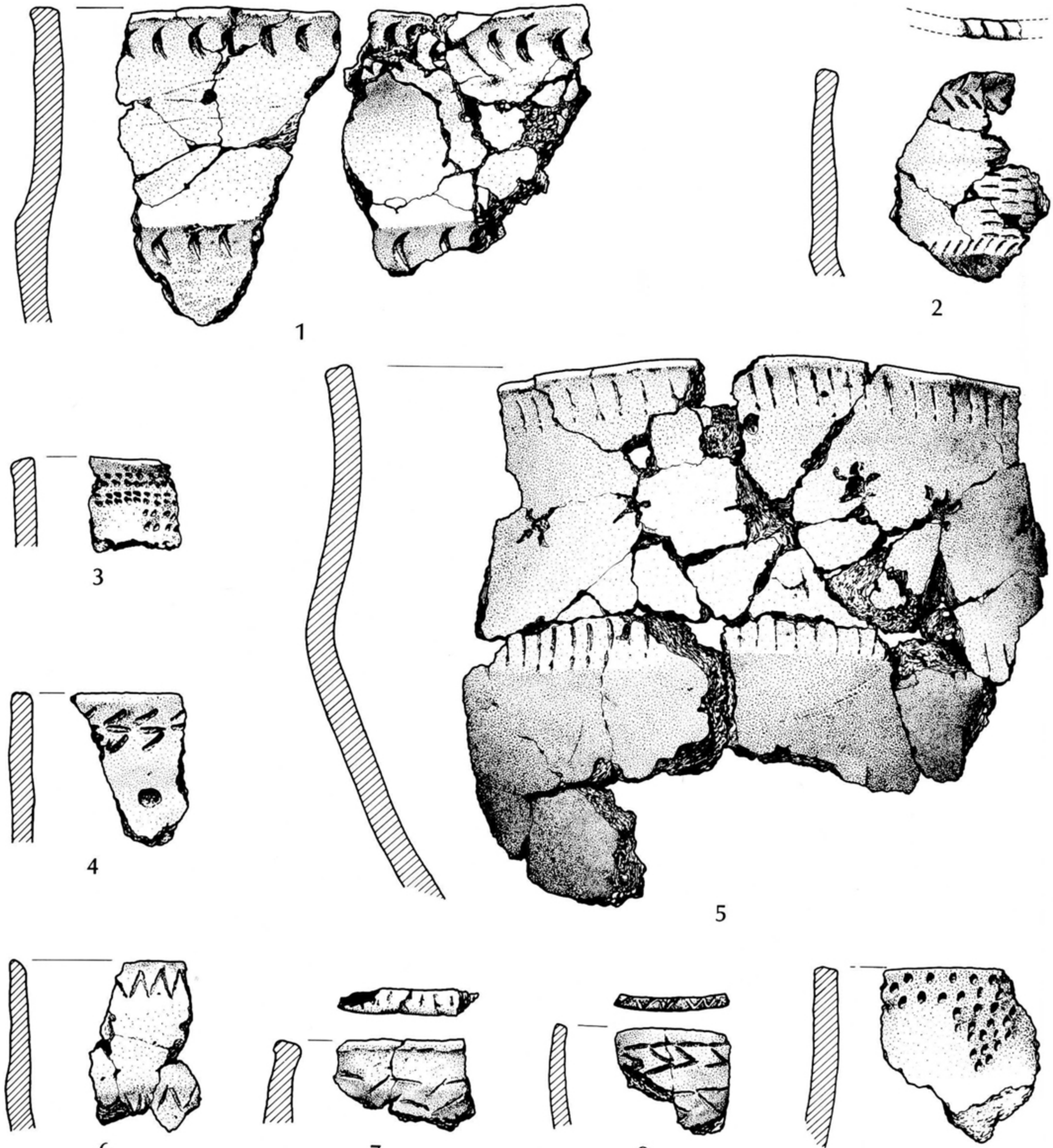


Fig. 4. Kainsbakke A 47. Pottery (drawn by Jack Bacher). 2:5.

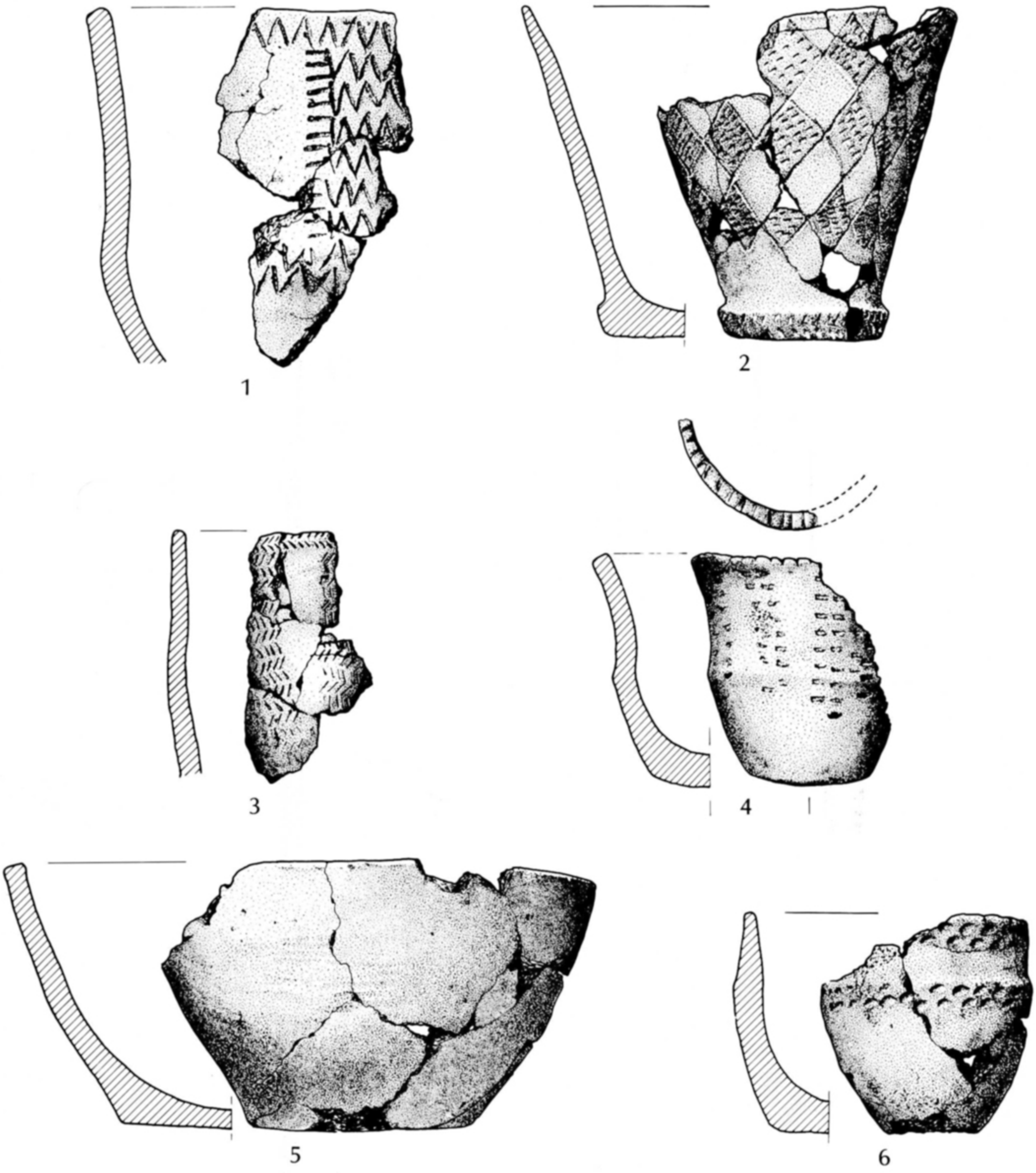


Fig. 5. Kainsbakke A 47. Pottery (drawn by Jack Bacher). 2:5.

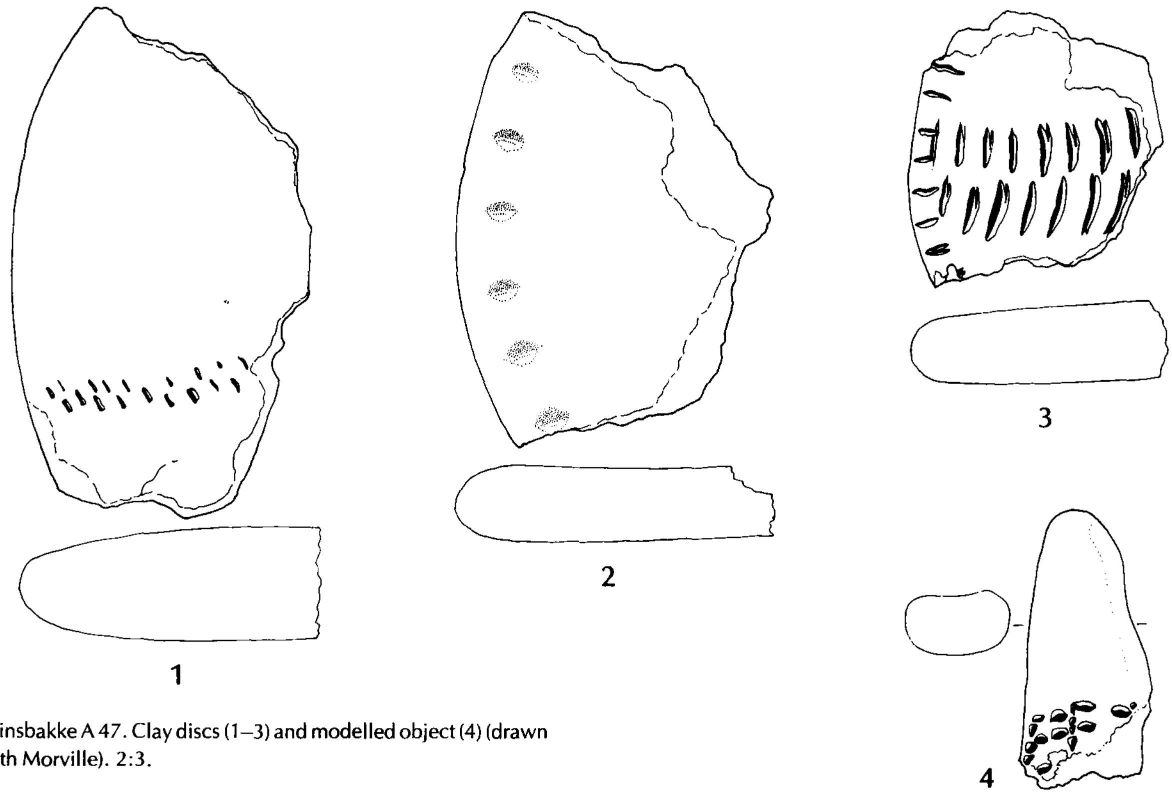


Fig. 6. Kainsbakke A 47. Clay discs (1–3) and modelled object (4) (drawn by Elsebeth Morville). 2:3.

that a swastika-like design results. Finally, one sherd has a faintly scratched rectangle in combination with a double pricked line under the rim.

Rim ornamentation appears on several rim sherds, in the form of straight, oblique and crescentic empressions, and also as zigzag and finger impressions.

The most common ornamental type is therefore round pits. Together with oval and triangular impressions (also relatively common), they are the most frequent decoration on large pots with rim diameters of over 0.30 m. Furthermore, pits are often combined with other motifs.

Next to these decorations vertical zigzag forms the most common type. Both vertical and horizontal zigzag are common on pots of medium (rim diameter 0.20 – 0.30 m) and small size (rim diameter under 0.20 m).

With the exception of the special cases mentioned above, all the ornamental types occur on pots with lightly concave neck, more or less prominent neck/belly transition, and relatively high lower part with small standing surface. Most commonly, the decoration forms horizontal rows immediately under the rim, and again immediately above and/or below the neck/belly transition. Apart from this it is also common for a row of quite widely spaced pits to occur on the most constricted part of the neck in addition to the above-mentioned types. Almost all decorative types also form parts of more complicated motifs such as inverted triangles, vertical and horizontal conjoined rows etc. Complicated motifs are mainly found on medium and small pots.

There is thus a distinction between coarse and fine pot types in the form of large, less decorated pots on the one hand and smaller, more decorated pots on the other.

Clay discs: Parts of at least 3 clay discs were found. The one shown in fig. 6:1 has a diameter of 0.22 m, a maximum thickness of 2.2 cm, and an edge thickness of 1.1 cm. There are traces of a hole, placed off-centre. The disc has a radial ornamentation consisting of two offset, slightly curved rows of short, oval impressions. The one in fig. 6:3 has a diameter of about 0.14 m, and a thickness of 1.6 cm. This also has a radial decoration, consisting of two offset rows of slightly curved impressions. Along the edge is a row of short, oval impressions. Fig. 6:2 has a diameter of about 0.16 m, and a thickness of 1.4 cm. Along the edge is a row of faint finger impressions.

Modelled objects: Two fragments of fired clay can be interpreted as such. One is an object with two slightly flattened sides, one of which is decorated (fig. 6:4). The other is an irregular hemispherical fragment with oblique strokes on one slightly flattened surface. The first-mentioned could be interpreted as an animal head, or as the pointed lower end of a clay idol. The second one could be part of a clay bead (Janzon 1983 fig. 8).

Flint: The excavation produced a large quantity of so far unsorted blades and waste flakes. The worked material is dealt with along the lines suggested by Malmer (1969). Tool types are distinguished as follows:

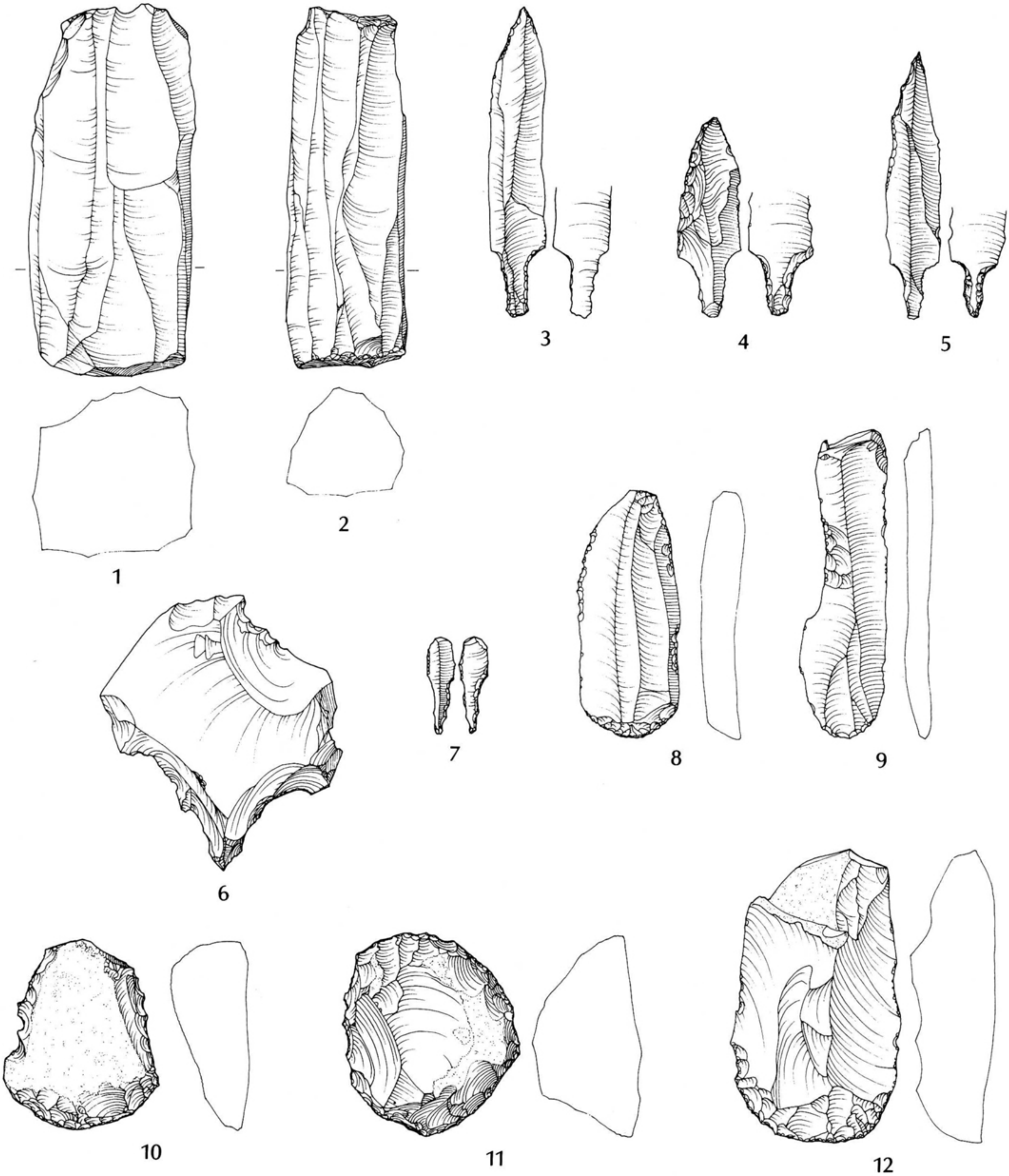


Fig. 7. Kainsbakke A 47. Flint tools: Cylindrical blade cores (1–2), tanged points type A1 (3) and A3 (4–5), flake borer (6), drill point (7), blade scraper (8), blade burin (9), and flake scrapers (10–12) (drawn by Elsebeth Morville). 2:3.

Cylindrical blade cores		46 examples
Tanged points		14 examples
type A1	3 examples	
type A2	2 examples	
type A3	5 examples	
Blade borers		1 examples
Burins		3 examples
Scrapers		244 examples
Flake borers		3 examples
Drill points		2 examples
Polished thick-butted axes, fragments		6 examples
Axes roughouts		7 examples
Chisels		1 examples

The tanged points (fig. 7:3–5) are formed by 30% type A1, 20% A2 and 50% A3. Four points cannot be more precisely determined within type A. A3 type points are thus predominant.

Of the scrapers, 42% are round, 48% oval and 9% are on blades. Oval scrapers are thus slightly predominant, while blade scrapers are in a minority. Both oval and round scrapers typically have steep edges and angled surfaces.

The three burins are all angled burins on breaks.

The six fragments of thick-butted axes are all polished on the broader sides. Butt indices of 76% and 79% fall within the limits for Valby axes (Becker 1957 p. 15). The fragments are unfortunately in such bad condition that measurement of the angle of the narrow sides is difficult, so they cannot be placed in relation to types A and B (Nielsen, P.O. 1977). The same holds for the 7 axe roughouts.

Stone: Large numbers of hammer stones occur (these have not yet been counted). One whetstone has been reconstructed from three fragments, found in different places in the pit in the lower part of layer 1.

Two fragments of greenstone axes were found. One of them (fig. 8:3) has sharp corners between the broad and narrow surfaces; the narrow surfaces are concave but the butt is not. It corresponds to Malmer's type A2 (Malmer 1975, p. 84). The other also has sharp corners between the broad and narrow surfaces, but neither narrow sides nor butt are concave. This corresponds to Malmer's type B (Malmer 1975 p. 84).

Bone and antler artifacts:

Bone:	
Harpoon, fragment of basal end	1 example
Points	3 examples
Cylindrical beads	8 examples and 20 fragments
Antler:	
Pressure flakers	3 examples
"Knives"	2 examples

Part of a red deer antler was also found; all the tines have been removed, some by ring cuts and some by blows. The harpoon fragment is made from a cow metatarsal, is 6 cm long, 2.5 cm wide at the base and 3.2 cm wide across the hole for attaching the line. It has a biconical cross section with a diameter of from 0.7 to 1.2 cm. The indentation (cut to make the barb) forms a shoulder at the point of transition from the base. The hole for the line is next to this, bored through from the flat surfaces, asymmetrically in relation to the midline (fig. 9:3).

One of the points is made on a red deer metatarsal with part of the articulation preserved. It has a length of 8.4 cm. The two others are made on chance fragments.

The cylindrical bone beads are on average 5 cm long, and are made of bird bone. There is a clear difference between finished and unfinished examples, in that the former have polished surfaces. The 20 fragments were found together with a fragment of a bird limb bone.

The two "knives" are 13.1 and 16 cm long, and both have a diameter of 2.7 cm. They are made of red deer antler tines, and are both curved. The edge is formed by flattening the concave edge to form sharp angles and a sort of chisel edge. The other ends of both show traces of ring cutting, and one also has a hole bored in the flat end surface (fig. 9:1).

The three pressure flakers are all tines of red deer antler. They have lengths of 14.7 cm, 15.1 cm and 14 cm, and diameters between 2.6 cm and 3.4 cm. They all have traces of ring cutting at the basal end. One is hollow along most of its length; this fragment was in very bad condition at the time of excavation, so this may be due to natural causes (fig. 9:2).

Worked shells: 2 cockle shells, one of them fragmentary, are perforated, and might have been used as personal ornaments (fig. 9:4).

Unworked bone: 20,000 fragments were recovered, including relatively many large fragments, and about 5 litres of bones of fish and small animals.

The analysis now in progress has demonstrated the presence of domestic cow and pig, sheep, dog, horse, roe deer, red deer, aurochs, brown bear, wild pig, grey seal, greenland seal, fox, beaver, badger, water rat, mouse, human being, various birds, herring, eel, garfish, cod, thin-lipped grey mullet, mackerel, plaice or flounder, 8 marine and 5 terrestrial snail species, oysters, cockles and mussels (4).

Many of the bones have cut marks. Almost all the bones are deliberately broken, many of them for their marrow.

Particularly noteworthy are three crania, four lower jaws and a humerus of brown bear, which form what is so far the latest find of this animal from a settlement (Richter in prep.). Concentrations occurred in several cases of particular bones from particular species, such as horn cores from domestic and wild cattle, and lower jaws of pig.

The largest bone elements were most concentrated near the centre of the pit between layers 1 and 3.

Unworked antler was represented by only one half of a roe deer antler.

The remains of probably two humans lay in the middle of the pit, immediately east of a large granite boulder in near the section near the bottom of layer 3. The bones were to some extent grouped together; further parts may lie in the unexcavated part of the pit.

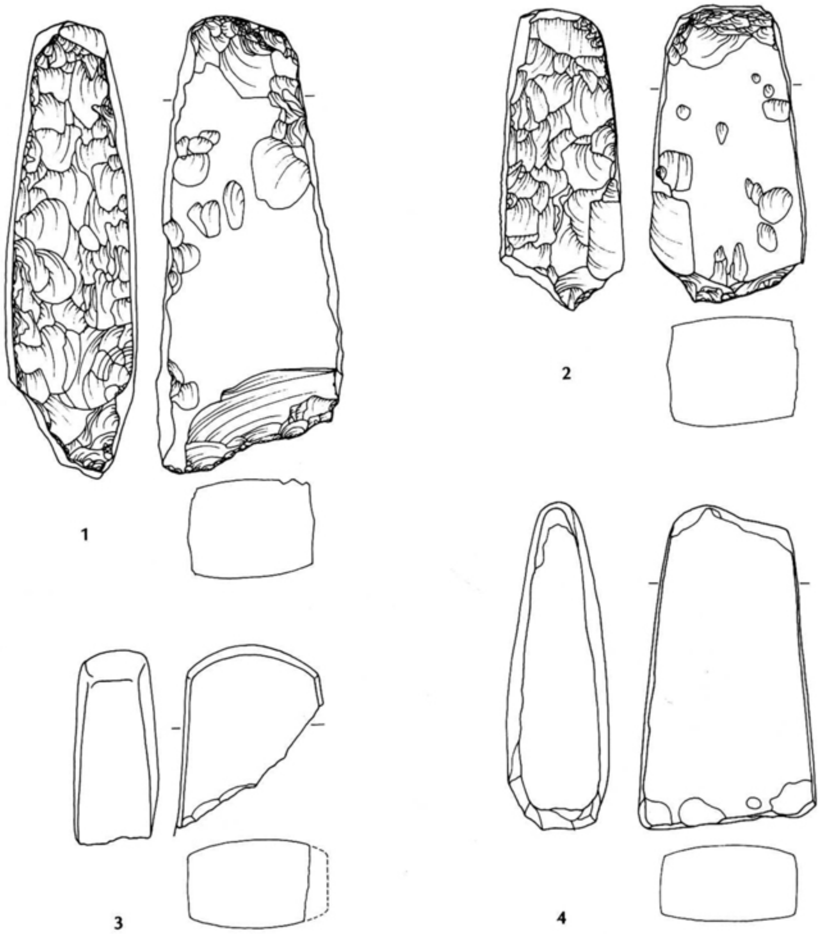


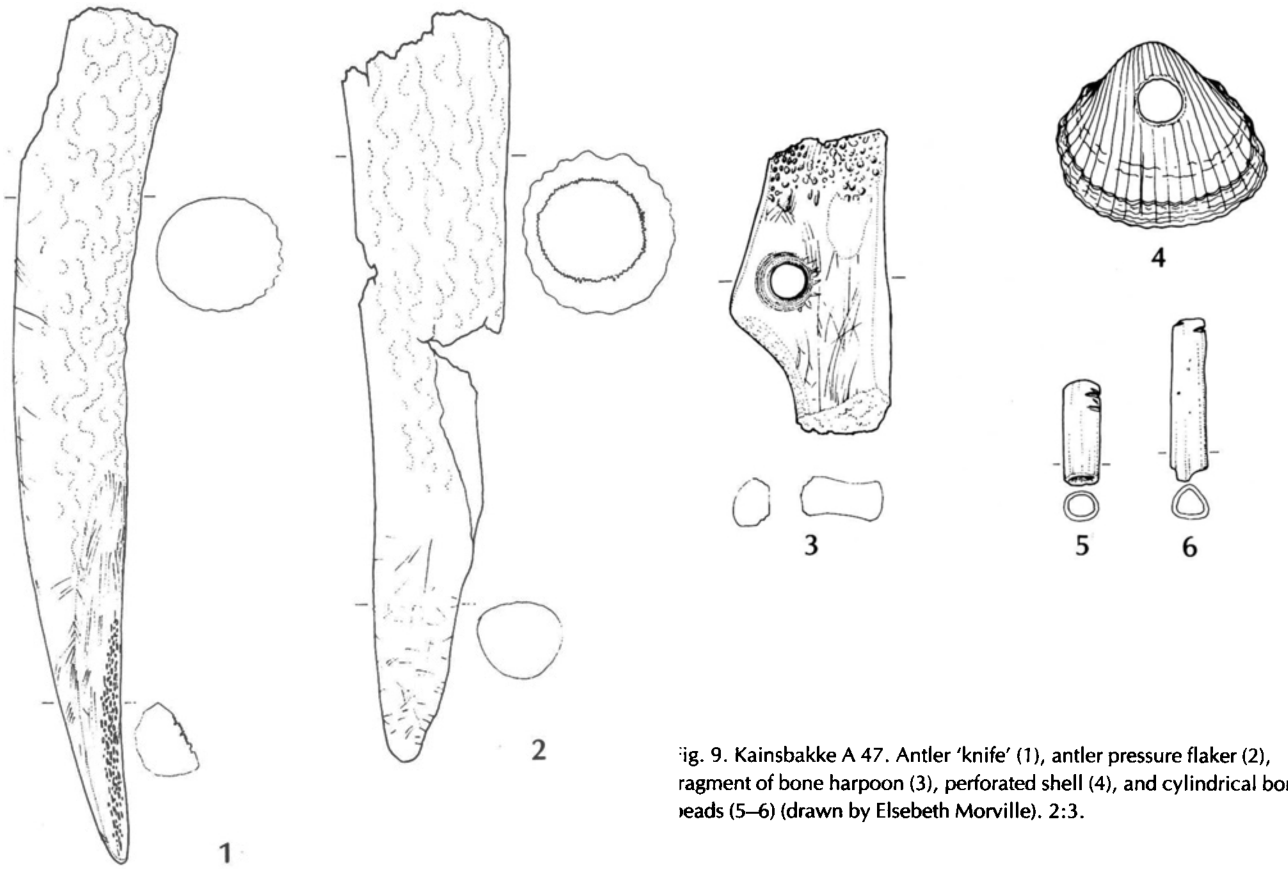
Fig. 8. Kainsbakke A 47. Flint axes (1–2) and greenstone axes (3–4) (drawn by Elsebeth Morville). 2:5.

RELATIVE DATING WITHIN THE PITTED WARE CULTURE

The proportions of scrapers and points from feature A 47 differ from those in material from other parts of Kainsbakke. The other settlement material had a strong predominance of type A3 tanged points, round scrapers were more frequent than oval ones, and blade scrapers were rare (Rasmussen L.W. and Boas 1980). In feature A 47 type A3 tanged points predominate only slightly, and oval scrapers slightly outnumber round ones. The rarity of blade scrapers agrees with the other material. The small number of tanged points means that more finds from the other half of the pit could easily change the proportions. The division of scraper types may reflect particular activities, the results of which would inevitably be more clearly visible in a pit than in a widespread cultural deposit.

With these reservations, a comparison with the Jonstorp settlements in Sweden reveals the following: there are more A3 tanged points in feature A 47 than at RÄ, but no B or C points as at the later M2 and M3. The scraper proportions correspond to RÄ in the slight predominance of oval types, but not as concerns the proportions between round and blade scrapers which are present at RÄ in equal numbers (Malmer 1969 pp. 28 and 47).

All the determinable axe fragments from A 47 are of Valby type with polished broad surfaces. All over polished thick-butted axes with oblique butts were found at the settlement of Livø on the Limfjord, but not at the typologically older site of Smedegårde (Marseen 1962 pp. 126 and 130). These axes also predominate only on the later sites at Jonstorp, together with hollow ground thick butted axes (Malmer 1969 p. 16).



ig. 9. Kainsbakke A 47. Antler 'knife' (1), antler pressure flaker (2), ragment of bone harpoon (3), perforated shell (4), and cylindrical bone eads (5–6) (drawn by Elsebeth Morville). 2:3.

In terms of decoration, the pottery from A 47 can be compared with that from the lower levels of RÄ. Zigzags are, for example, common, a trait reminiscent of the earlier MH phase. Comb impressions are furthermore almost entirely lacking from A 47. This ornamentation occurs particularly in RÄ's upper layer, and in the later M2 and M3. Most of the pots from A 47 have a marked shoulder at the transition from neck to belly, but some smoother profiles are also present. This also agrees with the lower layer of RÄ (Malmer 1969 p. 78 ff).

Feature A 47 therefore seems typologically most similar to Jonstorp RÄ, the proportions of tanged points suggesting a slightly younger date but still older than M2 and M3.

COMPARATIVE ANALYSES

The typical and most common pot types from A 47 are similar to those from the west Swedish Pitted Ware, but do not have direct parallels within the Funnel Beaker culture. The closest to any formal parallels are the large storage vessels from MN III/IV (Davidsen 1978 fig. 52).

The A 47 pottery has no handles or lugs, also a trait of the Funnel Beaker MN V. On the other hand there are no signs of typical Funnel Beaker MN V bucket shaped pots in the material so far recovered from A 47. Furthermore, there is none of the variation in pot types associated with the latest phases of the Funnel Beaker culture (Ebbesen 1975 pp. 16–17, Davidsen 1978 p. 100).

Inverted triangles occur on several of the pots from A 47; this is one of the elements in Ebbesen's Funnel Beaker IVb style, which is only known from two sites in Jutland (Ebbesen 1975 fig. 29,6 and fig. 57). The style is more widely distributed in Denmark in MN V, however. The fact that the trait occurs at Kainsbakke and also in the west Swedish Pitted Ware, lends some support to Davidsen's suggestion that this and other MN IVb motifs have their origin in the Pitted Ware (Davidsen 1978 p. 163–164, note 395). The complicated designs composed of zigzags also have some ornamental principles in common with (but are not identical to) Funnel Beaker MN IV pottery from the Danish islands (Ebbesen 1975, see among others fig. 83,4 and fig. 40,3). The pot in fig. 5:2 has formal and ornamental parallels with the pot from Ørum (Davidsen 1978 fig. 57g).

The Ørum pot's lozenge design is however carried out in comb-impressions a technique of ornamentation almost lacking at A 47. Davidsen places the Ørum pot in Funnel Beaker MN IV on purely typological grounds (Davidsen 1978 p. 116).

A few pots have the same decorative principles as Funnel Beaker MN V, with rows of decoration placed a bit below the rim. In only one case does this involve finger pits, which are in any case not common in the assemblage. Grooves made with a finger are also a common Funnel Beaker MN V element, but do not appear at all in the A 47 material.

The frequent occurrence of rim ornamentation is a feature the assemblage has in common with the late Funnel Beaker Culture (Davidsen 1978p. 109).

The clay discs are a purely Funnel Beaker tradition. The thickness of the three from A 47 is suggestive of the later part of the Funnel Beaker Culture. As far as the ornamentation is concerned, only the finger pits have close parallels in the Funnel Beaker MN V (Davidsen 1973 p. 28).

Objects modelled in clay are known in Denmark only from the early neolithic settlement of Stengade on Langeland (Skaarup 1975 pl. 36 and 68). They are, however, common on Swedish Pitted Ware settlements, which have also produced beads of fired clay. Both categories may be decorated (Welinder 1969–70 p. 75 ff, Janzon 1983).

It has been suggested that tanged points of type A form part of the late Funnel Beaker inventory (Ebbesen 1980 p. 54 ff). One argument for this is the find of a tanged point made as a secondary product from a blade sickle. Blade sickles made on A blades are, however known from several of the other pits from Kainsbakke, where they occur together with Pitted Ware material. The piece in question does not therefore prove that either the primary nor the secondary artifact definitely belongs in Funnel Beaker contexts. Neither is the presence of tanged points on late Funnel Beaker settlements and in passage graves seen as proof of their belonging to this cultural context.

Recent re-examination of thick-butted axes has led to the suggestion that type A axes belong to the Funnel Beaker Culture, and type B axes to the Pitted Ware Culture; that the middle neolithic can on this basis be divided into an earlier A phase and a later B phase; and that the Pitted Ware and Single Grave Cultures should belong in phase B (Nielsen P.O. 1977 p. 54 ff, Malmros 1979 p. 62). As pointed out above, however, type A axes belong to an older phase of the Pitted Ware, type B axes to a younger phase. In the Västerbjers cemetery type B axes were found in a later Pitted Ware context. The transition from A to B type axes seems rather to take place within the Pitted Ware, so that type A axes belong to the phase with type A tanged points, and type B axes to the phase with type B/C tanged points. It must be added that local variations may be involved in the introduction of type B axes (Nielsen P.O. 1977 pp. 57 and 60).

The two greenstone axes are both types dated to period 1–3 of the Swedish/Norwegian Battle Axe Culture (Malmer 1975 p. 84). The type with concave narrow surfaces also occurs in the Single Grave Culture of Jutland, but is usually referred to the Single Grave Culture of the Danish Islands (Glob 1944 p. 129).

Such observations as can be made about the harpoon fragment correspond to characteristics earlier described as neolithic (Andersen S.H. 1975). The fact that it is made of a cow's bone links it with the example of presumed neolithic date from Livø. The same applies to a number of Swedish harpoons (Andersen S.H. 1975 pp. 21–22). Close typological parallels are known from Gotland, and harpoons with a shoulder and an asymmetrically placed line hole (although made of antler) are known from three locations in Denmark (Janzon 1974 pl. 15, 51 and 48; Andersen S.H. 1971 fig. 23 and fig. 22,8). Harpoons are a well-known type within the Pitted Ware, while none are known from the Funnel Beaker Culture.

Bone points made of metatarsals with preserved articular end are known in several late Funnel Beaker finds, although they are made from sheeps' bones (Davidsen 1978 p. 138, Ebbesen 1975 fig. 244,12, fig. 42,2,3,5). From one of the other pits on Kainsbakke came a similar point made of a sheep's bone.

Cylindrical beads made of bird bone are a wellknown Pitted Ware type, but are also known from other neolithic contexts (Janzon 1974 p. 67, Becker 1950 p. 203). A single settlement find seems to link the type to Funnel Beaker MN V (Davidsen 1978 p. 138).

Pressure flakers and the objects here called knives, made of red deer antler tines, are also known from the funnel Beaker MN V settlements Alrø and As Vig. The example from the latter locality differs by not being made on a curved tine (Davidsen 1978 pl. 61,g and 81,e). A pressure flaker of the same type comes from the Pitted Ware settlement Kirial Bro (Rasmussen and Boas 1980).

Personal ornaments made of cockle shells have parallels in Pitted Ware graves from Gotland (Janzon 1974 p. 99).

Although the Pitted Ware Culture as it appears at Kainsbakke has close similarities with the Swedish Pitted Ware Culture, it can in several respects be said to have a material culture tradition rooted in the late Funnel Beaker Culture. There is, however, no suggestion of any such link with the Single Grave Culture. Only the two greenstone axes suggest any connection with the Single Grave and Swedish/Norwegian Battle Axe Cultures. It is difficult on the basis of the material presented above to see Kainsbakke as a Single Grave Settlement, along the lines of the interpretation of Malmros (1979).

There is however a chronological connection between the Pitted Ware and Single Grave cultures according to C14 dates, which also agrees with the abovementioned typological observation. At the time of the completion of this manuscript, no radiocarbon dates were available from feature A 47, but a total of 15 dates is available from other features on Kainsbakke and nearby Kirial Bro. These range from 2230 – 2000 bc, with a concentration around 2200 and 2100 (5). The datings overlap the latest Funnel Beaker MN V dates, correspond with those for the Undergrave phase of the Single Grave Culture, and partly overlap with those for the Groundgrave phase (Nielsen P.O. 1977 fig. 25). The phase in which type A3 tanged points predominate must thus largely correspond in time with the Undergrave phase of the Jutland Single Grave Culture.

This raises a series of problems with regard to the traditional placing of the Pitted Ware phases in relation to the Single Grave Culture. According to the traditional view, type C tanged points should be contemporary with the Undergrave/early Groundgrave phases (e.g. Sterum 1978 p. 66 ff). If the graves on which this is based are to be linked with the evidence from the settlements, then there would have to be a contemporaneous use of both type A and type C tanged points – which the settlements by themselves do not suggest was the case! It must, however, be born in mind that the C14 dates from the Single Grave Culture are mainly from wood samples. The actual age of these samples must therefore be regarded as greater than those of the Pitted Ware samples, which are shell or bone (Malmros and Tauber 1975 p. 81). The date of 2080 bc from Sølager layer 4 must be mentioned here. A tanged point of type B occurred in this layer, which harmonises well with the Kainsbakke and Kirial Bro dates (Skaarup 1973 p. 117).

INTERPRETATION

In the following, we will present some preliminary considerations about the function of pit A47. It is necessary to distinguish between primary function and secondary function:

Primary use: It has already been suggested that the pit may originally have been a hut structure. Finds of human bones in the lower part of the refuse deposit could furthermore indicate the presence of a burial like the Swedish settlement graves (Welinder 1969–70:85).

Secondary use: The refuse layer is regarded as a simultaneous deposit, which means that it was either accumulated over a short period of time or all at once. The voluminous faunal material does, however, hardly reflect the normal consumption of the settlement population. The large amount of meat represented by the bones of wild cattle, bears, deer, pigs, and domesticated cattle, presumably deposited at one and the same time, can only testify to the presence of a large number of people on one occasion. The occurrence of oysters, and the presence of garfish which passes the coast in shoals around August, indicate that the event took place during the summer season. The many different animal species make it unlikely that the reason for the congregation was the exploitation of a single wild resource.

The more likely interpretation is that people gathered at a favourable time of the year to participate in activities of a social nature. There are good reasons for supposing that Kainsbakke was a site of central importance. Even without postulating a direct link with the 'central sites' of the earlier Funnel Beaker Culture (Madsen 1982), the settlement shares with these the accentuated geographical setting, the large occupation area, and the wealth of find material.

There are in fact indications of a settlement pattern including central sites at the time of the Pitted Ware Culture in the area. Within a distance of 10 km from Kainsbakke there are at least two smaller, contemporary settlement sites situated along the adjoining waterways. Just 1 km from Kainsbakke lies the site of Kirial Bro. It has been revealed by excavation that this settlement had quite a different character (Rasmussen & Boas 1982).

In relation to the environment the large Kainsbakke settlement lies both protected and in a central position. It must be regarded as a permanently settled residential site and/or 'central site', being the scene of ritual and social gatherings where settlers of the whole area shared a selection of the great variability of food resources.

From the faunal contents of Kainsbakke A47 it would be unwise to try to determine whether the economy of the inhabitants was primarily foraging or farming and stock-raising. That there was a mixed economy is, however, beyond doubt. One is allowed to expect a more complex social system in a society with a mixed economy than in one based exclusively on hunting and gathering (cf. Tilley 1981–82).

Settlements with a mixed economy such as Kainsbakke are to be regarded as the continuation of an older tradition, because they are known from the later Funnel Beaker Culture. Coastal areas have yielded pits from this culture containing shells, bones of seals, and wild and domestic terrestrial mammals (Davidsen 1978 pp. 42 ff and 55 ff). These sites do not however provide a specialised artifactual inventory. The settlement type continued after the Pitted Ware, as is shown by the site of Kalvø, where the Single Grave Culture is represented by Groundgrave material and type D points (Andersen S.H. 1982, 1983).

CONCLUSION

Kainsbakke represents a "pure" Pitted Ware settlement in the sense that the material is distinct from that of other neolithic cultures, and corresponds closely with finds from particularly the West Swedish Pitted Ware Culture.

The finds from the half-excavated feature A 47 comprise one of the largest Pitted Ware assemblages from southern Scandinavia. The chronologically significant types show that the find derives from a limited phase towards the end of the earlier part of the culture.

The preserved faunal material shows a mixed economy, insofar as both wild and domestic, marine and terrestrial animals were exploited, and shells collected to a considerable degree.

The radiocarbon dates place the settlement after the end of the Funnel Beaker Culture, contemporary with the Undergrave phase of the Single Grave Culture.

There are elements within nearly all the artifactual categories which must be understood as being in the tradition of the late Funnel Beaker Culture. The settlement type, with its mixture of faunal elements, also has its roots in the later Funnel Beaker Culture. There are on the other hand very few traits in the material which could derive from the Single Grave Culture.

On the basis of this and other Pitted Ware finds from Denmark, it appears that two different but contemporary material "cultures" existed side by side in Denmark in the middle of the neolithic: the Pitted Ware to the northeast, with roots partly in the Funnel Beaker Culture; and the Single Grave to the southwest, with roots in continental groups.

Kainsbakke must be considered as a central or main residential site within a settlement system whose outlines are beginning to emerge. This pattern, and the special character of pit A47 and its contents, points to the existence of a complex social system within the Pitted Ware Culture in the area.

Translated by Peter Rowley-Conwy

Lisbeth Wincentz Rasmussen, Institute of Prehistoric Archaeology, University of Aarhus, Moesgård, DK-8270 Højbjerg

NOTES

1. Djurslands Museums No. 1900, Kainsbakke II, Ginnerup parish, Djurs Nr. herred, Randers county. National Museum sb. no. 118.
2. The excavation was carried out for Djurslands Museum, Grenå, by the author and N.A. Boas. Financial support was received from Fredningsstyrelsen in consequence of § 49, and from The Danish Research Council for the Humanities.
3. The analysis of the material from feature A 47 was supported by Dronning Margrethe II's arkæologiske fond. Drawings of the finds were paid for by The Danish Research Council for the Humanities. The material from Kainsbakke will be included in a larger research project by the author, based at Aarhus University.

4. Analysis of the faunal material is being carried out by Jane Richter. The work was supported financially by the Carlsberg Foundation. It is part of a research project by Jane Richter of Copenhagen University.
5. The radiocarbon dates are as follows:

Kirial Bro:

K-3683	shells	2090+80 bc
K-3684	shells	2070+80 bc
K-3685	shells	2150+75 bc
K-3720	bone	2150+55 bc

Kainsbakke:

K-3686	shells A2	2230+80 bc
K-3687	shells A6	2200+80 bc
K-3719	bone A2	2190+85 bc
K-3929	shells A64	2100+85 bc
K-3930	shells A64	2120+85 bc
K-3931	shells A64	2120+85 bc
K-3932	shells A64	2020+85 bc
K-3933	shells A64	2080+85 bc
K-3934	shells A56	3290+95 bc (disturbed in the iron age)
K-3935	shells A56	2000+90 bc
K-3936	shells A55	2090+75 bc

REFERENCES

ANDERSEN, S.H. 1971: Ertebøllekulturens harpuner. *Kuml* 1971 pp. 73–126.

– 1975: Nye harpunfund. *Kuml* 1975 pp. 11–28.

– 1982: Kalvø – en østjysk kystboplads med enkeltgravskultur. In H. THRANE (ed.): *Om yngre stenalders bebyggelseshistorie.* Skrifter fra historisk institut, Odense Universitet, no. 30.

– 1983: Kalvø – A Coastal Site of the Single Grave Culture. *Journal of Danish Archaeology* 2.

BECKER, C.J. 1950: Den grubekeramiske kultur i Danmark. *Aarbøger for nordisk Oldkyndighed og Historie* 1950 pp. 153–274.

– 1954: Die mittel-neolithische Kulturen in Südskandinavien. *Acta Archaeologica* 25, pp. 49–150.

– 1957: Den tyknakkede flintøkse. *Aarbøger for nordisk Oldkyndighed og Historie* 1957, pp. 1–37.

– 1980: Om grubekeramisk kultur i Danmark. *Aarbøger for nordisk Oldkyndighed og Historie* 1980 pp. 13ff.

DAVIDSEN, K. 1973: Neolitiske lerskiver belyst af danske fund.*Aarbøger for nordisk Oldkyndighed og Historie* 1973 p. 29ff.

– 1978: *The Final TRB Culture in Denmark.* Arkæologiske Studier Vol. V (Copenhagen).

– 1980: Undergravstid på de danske øer. *Aarbøger for nordisk Oldkyndighed og Historie* 1980 pp. 38–51.

EBBESEN, K. 1975: *Die jüngere Trichterbecherkultur auf den dänischen Inseln. Arkæologiske Studier Vol. II (Copenhagen).*

– 1980: Enkeltgravskulturen – 100 år efter opdagelsen. Aarbøger for nordisk Oldkyndighed og Historie 1980 pp. 52–72.

GLOB, P.V. 1944: Studier over den jyske Enkeltgravskultur. *Aarbøger for nordisk Oldkyndighed og Historie* 1944.

JANZON, GUNBORG O. 1974: *Gotlands mellanneolitiska gravar.* Studies in North-European Archaeology 6. (Stockholm).

– 1983: Zoomorphic clay figurines and beads from Ire, Hangvar parish, Gotland. *Fornvännen* 78, 1983, pp. 1–20.

MADSEN, T. 1982: Settlement Systems of Early Agricultural Societies in East Jutland, Denmark: A Regional Study of Change. *Journal of Anthropological Archaeology* 1, pp. 197–236.

MALMER, M.P. 1969: *Gropkeramikboplatsen Jonstorp RÄ.* Antikvariskt arkiv 36.

– 1975: *Stridsyxekulturen i Sverige och Norge.* Lund.

MALMROS, C. 1979: Den tidlige enkeltgravskultur og stridsøksekultur. *Aarbøger for nordisk Oldkyndighed og Historie* 1979 pp. 62–67.

MALMROS, C. and TAUBER, H. 1975: Kulstof-14 dateringer af dansk enkeltgravskultur. *Aarbøger for nordisk Oldkyndighed og Historie* 1975.

MARSEEN, O. 1962: Smedegårde og Livø, grubekeramiske pladser ved Limfjorden. *Kuml* 1962 pp. 123ff.

NIELSEN, P.O. 1977: Den tyknakkede flintøkses kronologi. *Aarbøger for nordisk Oldkyndighed og Historie* 1977 pp. 5–71.

NIELSEN, S. 1979: Den grubekeramiske kultur i Norden, samt nogle bemærkninger om flækkepilespidserne fra Hesselø. *Antikvariske studier* 3, 1979 pp. 23–48.

RASMUSSEN, L. WINCENTZ 1983: Grubekeramisk kultur på Djursland. *Historisk Årbog fra Randers Amt* 1983 pp. 5–15.

RASMUSSEN, L. WINCENTZ and BOAS, N.A. 1982: Kainsbakke og Kirial Bro. *Antikvariske studier* 5, 1982 pp. 105–114.

SKAARUP, J. 1973: *Hesselø – Sølager. Jagdstationen der südskandinavischen Trichterbecherkultur.* Arkæologiske Studier I, 1973 (Copenhagen).

– 1975: *Stengade. Ein langeländischer Wohnplatz mit Hausresten aus der frühneolithischen Zeit.* Meddelelser fra Langelands Museum (Rudkøbing).

STERUM, N. 1978: Nogle C 14-frie synspunkter på den beckerske kontakthypotese. *Hikuin* 4 (Århus) pp. 61–76.

TILLEY, C. 1981–82: An Assessment of the Scanian Battle-Axe Tradition: Towards a Social Perspective. *Kungl. Humanistiska Vetenskapssamfundet i Lund. Scripta Minora* 1981–82:1.

WELINDER, S. 1969–70: Överåda. A Pitted Ware Culture Site in Eastern Sweden. *Meddelanden från Lunds Universitets Historiska Museum* 1969–70 pp. 5–99.

Journal of Danish Archaeology vol. 3, 1984, pp. 99–103

A Late Neolithic/Early Bronze Age Settlement at Vejlby, East Jutland

by JENS JEPPESEN

In the spring of 1982 *Forhistorisk Museum*, Moesgård (Århus), carried out a number of excavations in areas that were going to be affected by construction work. One of these sites contained settlement remains with flint tools and pottery which can be dated to the Late Neolithic/Early Bronze Age (1).

The site is located directly above the southern slope leading to the Egå valley at Vejlby, north of Århus (2). The entire area is characterised by heavy clay soil, under which there is clay with scattered patches of sand.

A preliminary investigation of the site had revealed a pit containing waste flakes of flint, pottery and charcoal. When the pit was excavated, it appeared as an almost square course of fill, c. $4^1/_2 \times 4$ m large (fig. 1 E). As can be seen in fig. 1, it was interrupted at the western end by a later intrusion which, however, affected only a minor part of the pit. The fill of the pit consisted of heterogeneous greyish brown and blackish brown sand and clay with a considerable admixture of charcoal. There were numerous small fragments of granite, shattered by fire, scattered in the fill and at the bottom of the pit. The largest of them had a diameter of c. 10 cm. Nowhere did they form concentrations that might be interpreted as fire places. The section (fig. 1, below right) shows that the pit was a nearly flat-bottomed, shallow depression with a depth of c. 20 cm at the centre.

The *flint tools* from the pit comprised the following: 1 pressure-flaked, crescent-shaped sickle (fig. 2 a), the ends of 2 equilateral arrowheads, neither of which were notched (fig. 3 c, d), the tip of a small equilateral arrowhead (fig. 2 b), 3 scrapers formed from crude flakes, 4 fairly crude blades and 1 thick core borer. Furthermore, there were 1 unfinished sickle, 3 cores, 1 core transformed into a hammerstone and 880 waste flakes. The flakes include large, crude flakes as well as small chips from pressure-flaking. Some of the waste flakes show traces of careful pressure-flaking and may well be tools begun but later rejected.

The *pottery* in the pit included 44 sherds representing at least 4 different pots. Some of the sherds have been assembled to form the base and the lower part of a pot (fig. 3 c). It has a poorly defined base, 12 cm in diameter and a slightly convex lower part. The base and sides are c. 1.2 cm thick and made of coarse material. The colour is reddish brown throughout. The rimsherd (fig. 3 b) is of the same material and colour as the pot (fig. 3 c) and probably belongs to it. The sherd shows that the pot also had a slightly convex upper part and a splayed, attenuated rim. Below the rim the pot is 0.7 cm thick. The sherd in fig. 3 d comes from the transition between the side and the base of a pot with a base diameter of 10 to 11 cm. As was the case with those mentioned above, the material is coarse-grained and c. 1 cm thick. On the outside the colour is reddish brown while the inside is blackish brown. The base is marked with finger impressions. Fig. 3 a shows another type of pottery. It is a sherd from a rounded vessel with a sharply marked transition between the side and a splayed rim. As very little is left of the rim, its shape cannot be accurately determined. The vessel had a rim diameter of c. 14 cm and was fairly thin-walled, the sherd being 0.5 cm thick. The material is fine and well-baked, and is greyish brown throughout. The last type of pottery found is represented only by a single sherd. It is an undecorated sherd from the side of a pot, 0.5 cm thick. Like the preceding one it is fine-grained and well-baked. It is light brown on both sides, with a smooth surface.

Dating

The symmetrical, pressure-flaked sickle is a type of implement known from the Late Neolithic as well as the Early Bronze Age (Lomborg 1959: 164 ff.). As far as the

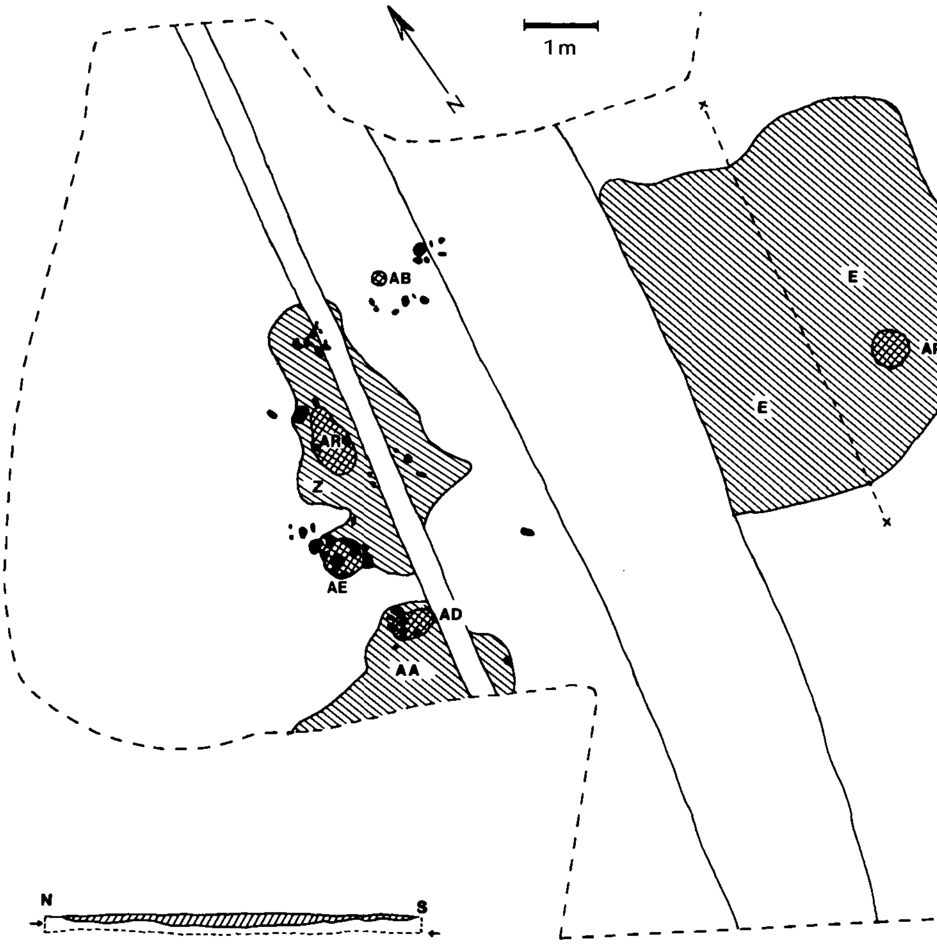


Fig. 1. Plan of the excavation. 1:100.

arrow-heads are concerned, the pressure-flaked, equilateral arrow-head is a type that has been dated to the end of the Late Neolithic or the Early Bronze Age, in contrast to the broad triangular arrow-head with curved edges, which has been assigned to the beginning of the Late Neolithic (Brøndsted 1966: 325–26; Glob 1952: 70). M. Strömberg has stated, however, that the broad triangular arrowhead with curved edges occurs not only during the Late Neolithic but continues through the Bronze Age, though mainly during the early periods (Strömberg 1954: 357 ff.). Furthermore, E. Lomborg has pointed out that it appears to be impossible to identify arrow-heads from the Bronze Age that do not occur also in the Late Neolithic (Lomborg 1959: 169). As the flint sickle and the three arrow-heads are types known from both the Late Neolithic and the Bronze Age, these tools cannot provide an accurate dating of the Vejlby find. It should be pointed out, however, that the narrow, equilateral arrowhead as well as the crescent-shaped flint sickle are characteristic types at the Egehøj settlement site, which dates from the Early Bronze Age, period I (Boas 1983).

If, as it is assumed, the pottery base (fig. 3 c) and the rimsherd (fig. 3 b) are asociated, we are dealing with a type of pottery rather like *Danske Oldsager* II, No. 567, which Glob has assigned to the Late Neolithic. Two similar vessels were found at the Norrvidinge settlement site in Sweden (Callmer 1971–72: 132, fig. 9), which has been dated to the Late Neolithic or the Early Bronze Age (Callmer 1971–72: 120–43). The majority of the pottery found belongs to the same type of coarse red-baked clay as fig. 3 b, c & d. This type of pottery corresponds very closely to the description of pottery from the settlement site at Egehøj, which also contained pots of the kind mentioned above (Boas 1983). It has proved impossible to find parallels to the rimsherd (fig. 3 a) and the sherd with a smooth surface mentioned above, but according to M. Strömberg, Swedish settlement sites dated to the Early Bronze Age have been found to contain pottery that is both thin-walled and well-baked. There is also a reference to pottery with a smooth surface. Incidentally, she states that as far as the simple vessels are concerned, it is impossible to date them more precisely than the Late Neolithic/Early Bronze Age (Strömberg 1954: 365 ff.).

A radiocarbon date of 1470 ± 80 bc (K-4024) was obtained from a sample of charcoal from the fill of the large pit. This date supports the conclusion reached above that the find dates from the beginning of the Early Bronze Age or from the transition Late Neolithic/ Early Bronze Age (c. 1500 bc).

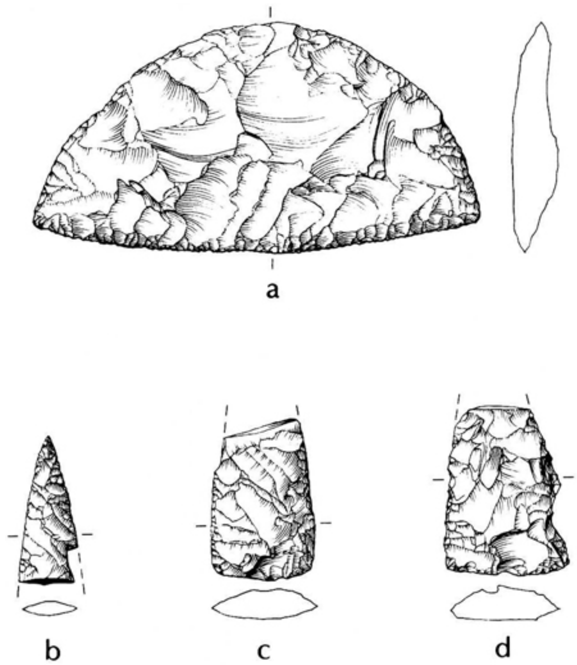


Fig. 2. Flint artifacts. a, crescent-shaped sickle. – b–d, arrowheads. Drawn by Orla Svendsen. 2:3.

Interpretation

As the almost square pit (fig. 1 E) resembled the sunken eastern ends of the Myrhøj houses, which date from the early part of the Late Neolithic (Jensen 1972: 61–122), the excavation trench was extended westwards to examine whether there were any demonstrable post holes like those of the Myrhøj houses. As shown by fig. 1, this excavation revealed a probable post hole (AB), which appeared as a blackish brown course of fill, c. 4 cm deep. Furthermore, there were two courses of fill (Z and AA), cut through by a modern drain. Both turned out to be blackish brown culture layers, c. 5 cm thick, with scattered patches of yellow sand. They contained some charcoal, a few waste flakes of flint as well as some pottery of the coarse-grained, red-baked type shown in fig. 3 b, c & d, which indicates that they are contemporaneous with the pit (E). Underneath the fill (Z and AA) were the probable post holes AD, AE and AR. They appeared as heterogeneous, greyish brown and blackish brown courses of fill and were 5 to 10 cm deep. They contained some charcoal and fire-shattered fragments of stone of the same type as those found in the pit (E). The post hole AD also contained a blade scraper made from a thick blade, 8 cm long and c. 2.8 cm wide, which was retouched along both sides, as well as a round flint hammerstone 8 cm in diameter. In AE a similar hammerstone was found also with a diameter of 8 cm. Another probable post hole (AP) was found underneath the south-eastern part of the pit (E). It was c. 10 cm deep, and its fill was blackish grey, containing scattered particles of charcoal and a round granite hammerstone 8 cm in diameter.

The site appears less regularly laid out than the Myrhøj houses, which have distinct post holes and rows of posts, but this may be because of the different conditions of preservation. The Myrhøj houses were well protected under a sand deposit, whereas the Vejlby site was found just below the topsoil in an area of high ground and was cut through by two later disturbances. In his paper on the Myrhøj houses J. Aarup Jensen writes that if these house sites had not been protected by an overlying sand deposit but had been found in an ordinary ploughed field, where erosion and farm work would have removed the top of the sites, they would probably have found only "diffusely defined courses of fill, measuring no more than 5 × 8 m and with a maximum depth of 20 to 30 cm. The culture layer that makes up the fill would contain potsherds and other artefacts as well as some fire-shattered stones. It would hardly be possible to demonstrate post holes ..." (Jensen 1972: 106). This description corresponds very closely to the Vejlby site, and it is therefore likely that the pit (E)

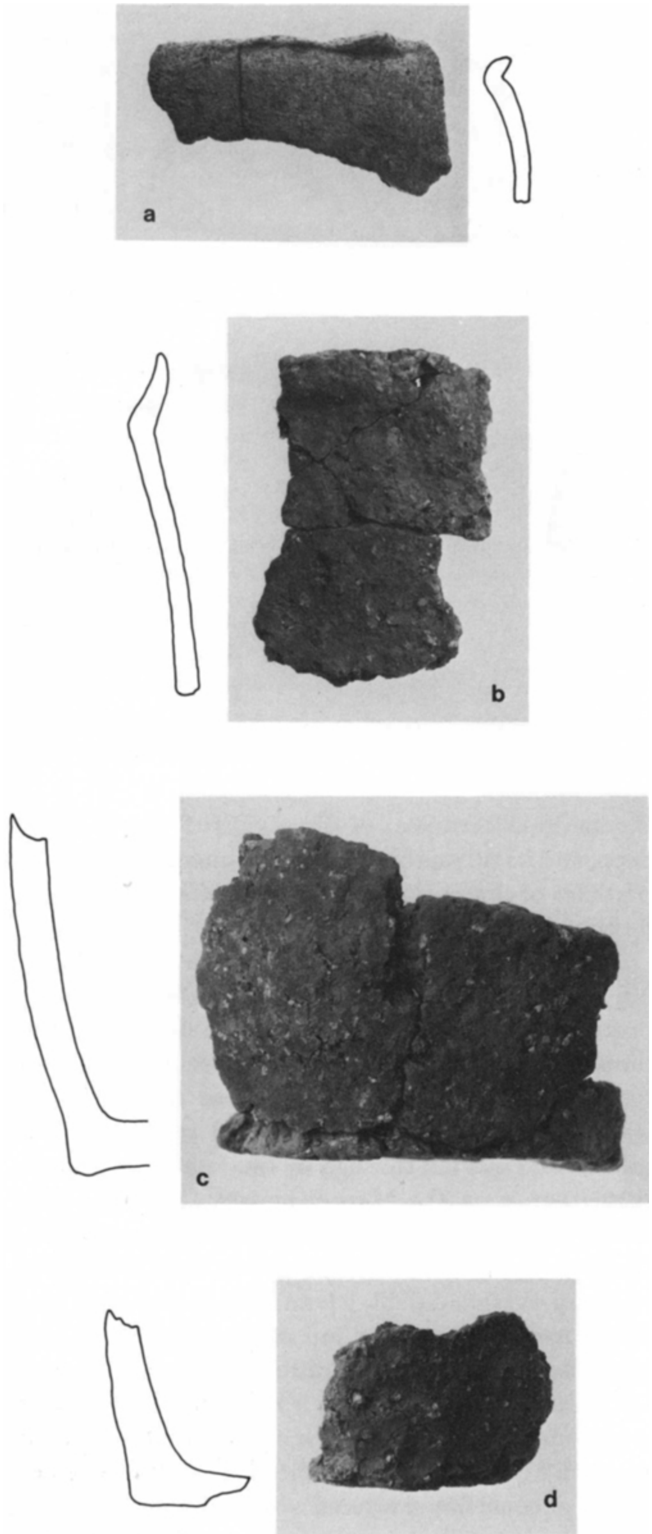


Fig. 3. Pottery. 1:2.

represents the sunken eastern end of an east-west orientated house, where the post holes AD, AE, AR and AB constitute a slightly rounded western end. If this is the case, we are dealing with a house at least 9.5 m long and 4 or 5 m wide.

Several settlement sites suggest that east-west orientated houses with sunken floors are a type characteristic of the Late Neolithic. The Vejlby site, as well as the Norrvidinge site discussed below, shows that this type of house may also have existed during the Early Bronze Age. The three Myrhøj houses dating from the early Late Neolithic are the oldest known representatives of this type of house. Furthermore, a site at Stendis near Holstebro (Northern Jutland)has been interpreted as a house of the Myrhøj type. It is a c. 15 m long and 4 to 5 m wide, east-west orientated pit with a depth of c. 25 cm in the centre. Associated with the pit there were some post holes, and the finds indicate that the pit is contemporaneous with the Myrhøj houses (Skov 1982). Similarly, the Late Neolithic house excavated in 1952 at Gug near Ålborg was east-west orientated and had a sunken floor. This house measured only 4 × 2 m (Brøndsted 1966: 311–12. – Simonsen 1983).

Late Neolithic house sites with sunken floors have also been found in South Sweden. In 1967 at Stockholmsgården east of Ystad a site was excavated, which M. Strömberg has termed a pit house. It is an east-west orientated pit, 4.2 m long, 1.9 m wide and 38 cm deep. It contained three fire places at different levels, and its artefacts indicate that it dates from the early Late Neolithic (Strömberg 1968: 1–15). Similarly, M. Strömberg interprets site No. 33 at Hagestad as a Late Neolithic house with a sunken floor. The pit is almost square, 2.8 m × 2.4 m, and the longer side extends east-west. The depth is given as c. 0.5 m. The northern and southern parts contained rows of stone with visible traces of wood on top, possibly the remains of benches (Strömberg 1971: 250–51). A third Late Neolithic house site, Hagestad No. 44, is discussed briefly by M. Strömberg. This house was c. 8 m long and 4 m wide. The eastern end was depressed and contained a fire place. Strömberg adds that the settlement contained several house sites. Judging by these sites, several house types apparently co-existed (Strömberg 1976: 43). A Late Neolithic site excavated at Furuland in 1962 may perhaps also be interpreted as a house with a sunken floor. It is an east-west orientated, almost rectangular pit, 4 × 6 m large and c. 0.5 m deep. The pit contained a fire place and a single post hole (Tilander 1962–63: 123–35). In 1971 settlement remains dated to the Late Neolithic/ Early Bronze Age were excavated at Norrvidinge. Two of the house sites, Nos. 338 and 339, from this settlement have been interpreted as houses with sunken floors. No. 338 was an east-west orientated pit of a fairly regular rectangular shape. It was c. 8 m long, 3.5 m wide and 30 to 50 cm deep. No. 339 was also an east-west orientated pit and had a more regular rectangular shape than No. 338. It was 8.5 cm long, 4.5 m wide and 40 to 50 cm deep. The settlement site contained other structures which have been interpreted as small storage huts (Callmer 1971–72: 120–43).

As appears from the above examples, a number of structures have now been found which can be interpreted as houses with sunken floors. In most cases these pits have a regular rectangular shape, indicating that we are not dealing merely with random refuse pits. Furthermore, most of them had associated post holes suggesting different types of construction. It should be noted, however, that these sites vary considerably in size. A common feature of the sites at Myrhøj, Hagestad 44 and Vejlby is the fact that only the eastern half of the houses is sunken. The relatively small size of some of the above structures may be because we are dealing with house sites where only the eastern, sunken part has survived, or else the excavation concentrated on this part. When future sites of this kind are discovered, it will therefore be important to examine a fairly large area around such pits.

Translated by Ole Bay-Petersen

Jens Jeppesen, Forhistorisk Museum, Moesgård, DK-8270 Højbjerg

NOTES

1. Forhistorisk Museum, Moesgård (Århus), file No. 2701, Engvang IV.
2. Vejlby parish, Hasle district, Århus county.

REFERENCES

BOAS, N. A. 1983: Egehøj. A Settlement from the Early Bronze Age in East Jutland. *Journal of Danish Archaeology* 2. Odense.

BRØNDSTED, J. 1966: *Danmarks Oldtid I, Stenalderen* (reprint of 2nd ed.). Copenhagen.

CALLMER, J. 1971–72: Preliminary report on a complex of buildings from the Late Neolithic – Early Bronze Age at Norrvidinge, Scania. *Meddelanden från Lunds Universitets historiska Museum.*

Danske Oldsager II, see GLOB 1952.

GLOB, P.V. 1952: *Danske Oldsager II, Yngre Stenalder*. Copenhagen.

JENSEN, J. AARUP 1972: Bopladsen Myrhøj. 3 hustomter med klokkebægerkeramik. *Kuml* 1972. Århus.

LOMBORG, E. 1959: Fladehuggede flintredskaber i gravfund fra ældre bronzealder. *Aarbøger for nordisk Oldkyndighed og Historie*. Copenh.

SIMONSEN, J. 1982: A Late Neolithic House Site at Tastum, Northwestern Jutland. *Journal of Danish Archaeology* 2. Odense.

SKOV, T. 1982: A Late Neolithic House Site with Bell Beaker Pottery at Stendis, Northwestern Jutland. *Journal of Danish Archaeology* 1. Odense.

STRØMBERG, M. 1954: Bronzezeitliche Wohnplätze in Schonen. *Meddelanden från Lunds Universitets historiska Museum.*

– 1968: Ett senneolitisk grophus i Vallberga. *Ale, Historisk tidskrift för Skåneland*, 1968: 2.

– 1971: Senneolitiska huslämningar i Skåne. *Fornvännen* 1971:1.

– 1976: *Forntid i Sydostskåne*. Föreningen för fornminnes- och hembygdsvård i sydöstra Skåne. Småskrifter 14.

TILANDER, I. 1962–63: A Late Neolithic settlement in Furuland, Scania. *Meddelanden från Lunds Universitets historiska Museum.*

Journal of Danish Archaeology vol. 3, 1984, pp. 104–110

The Egehøj Cereals

Bread Wheat (*Triticum aestivum* s. l.) in the Danish Early Bronze Age

by PETER ROWLEY-CONWY

INTRODUCTION

The site of Egehøj lies in eastern Jutland, near the north coast of the Djursland peninsula. It consists of three longhouses, all apparently contemporary, dating from period I of the Bronze Age. Three radiocarbon dates from the site are 1210 ± 100 bc (K-2238), 1390 ± 100 bc (K-2239) and 1290 ± 100 bc (K-2240). The site was excavated during 1969–73 by Niels Axel Boas, and has subsequently been published (Boas 1983).

The three longhouses were all similar, having one end dug down 20–40 cms into the subsoil. House III produced the cereal grains to be described here. It measured 19 × 6 m, its sunken east end measuring about 7.5 × 5 m (Boas op. cit.). During the excavation of this eastern end, a 30 cm wide baulk was left standing running along the length of the house (fig. 1). It was noticed that this baulk contained many cereal grains. It was therefore divided into portions, bagged, and stored in Randers Museum. Soil from a shallow pit (designated pit *caa*) below the baulk was also bagged and stored. This far-sighted policy enabled the present writer to sample selected portions in 1979, using a froth flotation unit of the type described by Jarman, Legge and Charles (1972).

The Cereals

Preservation was poor, a fact also noted by Helbæk, who briefly examined some of the grains (quoted in Boas 1983, p. 97). A total of 2370 grains was recovered, divided into 14 samples, 13 from the sunken part of the longhouse, and one from pit *caa*. Of these grains, 772 could not be identified (see table 1). This is a substantial proportion (almost one third), and this should be remembered throughout the following discussion.

Bread wheat (*Triticum aestivum* sensu lato) is very common. Many of the grains were quite compact (fig. 2), a fact already noted by Helbæk (in Boas op. cit.). All the grains are, however, referred to one taxon (cf. van Zeist 1968). No spikelet remains were found. For measurements see table 2a.

Barley (*Hordeum vulgare*) was also common (fig. 3). Many grains were twisted, indicating the 6 row variety. All the determinable grains were naked; poor preservation could however, have obliterated traces of the hulls in some cases, so it may be that a proportion of the barley grains could originally have been hulled. Measurements are given in table 2 b.

The third cereal type present is referred to emmer type (*Triticum cf. dicoccum*). The presence of spelt (*T. spelta*) among these grains cannot be dismissed, as this cereal has been recorded in the Late Neolithic and Early Bronze Age of Denmark (Jørgensen 1979). The grains are difficult to distinguish, particularly where preservation is poor. Most grains seemed typically emmer-like rather than spelt-like, and for this reason are tentatively referred to emmer. No chaff fragments were found. Measurements are listed in table 2 c.

No rachis or glume fragments were recovered, and weed seeds were very rare (see table 1). It seems, therefore, that the Egehøj house III samples represent cleaned grain, not residues from crop processing. House III is believed to have been destroyed by fire (Boas 1983 p. 92), so the material is likely to represent what was stored in the building when this happened.

The samples offer little direct evidence as to how the cereals were stored. One might expect that ground level storage in the sunken end of the longhouse would have been a problem due to damp. Hillman (1981) states that glume wheats (einkorn, emmer and spelt) in wet areas are often stored as semi-cleaned spikelets rather than as cleaned grain, because "in wet areas, the grain of glume wheats is less likely to spoil if stored as spikelets rather than naked grain" (p. 138).

The samples from Egehøj, however, show that the

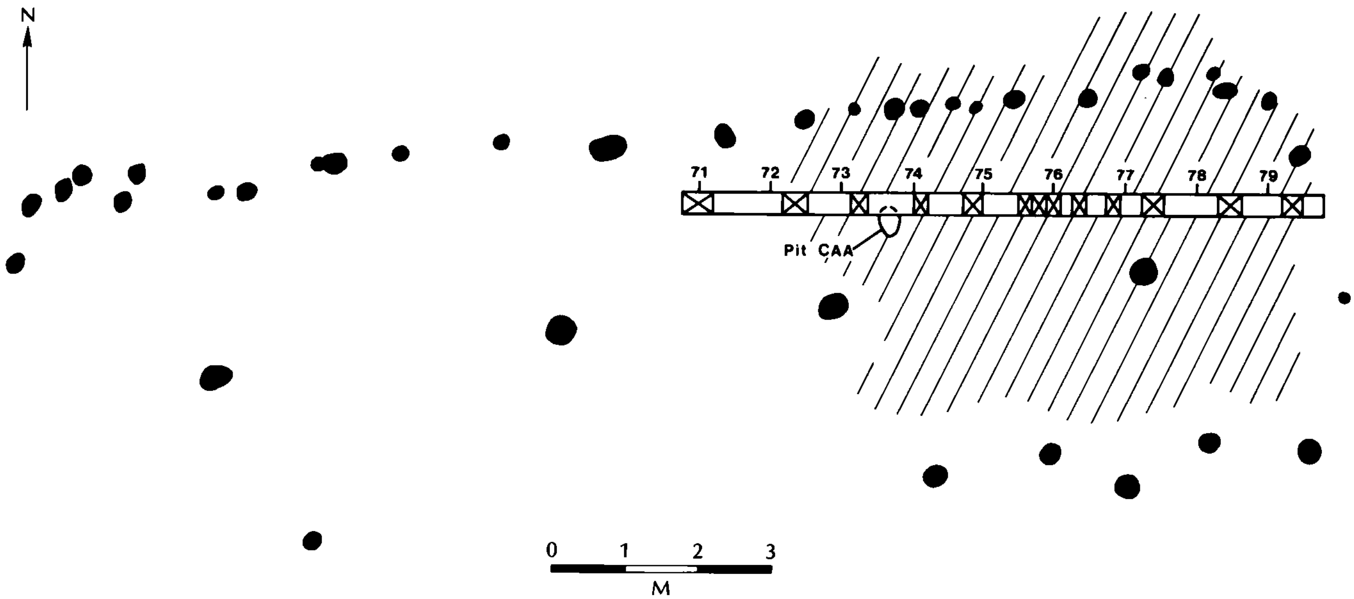


Fig. 1. Plan of Egehøj House III, showing the baulk from which the samples were taken. Crossed portions were sampled. Oblique shading indicates the deeper area in the east end of the longhouse. Some of the postholes in the north west part of the house may belong to house I, which overlaps house III at this point.

Egehøj emmer type grains seem to have been treated in the same way as the other cereals. One possibility is that the cereals were stored above ground level, perhaps up in the roof space, and so less exposed to damp. If this is correct, they would have arrived at ground level when the house was burnt down.

It must be stressed that samples of cleaned grain are the *end-product* of a long sequence of cleaning and processing activities (cf. Hillman 1981, Jones 1984), so that they offer little indication of the nature of the cultivation system that produced them. An absence of weeds in stored cereals cannot therefore be used to argue that they were absent in the field in which the crop was grown (cf. Madsen 1982 p. 225).

Spatial Analysis

Considerable variations in the representation of cereals occur along the length of the sunken section of house III. There is a major peak in the density of cereals per litre of deposit around the 72 and 73 m co-ordinates (fig. 4). This is not solely due to the heavy storage of one type of cereal in this portion of the longhouse – observed trends in crop proportions continue across this area without showing major distortions. It is thus most likely that the variations shown in fig. 4 are due to variable preservation.

Variations in the proportions of cereals are shown in fig. 5a and 5b. Barley is relatively common throughout, although less so to the west. Bread wheat and emmer type show clear trends: bread wheat is common in the west, and emmer type in the east. This separate storage shows that the three main cereal types were all grown as separate crops – the bread wheat was not just a weed of cultivation in another crop. Emmer type shows only a single peak. Had spelt been cultivated, processed and stored separately, there would have been two peaks unless emmer and spelt were stored next to one another. Storage close together cannot be ruled out, but in the absence of two distinct peaks it can be said that the presence of spelt as well as emmer receives no direct support. At the other end of its range of variation, spelt can resemble bread wheat. Once again, the single peak of bread wheat offers no support for the separate cultivation of spelt.

These variations must be born in mind before any conclusions are drawn regarding the relative importance of the three main crops. Bread wheat is the most common identified grain (see table 1). This is partly due to the fact that it happens to reach high relative values (fig. 5) where preservation was best and grains

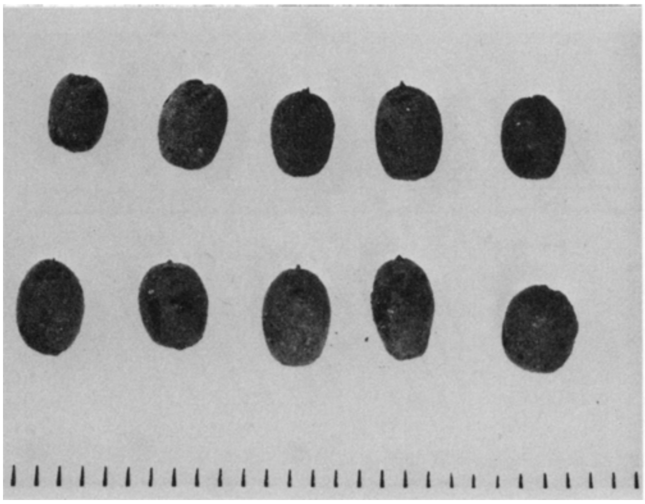


Fig. 2. Bread wheat (*Triticum aestivum* s.l.) from Egehøj house III. Scale in mm.

Fig. 3. Barley (*Hordeum vulgare*) from Egehøj house III. Scale in mm.

most numerous (fig. 4). If preservation had been best at the other end of the sunken part of the longhouse, more emmer grains and fewer bread wheat grains would have been found overall. Perhaps the best approximation of the proportions of the cereals *inside this part of house III at the time of its destruction* is an average of the percentages in the eight major samples plotted in fig. 5:

barley	25%
bread wheat	23%
emmer type	11%
unidentified wheat	6%
unidentified cereals	34%

The shallow pit *caa* contained cereals in roughly the proportions in the baulk above it. The grains presumably derive from the same event that produced all the other samples.

Comparison with Other Sites

Bread wheat is very rare throughout the prehistoric period in Denmark. Although the earliest publication of prehistoric plant materials from Denmark was of a single grain of club wheat from the Bronze Age site of Nagelsti on Lolland (Rostrup 1877), the analysis of Late Bronze Age cereal impressions in pottery by Sarauw later in the nineteenth century revealed only 4% bread wheat among a total of 246 impressions. It was correspondingly low in the other periods (quoted in Hatt 1937). Carbonised cereals are available from only a few Bronze Age settlements, but have shown a similar picture. Bread wheat was very rare at Lindebjerg, dating from Bronze Age I (Rowley-Conwy 1978); absent at Vadgård, dating from Bronze Age II, c. 1250 bc (Jørgensen 1979); and very rare at Voldtofte, dating from Bronze Age V, c. 800 – 600 bc (Rowley-Conwy 1984). Nor does it seem to have been more common in the neolithic. It was present as a trace in the earliest Neolithic at Store Valby (Helbæk 1954a), and at earlier Middle Neolithic Sarup (Jørgensen 1976, 1981; Rowley-Conwy in preparation). Finds from the later neolithic are less clear: Helbæk (1952) mentions the presence of bread wheat at Birknæs (c. 1700 – 1500 bc) without giving any indication of its frequency.

Later periods also offer little evidence of bread wheat. For example, pre-Roman Iron Age Gørding Hede had none (Helbæk 1951), nor did the Roman Iron Age sites of Østerbølle (Helbæk 1938) or Ginderup (Jessen 1933). Mention is made of bread wheat at the unpublished site of Alrum (Roman Iron Age), although there is no indication of its importance (Helbæk 1954b). The major unpublished find of Nørre Fjand (pre-Roman and Roman Iron Age) apparently contained none (Helbæk, quoted in Hatt 1957). Migration period Oxbøl contained none (Helbæk 1958), nor did Viking Age Aggersborg (Jessen 1954).

Jessen's conclusion was that "club and bread wheat ... are so far not known from the Viking period and are very rare in finds from the immediately preceding pe-

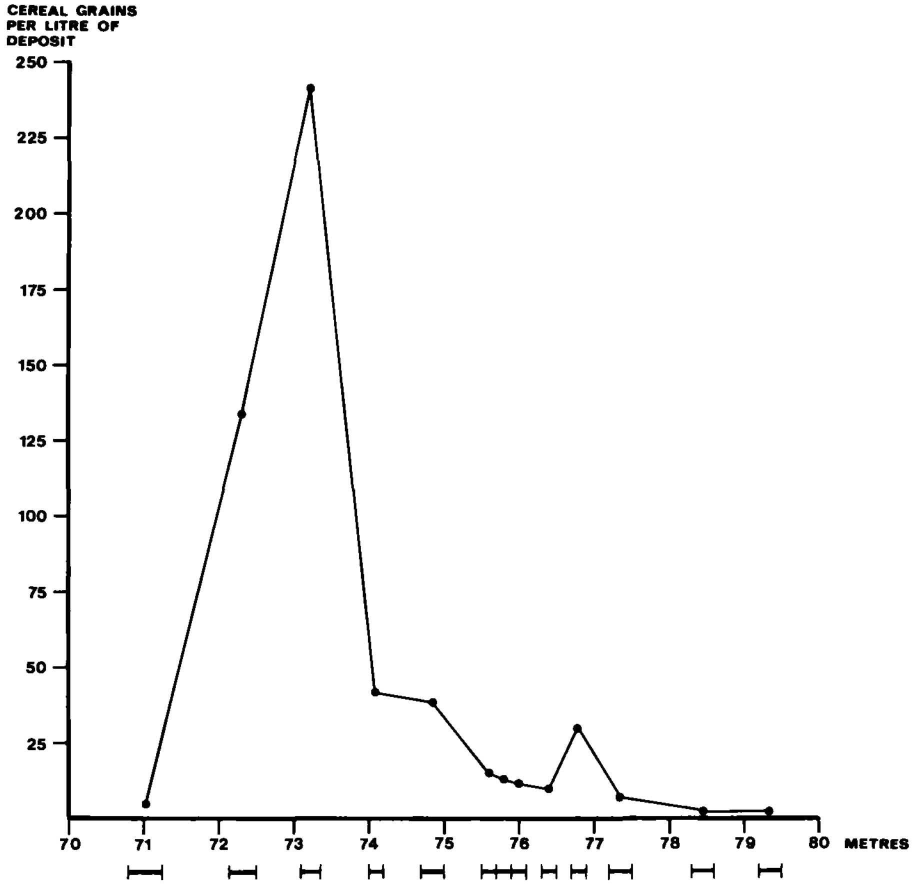


Fig. 4. Number of cereal grains per litre of deposit through the sunken section of the longhouse. The sampled portions are shown below the horizontal axis.

riod. In prehistoric Denmark these two cereal types were probably only chance weeds in seeds of other crops" (1954 p. 131, my translation).

Conclusion

Naked barley and emmer are the characteristic crops of the Danish Bronze Age, and their presence in house III at Egehøj is no surprise. What is remarkable is that bread wheat should occur, in circumstances clearly indicating that it was cultivated as a crop in its own right. Egehøj is unique within Denmark in this respect.

Interpretation of the find is thus something of a problem. Similar problems have arisen elsewhere. In the Netherlands, van Zeist (1968) found that 199 out of 289 seeds (69%) from the Neolithic site of Vlaardingen (2350 bc) were bread wheat. No other seeds of bread wheat are known from the Netherlands until the Roman period (van Zeist op. cit.). Similarly, in Greece a pure find of bread wheat is known from Pre-Pottery Neolithic Knossos (c. 6000 bc) (Evans 1968). No other pure finds are known thereafter until Late Bronze Age Assiros (late second millennium bc), from where a sample has been identified to either bread wheat or *Triticum durum* (Glynis Jones pers. comm.). Denmark is therefore not the only area to provide apparently anomalous finds of bread wheat.

There are two alternatives. Firstly, Egehøj may represent an isolated occurrence of bread wheat cultivation on a local and temporary basis. This was the view van Zeist put forward for Vlaardingen.

The second possibility is that bread wheat may have been more widely, if sporadically, cultivated than the single find from Egehøj would suggest. This may be more likely for Denmark (where a few seeds are known from several other prehistoric sites) than for the

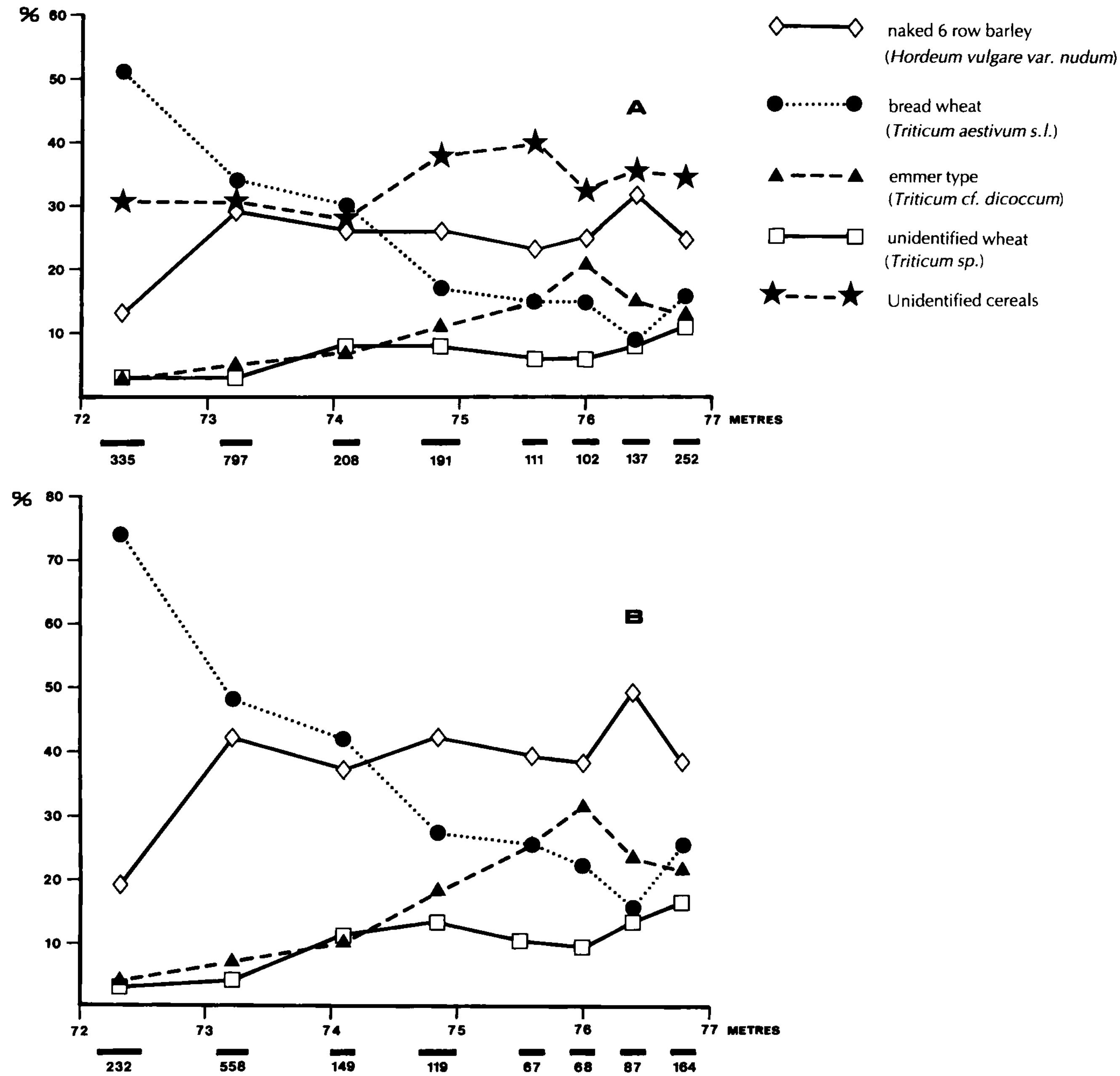


Fig. 5. Variations in the proportions of the various cereal types in the central part of the eastern end of the longhouse. A: unidentified grains included. B: only grains identified to species included. Samples and numbers of grains are shown below the horizontal axes.

Netherlands (where the cereal is completely absent before the Roman period, except for Vlaardingen). Many of the Danish samples from all periods derive from destroyed buildings, and thus represent only what was stored in the building *at time of its destruction*. If a species was cultivated sporadically and in not very great quantities, then it is quite possible that it might not have been in store in any of the buildings yielding the plant samples at the times of their destructions.

Denmark has a long history of phytoarchaeological research, but the number of published samples is by no means large enough to exclude this possibility. One can

Excavation co-ordinates	70.80–71.25	72.15–72.50	73.10–73.35	74.00–74.20	74.70–75.00	75.50–75.70	75.70–75.90	75.90–76.10	76.30–76.50	76.70–76.90	77.20–77.50	78.30–78.60	79.20–79.50	pit *caa*	total
Naked 6 row barley	4	43	232	55	50	26	11	26	43	62	13	–	3	36	604
(*Hordeum vulgare*)		*(13%)*	*(29%)*	*(26%)*	*(26%)*	*(23%)*		*(25%)*	*(32%)*	*(25%)*				*(29%)*	
Bread wheat	–	171	267	63	32	17	6	15	13	41	3	3	2	21	654
(*Triticum aestivum s.l.*)		*(51%)*	*(34%)*	*(30%)*	*(17%)*	*(15%)*		*(15%)*	*(9%)*	*(6%)*				*(17%)*	
Emmer type	1	9	37	15	21	17	4	21	20	34	5	2	2	18	206
(*Triticum cf dicoccum*)		*(3%)*	*(5%)*	*(7%)*	*(11%)*	*(15%)*		*(21%)*	*(15%)*	*(13%)*				*(14%)*	
Unidentified wheat	2	9	22	16	16	7	4	6	11	27	3	–	2	9	134
(*Triticum sp.*)		*(3%)*	*(3%)*	*(8%)*	*(8%)*	*(6%)*		*(6%)*	*(8%)*	*(11%)*				*(7%)*	
Unidentified cereals	5	103	239	59	72	44	14	34	50	88	11	12	–	41	772
(*Cerealia*)		*(31%)*	*(30%)*	*(28%)*	*(38%)*	*(40%)*		*(33%)*	*(36%)*	*(35%)*				*(33%)*	
Cereal grains, total	12	335	797	208	191	111	39	102	137	252	35	17	9	125	2370
Cereal grains per litre of deposit (approx)	5	134	241	42	38	15	13	12	10	30	7	2	2	50	
Bilderdykia convolvulus	–	1	–	1	–	1	–	–	–	–	–	1	1	–	5
Bromus sp.	–	–	–	–	–	1	–	–	–	1	–	–	–	1	3
Spergula arvensis	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1
Polygonum cf persicaria	–	–	–	–	–	–	–	–	–	2	–	–	–	–	2
Polygonaceae indet.	–	–	–	–	–	2	–	–	–	–	–	–	–	–	2
Weeds, total	–	1	–	1	1	4	–	–	–	3	–	1	1	1	13

Table 1. The seeds from Egehøj house III, divided by sample.

envisage a situation in which bread wheat might not have been cultivated by each settlement or household each year, and only in small quantities when it was cultivated. Furthermore, we have no right to assume that all stored cereals were necessarily consumed at the same rate. If bread wheat was a winter planted cereal, then the seed corn would not have been stored very long before being sown. If the cereal was a relatively rare luxury, it might be that it was consumed quickly after being harvested, and not stored for use throughout the year[1]. In such circumstances, there would only be short periods in which bread wheat would be a major component of carbonised remains if buildings were destroyed. Given the rarity of such "windows" through which to observe bread wheat, it is not particularly surprising that the species has remained virtually invisible. Egehøj in this view would represent a (for us) lucky destruction of a building in one of its brief bread wheat storage phases.

Whether this suggestion will be proved correct remains to be seen. To call on future work to answer present problems is perhaps to take the easy way out; but this discussion does highlight two major needs in Danish phytoarchaeological work. (1) Some of the classic finds remain unpublished. (2) We cannot go on relying

		mean and standard deviation	range
A. Bread wheat (*Triticum aestivum* s.1.) N = 50			
	length	3.7 ± 0.4	3.0–4.6
	breadth	2.7 ± 0.3	1.8–3.4
	thickness	2.3 ± 0.4	1.5–3.0
B. Barley (*Hordeum vulgare*) N = 50			
	length	4.4 ± 0.5	3.4–5.6
	breadth	3.0 ± 0.5	1.9–4.3
	thickness	2.3 ± 0.3	1.4–3.1
C. Emmer type (*Triticum cf. dicoccum*) N= 20			
	length	5.2 ± 0.4	4.5–6.2
	breadth	2.7 ± 0.3	2.1–3.2
	thickness	2.2 ± 0.3	1.4–2.8

Table 2. Dimensions of grains from Egehøj house III. Measurements in mm.

on chance finds of destroyed buildings. As excavation costs increase, excavation size will continue to decrease, so such finds will become less common. Much more must be made of normal excavations, in other words flotation must be employed much more widely on sites of all periods. This will have the advantage of bringing to light the residues from many stages of crop processing (cf. Hillman 1981, Jones 1984). These residues are less easily visible during normal excavation work. They are, however, often of crucial importance for the identification of the cereals, and also provide a much better idea of the day to day activities carried out on the site. This is of more than botanical interest – Hillman writes:

"... it is more common for the composition of samples of plant remains... to provide the basis for assigning past functions to the features, structures, or even whole sites from which the samples were recovered than it is for the excavator's identification of context-type to provide the basis for interpreting the samples of plant remains. This observation cannot be stressed too strongly." (1981 p. 125)

Plant remains as an expression of human activities are thus a great source of information for the archaeologist. Egehøj highlights the need for more work in this area.

Peter Rowley-Conwy, Department of Extra-Mural Studies, University of London, 26 Russell Square, London.

NOTES

Acknowledgements: I would like to thank Niels Axel Boas for suggesting that the sampling be carried out, and for arranging facilities at Randers Museum, and my wife Debbie for helping to operate the froth flotation unit. I would also like to thank Paul Halstead and Glynis Jones for discussions, advice and unpublished information. Any errors remain my own.

1. I am grateful to Paul Halstead for drawing my attention to this possibility.

REFERENCES

BOAS, N. A. 1983: Egehøj. A Settlement from the Early Bronze Age in East Jutland. *Journal of Danish Archaeology* 2, 90–101.

EVANS, J.D. 1968: Knossos Neolithic part 2: summary and conclusions. *Annual of the British School at Athens* 63, 267–276.

HATT, G. 1937: *Landbrug i Danmarks Oldtid.* Copenhagen: Udvalget for Folkeoplysningens Fremme.

– 1957: *Nørre Fjand. An early Iron Age Village Site in West Jutland.* Arkæologisk-kunsthistorisk skrifter, Det Kongelige Danske Videnskabernes Selskab, 2, no. 2.

HELBÆK, H. 1952: Spelt (*Triticum spelta*) in Bronze Age Denmark. *Acta Archaeologica* 23, 97–107.

– 1938: Planteavl. pp. 216–226 of: Jernalders bopladser i Himmerland, by G. HATT. *Aarbøger for Nordisk Oldkyndighed og Historie* 1938, 119–266.

– 1951: Ukrudtsfrø som næringsmiddel i førromersk jernalder. *Kuml* 1951, 65–74.

– 1954a: Store Valby. Kornavl i Danmarks første neolitiske fase. (English summary). *Aarbøger for Nordisk Oldkyndighed og Historie* 1954, 198–204.

– 1954b: Prehistoric food plants and weeds in Denmark. *Danmarks Geologiske Undersøgelse* II, 80, 250–261.

– 1958: The Oxbøl grain. *Acta Archaeologica* 29, 155–157.

HILLMAN, G. 1981: Reconstructing crop husbandry practices from charred remains of crops. In: *Farming Practice in British Prehistory*, ed. R. MERCER, 123–162. Edinburgh University Press.

JARMAN, H.N., LEGGE, A.J. and CHARLES, J.A. 1972: Retrieval of plant remains from archaeological sites by froth flotation. In: *Papers in Economic Prehistory*, ed. E.S. HIGGS, 39–48. Cambridge University Press.

JESSEN, K. 1933: Planterester fra den ældre Jernalder i Thy. *Botanisk Tidsskrift* 42, 257–288.

– 1954: Plantefund fra vikingetiden i Danmark. *Botanisk Tidsskrift* 50, 125–139.

JONES, G. 1984: Interpretation of archaeological plant remains: ethnographic models from Greece. In: *Plants and Ancient Man: Studies in Palaeoethnobotany*, eds. W. VAN ZEIST and W.A. CASPARIE, 43–61. Rotterdam.

JØRGENSEN, G. 1976: Et kornfund fra Sarup. Bidrag til belysning af tragtbægerkulturens agerbrug. (English summary). *Kuml* 1976, 47–64.

– 1979: A new contribution concerning the cultivation of spelt, *Triticum spelta* L., in prehistoric Denmark. *Archaeo-Physika* 8, 135–145.

– 1981: Korn fra Sarup. Med nogle bemærkninger om agerbruget i yngre stenalder i Danmark. (English summary). *Kuml* 1981, 221–231.

MADSEN, T. 1982: Settlement systems of early agricultural societies in East Jutland, Denmark: a regional study of change. *Journal of Anthropological Archaeology* 1, 197–236.

ROSTRUP, E. 1877: En notits om plantevæxten i Danmark i "Broncealderen". *Aarbøger for Nordisk Oldkyndighed og Historie* 1877, 78–82.

ROWLEY-CONWY, P. 1978: The carbonised grain from Lindebjerg. *Kuml* 1978, 159–171.

– 1984: A new sample of carbonised grain from Voldtofte. *Kuml* 1982–83, 139–152.

VAN ZEIST, W. 1968: Prehistoric and early food plants in the Netherlands. *Palaeohistoria* 14, 41–173.

Journal of Danish Archaeology vol. 3, 1984, pp. 111–119

Bog Bodies Investigated in the Light of Forensic Medicine

by S. RY ANDERSEN and PREBEN GEERTINGER

THE BORREMOSE FIND

A body found in the summer of 1948 during peat-cutting in Borremose, a fen near Aars in Himmerland, Denmark, was transported in a large purpose-made box together with its surrounding peaty soil to the National Museum in Copenhagen, Denmark, where a thorough examination of the contents of the box was carried out by the assistant curator, B. Brorson Christensen.[1]

The body was lying on its stomach, face downwards, in the bog, and was partly covered by a woollen skirt (Fig. 1) cf. E. Munksgaard, this volume). The occiput was "scalped", and the scalp was lying close to the left side of the head. However, this injury possibly occurred during peat-cutting. No sticks, stones or ornaments were found. After the body had been turned over on to its back, it was apparent that "the head is almost completely crushed; the lower part of the face, chin, cheeks, etc. are preserved, but pressed entirely out of shape. The soft parts of the head have either disappeared or have been "dislocated". There are consequently no contiguous or recognizable remains of nose, eyes or ears. The scalp with its hair has been torn off, and the greater part of it is lying above or in prolongation of the rest of the head. The hair, which appears to have been of medium length, is a tangled mass, in which it has not been possible during soil-removal and cleaning to find any trace of plaiting or any form of hairstyle. The bones of the cranium are crushed, and have no natural cohesion. They are mixed with scraps of yellowish cerebral substance within and above the soft parts of the lower face referred to above" (Fig. 2).

Brorson Christensen believed that it could be established that the head was shattered before the body was placed where it was found, since it was lying face downwards and the back of the head was relatively the least damaged part.

The neck was so poorly preserved that it could not be determined whether the body had been hanged or strangled. The left arm was lying in a gentle curve downwards around the left leg, which was drawn forcibly upwards. The right arm was bent, and the right hand partly covered the remains of the face.

The body was in a relatively poorer state of preservation than the limbs, which showed no signs of warding-off injuries. The breasts were, however, preserved, but quite small. The state of nourishment was considerably above the average, and she has subsequently been referred to as "the Borremose fat girl". The abdominal organs were too damaged for examination, but no fetal remains were found. The bones were generally rubbery.

Carbon-14 analysis of the heart and lung remnants dated the Borremose woman to about 770 B.C. (± 100 years), i.e. the body was about 2,700 years old and dated from the transitional period between the Late Danish Bronze Age and the Early Danish Iron Age. A similar analysis of the surrounding sphagnum (peat moss) showed that this was about 80 years more recent than the body, probably because of the growth of the peat or the flow of liquids. The National Museum placed the body in a zinc box in an aqueous phenol solution of about 1% containing glycerine; this was replaced after four months by a 2% aqueous solution of formaldehyde.

The finding of the body was described (1969) by P.V. Glob as the third Borremose find during post-war peat-cutting. In 1972, Professor P.V. Glob gave permission for three loose pieces of tissue to undergo histological examination at the Øjenpatologisk Institut (Institute of Eye Pathology, Copenhagen),[2] but the matter was put aside because of pressure of time.

In 1977, we decided in co-operation with Assistant Curator Elisabeth Munksgaard of the National Museum to attempt a proper autopsy of the Borremose woman at the Retsmedicinsk institut (Institute of Forensic Pathology, Copenhagen).[3]

We wished to see how far we could progress with all that modern technology has to offer. A number of departments at the Rigshospital in Copenhagen became

Fig. 1. The Borremose woman's body (Borremose III) as she lay in the bog, partly covered by a woollen skirt. Note the "scalp" close beside the left of the head (arrow).

Fig. 2. Woman's body, Borremose III, photographed during excavation. The body is turned so that the side that faced downwards in the bog is facing upwards in the picture.

involved, and the autopsy was carried out in the presence of museum staff, experts from the Criminal Investigation Police Department and a number of interested doctors and dentists.

X-ray photographs of the body's bones (Gregers Thomsen) found these to be almost completely decalcified. They had also shrunk considerably, measurements of the length of the bones resulting in a body height of 143 cm, which scarcely corresponds to reality. A subsidence of the bones around the right knee joint had probably occurred as a result of the peat's significant pressure on the body over the years (cf. Fig. 2).

The bones of the face were crushed and its soft parts split open. The cranium was reconstructed by the Technical Department of the Danish Police Force. Examination of the cranium's bones and sutures indicated that this was a woman aged between 20 and 35 (J. Balslev Jørgensen). The calvarium had apparently suffered no fracture while the woman was alive (Fig. 3).

Like the bones, the teeth were extensively decalcified, and most of them had fallen from their sockets, undoubtedly after death. Professor dr. odont. P.O. Pedersen of the Copenhagen Dental School and the dentist J. Keiser-Nielsen took part in the investigation. They decided that the teeth remains permitted no conclusion as concerns the woman's dental health.

The skin had been "tanned" brown, the hair was reddish-brown, and all the nails – like the epidermis – had flaked off. During detailed investigation of the peat, however, Brorson Christensen succeeded in finding six of the nails lying beside the body.

The hair of the head lay across the domed section of the cranium, and some of it lay along the neck. The hair was still fixed to the flaked-off upper skin layer (epidermis), but there was no trace of haemorrhage in the cranium. »Scalping« while the woman was alive must therefore be considered unlikely. There were no "warding-off injuries" on hands or forearms. Examination of the interior of the body was very disappointing, since almost all the organs were absent. In the case of the abdominal organs, this is undoubtedly due to putrefaction. The thoracic cavities had already been opened at some time during storage at the National Museum, and parts of the organs had probably been included in the carbon-14 analysis. It was, therefore, quite impossible to determine whether there had been an intake of blood into the air passages. No sign of advanced pregnancy could be detected.

About 65 tissue samples were removed from the remains of the internal organs and from the skin during the autopsy as specimens for the Institute of Eye Pathology.

The procedures employed were the same as in normal microscopy, but the transit of the tissue from a formalin solution to paraffin was very slow and gradual over a period of a month. After cutting, the paraffin sections were stretched on a water bath, but at 42° only and for a few seconds in order not to split the crumbling tissue. The sections were coated with albumen glycerine, as they showed a great tendency to fall off. Many different methods of stain were tested. It proved necessary to employ double staining-times throughout. Viggo Eskelund's combined Alcian blue-elastin-v. Gieson stain (Eskelund 1957) proved to be most suitable, particularly in distinguishing the body's structures from the sphagnum peat. Among other good stains we should mention Masson-trichrom connective-tissue stain, Unna-Pappenheim's methyl-green-pyronin stain and Heidenhain's iron-hematoxylin, azan variant, the latter two particularly in the staining of red blood cells. In total, some thousands of sections were examined.

Microscopy of the skin showed quite well-preserved connective-tissue structures, hair follicles and hair anlages. Sphagnum (peat moss) was often to be observed grown into the deeper layers of the skin. (Fig. 4). Between the connective-tissue fibrils, occasional pollen

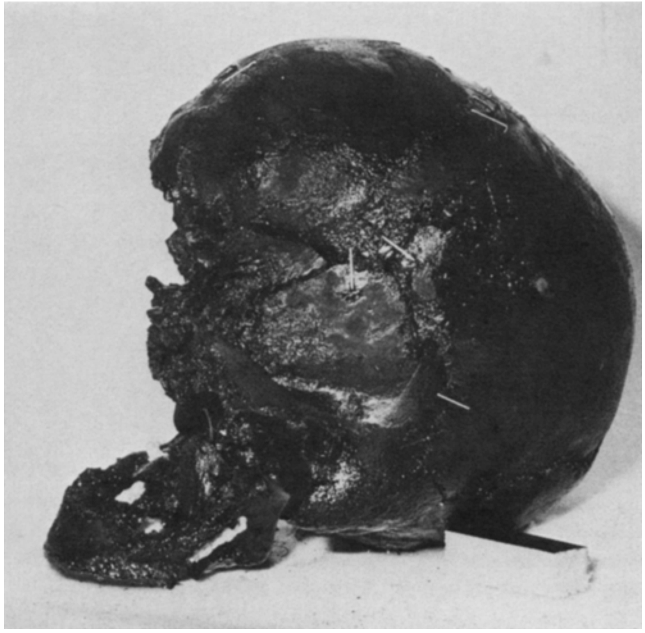


Fig. 3. The cranium after reconstruction.

grains of the "ling family, but not heather", possibly cowberry or cranberry, were to be seen (cf. Fig. 4 insert). Only autumn pollen was found in the body.

Between the connective-tissue fibrils, lines with marked "cross striations" were sometimes to be seen, which directly suggested striated musculature. Electron-microscopy showed, however, that this was probably connective tissue (collagenous fibrils), some of which had broken into small discs. The transverse bands characteristic of striated musculature were lacking. So-called "cross striations" are frequently found in mummies, but in our opinion electron-microscopy must determine the issue.

Tissue from the skin, musculature and remains of the viscera proved to be too poorly fixed to find blood vessels or blood.

Three small pieces of tissue found in 1972 in the bottom of the zinc box were in a better state of preservation. One of the loose pieces was decayed cerebral tissue with peat culm and other more amorphous bog remains grown into it. The second piece of tissue, a torn-off ear, contained well-preserved blood vessels with round bodies 1 micron in size (Fig. 5). The third loose piece of tissue proved to be a collapsed eye, partly covered by well-preserved eyelids with eye socket attached. Under microscopy, there could be recognized

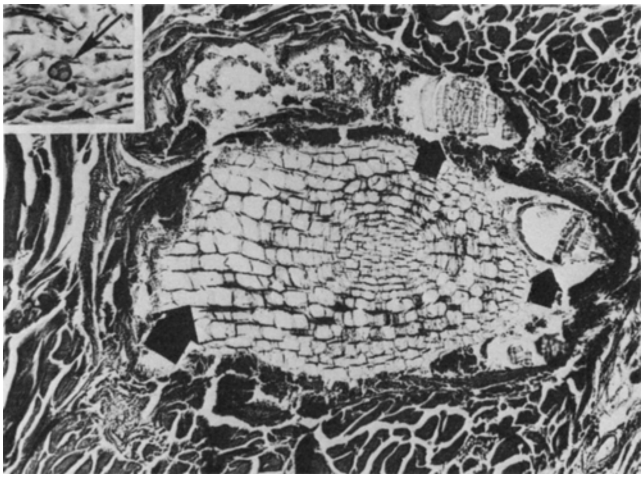


Fig. 4. Skin from the scalp, with sphagnum (peat moss) (large arrow) grown into it and hair follicles (small arrows). Eskelund's Alcian blue-elastin-van Gieson stain. Enlargement × 110. Insert: Pollen grains of the "ling family, but not heather". Same stain and enlargement (arrow).

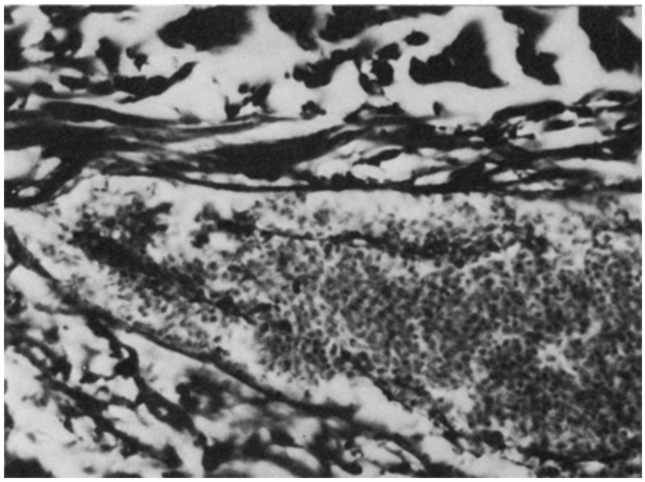


Fig. 5. Section of blood vessel from the detached ear with round bodies of 1 micron size, each with a central dark spot surrounded by a lighter zone, possibly the remnants of burst red blood cells. Unna-Pappenheim's methyl-green-pyronin Stain. Enlargement × 1,100.

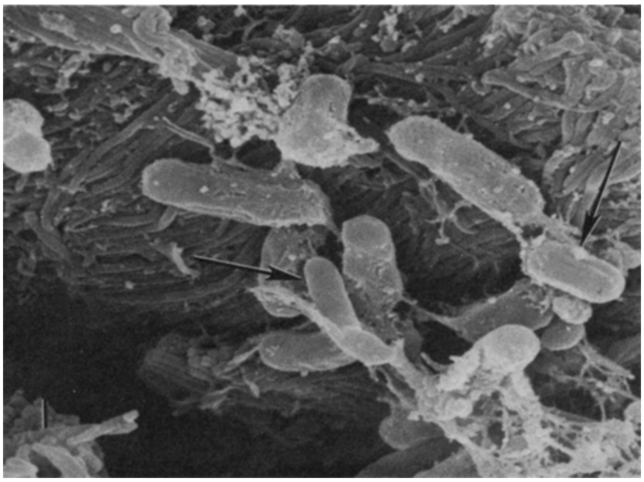


Fig. 6. Scanning electron-microscopy of the inside of the eye's sclera with regular granules 3–4 microns in length, probably melanin granules from the retina (arrows). Enlargement × 6,000.

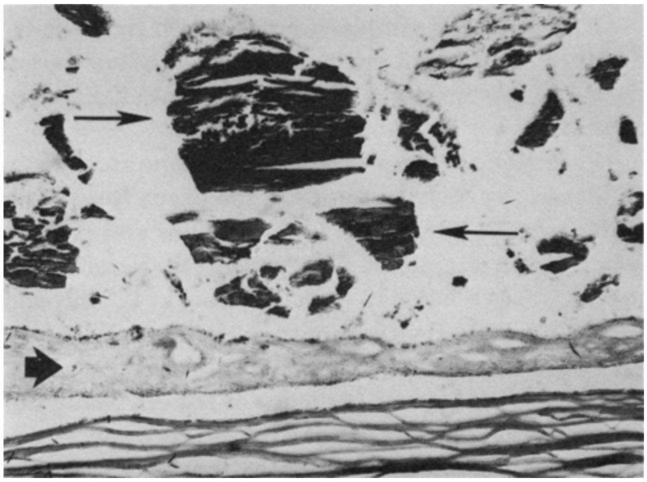


Fig. 7. Inside of the eye. Below, sclera; in middle, choroid (large arrow); at top, thread-like structures, probably splinters of wood (small arrows). Eskelund's Alcian blue-elastin-van Gieson stain. Enlargement × 45.

between the sclera's upper and bottom layers a choroid (membrane) coated with melanin granules of the same size and type as the retina's, which was confirmed by electron-microscopy (Fig. 6). In addition, some distinctive, dispersed, thread-like structures surrounded by remains of bog water were to be observed. We consider that an origin from the body itself or from the skirt can be excluded, and we therefore believe that they are foreign bodies. They are not textile remains; more likely splinters of wood. (Fig. 7).

Between what were assumed to be foreign bodies and the sclera there was an unusually well-preserved choroid with blood vessels. Some of the vessels contained bodies of the same size and appearance as in the vessels of the ear.

Great forensic interest lay in establishing whether there were signs that violence had occurred during life, and in particular whether the condition of the face had been caused by, for example, one or more bludgeon blows to the face while the woman was still alive. The determination of this question must rest upon the so-called vital reaction, for example whether the tissue remains of the face show under microscopic examination traces of the leaking of blood from burst blood vessels in the tissue. Heidenhain's iron hematoxylin stain and Unna-Pappenheim's stain give the round bodies of about 1 micron in the choroid of the eye and in the blood vessels of the ear a blue-violet tint, which is different from the other small particles in the area. Corresponding granules could not be recovered outside the blood vessels. Transmission electron microscopic tests on the ear were unable to demonstrate blood vessels, and no more tissue from the eye was to be found.

However, it was possible to carry out scanning electron-microscopy on paraffin sections already prepared from the choroid. The choroid's blood vessels were clearly to be seen, with bars extending into the vessels' lumen. This may be a part of the blood vessels' wall, but may also be sphagnum remains that have grown into it. Some round bodies of uniform size – about 1 micron – with a slightly humpy surface were also to be seen. They were 7–8 times smaller than a normal red blood cell, but it certainly deserves to be considered whether they might be the shrunken remains of burst red blood cells.

The forensic serologist, Klavs Henningsen, tried suspending human blood cells in water at 4° for a week, when they burst, but the remains of the blood cells did not change in size. Direct comparison with the circumstances of the Borremose body is for obvious reasons impossible. Staining for hemoglobin and endogenous peroxidase in the choroid has been negative; neither has it been possible to determine the blood group in bone marrow from the sternum, but this may be because all the tissue was formalin-fixed.

To summarize, we consider it very probable that the small round bodies in the blood vessels of the eye and ear are remains of burst red blood cells, and that no haemorrhage has occurred from the vessels into these tissues. This also indicates that the severe cranial injury occurred after death.

Fig. 8. Cranium of a bog body from Vester Thorsted.

THE VESTER THORSTED FIND

On 4 June 1913, the body of a man dressed in only a leather coat was found during peat-cutting at Vester Thorsted, Denmark. The body was lying a good two feet below the present surface of the bog, and quite close to the natural sandy bottom. A large branch was lying across the body, and the local police authority – represented by the district judge at Kolding – had to consider the possibility that the person concerned had been killed and buried in the bog. The judge therefore arranged for the body to be sent to the Institute of Forensic Pathology in Copenhagen for autopsy and for answers to a number of specific questions, including the cause and manner of death.

The judge, however, appears to have suspected that this was an old body, and at the same time he asked the National Museum (through the curator, J. Olrik) to take a part in the matter. In addition to the statement made by the forensic pathologist, statements were also provided by the National Museum in regard to the deceased's clothing and the date on which it must be assumed that the deceased was placed in the bog.

Forensic examination of the body was carried out by Vilhelm Ellermann, an Assistant (later Professor) at the Copenhagen University's Institute of Forensic Pathology. The investigation resulted in a very short statement to the judge, which read as follows: "It is impossible to determine whether the man found died a natural death; but there is nothing to indicate with certainty that he has been subjected to violence. In this connection, it is pointed out that it appears unnecessary to regard the holes in the clothing referred to in the judge's letter as tears or to assume that they were caused by a sharp weapon. As concerns age, it can only be stated that he was fully grown."

In his covering letter, the judge had also asked: "1) How long has the body been lying in the bog," and, "2) Are there specific marks of any kind on the body which may be taken as an indication of his nationality or identity?" Ellermann was wise enough to refrain from answering these two questions, but in the Institute's internal records he states that "the strange manner of the body's preservation was unknown to the Institute, and no description of similar finds is to be found in the reference books". However, the National Museum's statement on the matter contained no reservations. An examination of the leather jacket, which was probably of oxhide, compared it with other related bog bodies found in Jutland, the remains of which were preserved in the museum, and there was no doubt that the find in the Vester Thorsted bog belonged to the same group. The jacket in which the body had been wrapped was made from many pieces of hide and was sewn together with leather thongs. It was said to be typical of most of these finds, and those that included parts of bodies had gone through a process similar to that of the Vester Thorsted body, i.e. crumbling bones, compressed cranium, etc. (Fig. 8). The National Museum said in its statement that the very simple clothing which characterized these bog bodies indicated that the people concerned "were not members of respectable society". The statement ended by saying that they must be gypsies, and that the body was attributed to the zenith of the gypsy period in the 16th and 17th centuries. The statement considered whether it might be a certain labourer who disappeared in 1860, but this was believed to be less likely since at that time a labourer would scarcely have gone about in such a patched and primitive jacket of animal hide.

When the forensic pathologist Vilhelm Ellermann had submitted his statement to the judge, expressing the opinion that the finding of the body scarcely deserved the attention of the judiciary, he began to speculate more deeply about the strange body changes, which he obviously encountered here for the first time. He was of course familiar with a number of the processes that can take place in a body: putrefaction, autolysis, mummification, formation of adipocere, etc., and he divided these into two groups: the destructive and the preservative. It was clear to Ellermann that the strange changes that characterized the Vester Thorsted body must be attributed to the preservative group.

To discover the processes that might have been concerned, Ellermann now carried out a series of tests, since it was evident to him that behind this strange process of preservation there must be some special circumstances associated with bog peat. To this end, he collected peaty soil from a bog at Lyngbyvejen near to the Institute of Forensic Pathology and added distilled water to it. In this peat mush he placed human skin, which he then observed over a number of months. The first peat mush used by Ellermann gave a neutral reaction to litmus paper. To his disappointment, no changes similar to those in the bog body appeared in this skin, even after many months. On the contrary, the skin was transformed into a chalk-white mass – typical adipocere.

In his next test, however, Ellermann employed a different kind of peat, since he now undoubtedly realized that peat can be of many different kinds. For this test, he used peat litter purchased from a supplier in southern Sweden. The mush made from this gave a strong acid reaction to litmus paper, and after two years and four months human skin was now dark brown and tanned and bones heavily decalcified. Following this successful test, Ellermann, in co-operation with specialists on bogs, extended his knowledge of bogs and peat. He concluded in an article (1916) that: ... "Bog-tanning is formed by deposition in an acid-reacting raised bog. It is most natural to assume – an assumption supported by the tests performed – that sphagnum acid is the most important element in the process. The acid causes tanning of the skin so that it becomes exceptionally durable and decalcification of the bones, as well as tanning of their organic components. The tests indicate that bog-tanning can occur only in typical raised bogs, whereas bodies will decompose in the normal manner or saponify (i.e. become adipocere: author's Note 4)) in neutral-reacting forms of bog."

Ellermann's tests and reasoning demonstrate clearly that formation of adipocere and bog tanning are processes with the common feature that they are both of a preservative nature. On the other hand, widely differing processes are concerned here. Adipocere formation occurs typically in running water containing oxygen and lime, while bog tanning occurs exclusively in a strongly acid environment, poor in lime and oxygen.

It was of course not by chance that Ellermann added water to his peat material. It must have been clear to him that chemical processes of the kind here concerned can occur only in an aqueous environment. As concerns the circumstances under which bodies were placed in bogs, however, it is possible to draw conclusions far more wide-ranging than Ellermann can have felt prompted towards at the time. In 1913, it was apparently believed that bodies such as that here concerned could not be more than about 300 years old. We know today that these bodies – including the Vester Thorsted body* – are often as much as two or three thousand years old. The circumstances of their origin have therefore become of far greater interest.

DISCUSSION

The raised-bog bodies undoubtedly present common features, and historians and prehistorians have explained them in various ways. In particular, when discussing their state of preservation, they have understandably tried to give life to their opinions by describing the situation surrounding the actual deposition of the dead or dying person in the bog.

However, the various theories appear not to take into consideration – or at least to do so to only an insignificant extent – the laws and disciplines of nature with which the process of burial must necessarily accord if the theory concerned is to be considered probable. A historian may assert, for example relative to the Borremose woman, that the body is that of an unfaithful woman who was surprised by her husband, and that for this reason she was driven into the bog – attentively followed by the village population – beaten with sticks and scalped before finally being laid in a hole in the bog soil: "Out there in the bog, the walkers slowly formed a circle around the two, and while the men began to dig her grave in the black peat the man came forward and once again recounted what he knew...". After the last crushing blow to the face she no longer moved and was thrown into the grave, which was then filled in (Lauring, 1972, p. 178).

It is beyond the scope of this paper to express an opinion on the probability of such a background to the assumed acts of violence. However, on the basis of the physio-chemical and biological phenomena referred to above, it can be demonstrated that "burial" in the bog cannot have taken place as described.

In the first place, the deceased cannot have been placed in a dry hole in the bog. The chemical effect on the body surface, which is a precondition for preservative "tanning", can only take place in an *aqueous* environment, and, so that it can compete with putrefaction which is a far more rapid process, it must begin immediately after death. Another reason is that in a dry hole the abundance of carrion-eating organisms which live in the earth crust would immediately attack the body and consume important parts of it within a very short time. What is particularly significant from the aspect of forensic medicine is the condition of the nails. If the deceased had been laid in a dry hole, the nails would have remained in place on the hands and feet of the deceased, and not, as in the case of the Borremose woman, be spread around in the peat. In a body in water, the upper layer of skin flakes off, together with the nails. In a dry body (mummified), the nails remain in position, firmly fixed by the parchment-like skin.

The well-preserved skin on the Borremose woman's extremities shows that she was not exposed to post-mortem injury in the form of bites by animals, large or small. Depending upon the season, a number of insects and other animals from fly maggots and ants to rodents and foxes will very quickly leave their traces on a body, and bodies in water containing only a moderate amount of oxygen will be attacked by a large number of carrion eaters, such as crayfish. As we have said, the Borremose woman's skin showed not the slightest trace of attacks of this nature, and only under absolute anaerobic conditions can attacks by carrion-eating organisms in water be excluded. These conditions are present in the acid environment found in the mud at the bottom of a pond or bog hole.

The question of the temperature at the time the Borremose woman was placed in the bog is certainly

* Carbon-14 analysis performed in 1984 dated the thigh-bone from the Vester Thorsted body to about 95 B.C. and his skin to about 145 B.C., both calibrated a. m. Clark (± 70 years).

interesting. It will be seen from many aspects of the above that putrefaction is the (competing) change which is the most crucial factor determining whether bog tanning or the formation of adipocere can in any way occur.

The formation of adipocere is caused by the decomposition of fatty substances in the subcutaneous tissue, forming fatty acids, which in turn, under the effect of lime and magnesium in the surrounding water, are saponified to form a chalk-white mass replacing the subcutaneous tissue. This process can be observed most markedly in bodies that have been lying in cold water for a long period. It is generally true of chemical processes that the higher the temperature the more rapidly they occur. The formation of adipocere should therefore in principle be far more frequent in bodies which have been lying in warm water. That this is not the case is because bodies which have been lying in a warm environment putrefy so quickly that the formation of adipocere cannot arise. Conversely, the putrefaction process comes to a stop at temperatures below 4°C (refrigerator temperature), and bog tanning will therefore occur only in bodies lying in cold water.

The temperature in bogs is low (cf. "ground mist"), but we have no information of the actual temperature at that time and at the different seasons at the bottom of water holes in Danish raised bogs. It is probable however that only bodies placed in the bog during winter had any possibility of passing through the strange preservative process which bog tanning represents. Other bodies may have been put into the same bogs during the summer and almost totally destroyed.

CONCLUSION

Our intention has been to consider whether we can with any reasonable degree of certainty, and from the medical and forensic aspect, assist in clarifying the circumstances surrounding the death of the Borremose woman about 2,700 years ago.

It will be seen from the above that we have found reason to support Ellermann and his investigations into another bog body dating from antiquity, and on this basis we venture to outline a conclusion in the case of the Borremose woman.

It is clear from Brorson Christensen's report that the Borremose woman showed signs of putrefaction in those parts of the abdominal wall where "the intestines are located very near to the surface". It is precisely in these areas that putrefaction can first be recognized, since the putrefactive bacteria living in the human colon begin to develop rapidly as soon as death occurs. The Borremose woman may therefore be seen as an example of the process of putrefaction being delayed sufficiently for tanning to prevail, and this "delay" was undoubtedly because of the temperature. Since the climate at the time was not significantly colder than at present, the Borremose woman must have died in winter.

It was of great interest from the viewpoint of forensic medicine to seek to establish whether there were signs that violence occurred while the woman was still alive, and in particular whether the condition of the face might be due to bludgeon blows while alive, (cf. the possible intraocular splinters of wood, Fig. 7.). Determination of this question must depend upon the vital reaction already referred to. No haemorrhage in the soft parts of the face could for instance be demonstrated. Had they occurred during life, facial injuries of the kind here concerned would undoubtedly have caused severe haemorrhage from the face downwards into the air passages. Blood quantities of such a magnitude could probably have been demonstrated with the aid of modern technology, but since the air passages were absent this could not be investigated.

Our investigations indicate that, although her face was smashed, probably by one or more heavy blows, nothing has emerged to suggest that this occured during life. As concerns the cause of death (hanging, drowning, etc.), we cannot express an opinion.

As is typical of bodies in water, the upper layer of skin (epidermis), the hair and the nails had been shed. These finds give good reason for assuming that this must be an example of a body in water. The body's exceptionally good state of preservation as a result of a long-term "tanning process" indicates that the water in which she was submerged (or sank) was cold, since otherwise the putrefaction process would undoubtedly have prevailed.

The unusually well-preserved skin, in particular on the arms and hands, leads to the conclusion that the woman can scarcely have been exposed to brute force, such as "blows with a stick". A very typical reaction to such violence is for the person concerned to raise his/her arms to protect the head, and typical marks are then to be found on the back of the hands and forearms. These so-called warding-off injuries could undoubtedly have been established had they existed.

Systematic X-ray investigation of the entire skeleton revealed no fractures which it was certain had occurred during life, and the extensive cranial injury must be assumed to have occurred after death.

The cause of death has not been determined by the investigations. From the viewpoint of forensic medicine, and having regard to the very limited potential for investigation, no certain evidence has emerged to decide the manner of death (murder, suicide, accident, or natural death). Neither can it be established whether death occurred before the woman was deposited in the water (the bog).

Translated by F.C.J. Crowley

S. Ry Andersen, Øjenpatologisk institut, Frederik V's vej 11, DK-2100 Copenhagen Ø.
Preben Geertinger, Retsmedicinsk institut, Frederik V's vej 11, DK-2100 Copenhagen Ø.

NOTES

1. B. Brorson Christensen's 1948 investigation of the Borremose woman's body and the other contents of the box are to be found in his report to the laboratory of the National Museum dated February 1949 (File No. 447/48), Borremose III.
2. The histological and electron-microscopic investigations of the Borremose body were carried out at the Institute of Eye Pathology. The three loose pieces of tissue (eye with eyelid, ear and cerebral tissue) have been given the File No. 728/72, and the other histological tissue samples from the body File No. 1200/77. The electron-microscopic studies (SEM No. 473 b) were carried out by O.A. Jensen and J.U. Prause.
3. The autopsy of the Borremose body was carried out at the Institute for Forensic Pathology.
4. As to adipocere, putrefaction, mummification, etc., see e.g. Polson 1965.

REFERENCES

Ellermann V. 1916: En ejendommelig Forandring af Lig ved Henliggen i Tørvemoser (»Mosegarvning«) (*A striking change in bodies deposited in peat bogs*). *Ugeskrift for Læger*, 78, 1969–78 (in Danish).

– 1917: Eine eigentümlische Veränderung von Leichen in Torfmooren (»Moorgerbung«). *Vierteljahrschrift f. ger. Med. u. öff. San.-Wesen*, 54 pp. 181–192.

Eskelund V. 1957: Mucin staining with Alcian blue. *Acta path. et Microbiol. Scand.*, 40, pp. 104–09.

Glob, P.V. 1969: *The Bog People. Iron Age Man Preserved.* London, Faber and Faber, pp. 93–95.

Lauring, Palle 1972: *De byggede riget. Dansk Oldtids historie* (They built the Kingdom. Danish ancient history). Copenhagen, Gyldendal, p. 178. (in Danish)

Polson, C.J. 1965: *The essentials of forensic medicine.* Oxford, Pergamon Press, pp. 18–23.

Journal of Danish Archaeology vol. 3, 1984, pp. 120–123

Bog Bodies –

a brief Survey of Interpretations

by ELISABETH MUNKSGAARD

"Bog bodies" is a term for human bodies found in acidic raised bogs which have a conserving effect on materials containing keratin (skin, hair, nails, wool, and leather), but which decalcinate bones. The find group is therefore unified only by a common means of preservation, and the term implies nothing about date, nor about how the people ended up in the bogs. It can also be shown that bog bodies occur everywhere where this particular preservative context exists, and from all periods from the later Stone Age to most recent times (Dieck 1965 p. 34f.; Allan Lund 1976; see also Andersen and Geertinger, this volume).

The woman's body, Borremose III, was found in 1948 during peat-digging in Borremose in Himmerland, where already two bog bodies had been found through post-war peat-digging (K. Thorvildsen 1947 p. 57ff.; E. Thorvildsen 1952 p. 32ff.). The dead woman lay face-down in the bog, laid in her woollen skirt, which lay doubled over on the short side with the fringes facing downwards, and was pulled right up under her arms. The skirt enveloped the body rather like a loose cover on a book (Andersen and Geertinger fig. 1). The woollen skirt was a woven twill, measuring about 180 × 120 cm. All four weaving-borders are preserved, i.e. the starting- and finishing-borders, and both selvedges. The skirt has fringes 2 cm. long on either short edge (Munksgaard 1974 p. 140). The skirt has an oblique fold at about the middle of the short edge, and two groups of small holes are found on either side of this. Remains of a leather strip which had been used as a lace or girdle lay in the fold, bound through the holes. When the skirt is folded so that the two groups of holes meet, the waist measures about 70–75 cm. (fig. 1).

The Borremose woman is C 14-dated to about 770 B.C., and the bog bodies or their accessories, e.g. animal skin capes, that are C 14-dated run over a period from the 9th. to the end of the 1st. centuries B.C. (Tauber 1979 p. 73ff.). However, very few bog bodies are C 14-dated, and there are many exceptions (cf. the introductory words about bog bodies as a find group).

Although bog bodies appear from all periods, they have nevertheless many common characteristics (we

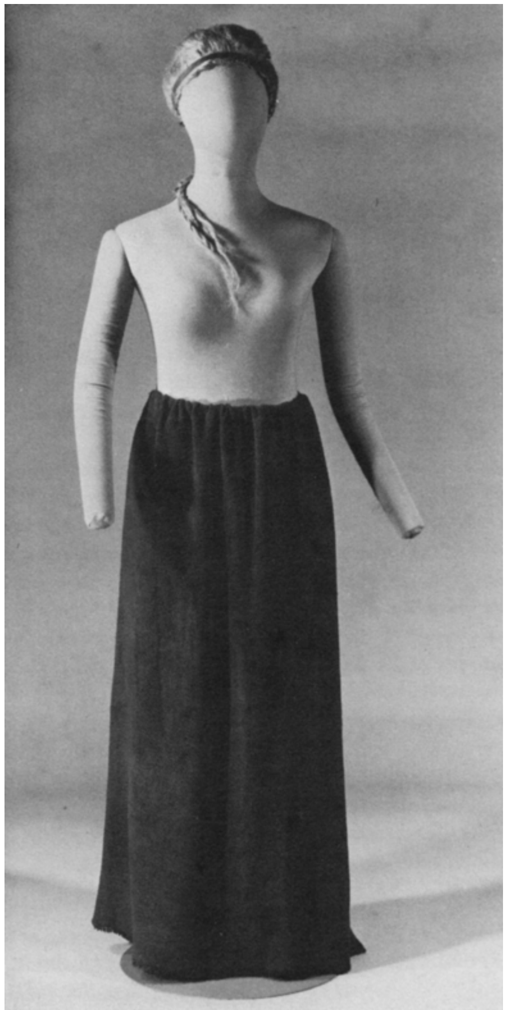


Fig. 1. The woolen skirt from Borremose III placed on a manikin in the National Museum's exhibition of costumes and textiles of the early Iron Age.

must naturally exclude here those cases which are certainly the results of accidents). The deceased are virtually never clothed, although a costume may be laid beside them. The deceased are found enveloped, like the Borremose woman, in a skirt, a cloak, or an animal-skin cape. Sometimes the women have had their hair cut off, and the men are usually short-haired and always beardless. Exceptions to this general unclothed state are the two medieval bog bodies from Skjoldehamn in northern Norway (G. Gjessing 1938 p. 28ff.) and Bocksten in Halland (Sandklef 1937 p. 1ff.). The Skjoldehamn man was clothed, but lay on a reindeer skin, and was rolled up in a blanket. The bodies often show signs of external violence, such as hanging, decapitation, or throat-cutting, and staking-down is often observed. This might have a practical significance in preventing the body from floating up to the surface, if, for example, it was thrown down into a water-filled peat cutting, but it could also be a ritualistic procedure to prevent the dead from walking again. In other cases the deceased appear to be partially covered with sticks or logs. Decapitated heads also are found, as, for example, from Roum in Djursland and Stidsholt in Vendsyssel. The Roum head was at first thought to be female because of its graceful features, but traces of beard stubble indicate that it is male. The Stidsholt head by contrast is female (fig. 2), with the hair tied up, as is also seen on three other bog bodies: Store Arden in Himmerland, Huldremose in Djursland, and Haraldskær near Vejle (Munksgaard 1976 p. 5ff.).

Not all bog bodies are well-preserved or particularly nice to look at. The much damaged bog body from Borremose known as Borremose II was found in 1947. It was first thought to be male and published as such (E. Thorvildsen 1952 p. 32ff.), although the items of costume seem to indicate that this is a woman. After various considerations this body has also subsequently changed sex. The costume consists of a skirt of four-shaft twill, corresponding closely to Borremose III in size and fashion, and a long, fringed shawl – typical early Iron Age woman's costume (fig. 3). This is known from the above-mentioned bog bodies from Store Arden and Huldremose (Munksgaard 1974 p. 136ff.). The body is C 14-dated to 475 B.C. But the skirt has also been used as a man's cape, as can be seen from the pin-holes by the edge and signs of wear in the middle[1] (fig. 4).

Research into the interpretation of the bog bodies

Fig. 2. The decapitated head from Stidsholt in Vendsyssel, found in the last century. The head has shrunk significantly because of internal drying.

can be divided into two camps, one which prefers the sacrifice-theory (Glob 1965; E. Thorvildsen 1952), and another which prefers the punishment-theory (Dieck 1965 p. 34f; Allan Lund 1976; see also Andersen and Geertinger, this volume). Tacitus' *Germania*, of the 1st. century A.D.,[2] is used to support an interpretation of the bog bodies as sacrifices to Odin, as Tacitus writes in chapter 9,1:

> 'Above all other gods they worship Mercury, and count it no sin, on certain feast-days, to include human victims in the sacrifices offered to him.'

In Chapter 39,2, Tacitus writes of the Semnones, a Germanic folk group who lived between the Elbe and the Oder:

> 'At a set time, deputations from all the tribes of the same stock gather in a grove hallowed by the auguries of their ancestors and by immemorial awe. The sacrifice of a human victim in the name of all marks the grisly opening of their savage ritual.'

In a third place, Chapter 40,5, Tacitus refers to the Germanic groups who worship the goddess Nerthus (Mother Earth). She drives around amongst her adherents in a wagon drawn by oxen, hidden under a cloth. On her return to the sacred grove, which lies on an island in the Ocean:

Fig. 3. The fringed shawl from Borremose II placed on a manikin in the National Museum's case of costumes of the early Iron Age. The stretched edges with the pin-holes meet on the breast, and the fringes show wear by the wrists.

> '... the chariot, the vestments, and (believe it if you will) the goddess herself, are cleansed in a secluded lake. This service is performed by slaves who are immediately afterwards drowned in the lake.'

But a lake is a rather different thing from a raised bog (see Andersen and Geertinger, this volume).

A late source, Thietmar of Merseburg, in the 11th. century, also mentions human sacrifices to Odin, in his description of the sacrificial grove at Lejre, but none of these sources state that the sacrificed ended up in a bog. All that is said is that "human sacrifices" were "slain", while Thietmar also refers to hanging in a sacred grove.

The human sacrifices which are known from the early Iron Age are essentially different from the bog bodies in that they are always found accompanied by domestic animals, pottery, or sometimes parts of wagons. Such sacrificial bogs are sunken bogs, which were very likely open lakes when the religious activites took place (J. & K. Ferdinand 1961 p. 47ff. and Kunwald 1970 p. 42ff.; Struwe 1967 p. 57ff.). The fact that one really never finds children as bog bodies also argues against the sacrifice-theory. Only a few examples are known from Germany, and these are undoubtedly cases of accidents. But in the sacrificial bogs, children's bones are often found amongst the skeletal remains.

It may be said that the sacrifice-theory relies too heavily and exclusively on finds dated to the early Iron Age. It must also be emphasized, as already stated, that bog-corpses are found far outside the territories in free Germania which were described by Tacitus.

Thus, as the find-relationships and sources present themselves, the punishment-theory seems to be that which best, or alone, is able to cover the finds of bog bodies from various periods.

A special punishment, described by Tacitus in Chapter 12,1, is often quoted in connection with the bog bodies:

> 'Treaitor and deserters are hanged on trees; cowards, shirkers, and sodomites (*corpore infamis*) are pressed down under a wicker hurdle into the slimy mud of a bog.'

Corpore infamis means "disreputable in body", and may well be construed as homosexuality and/or female prostitution. It must be mentioned in this connection that the corpse Borremose II was found together with bones of a new-born baby (E. Thorvildsen 1952 p. 32ff.). But it cannot be the case that *corpore infamis* refers to wifely infidelity. Adultery is in all Germanic-language law a matter of civil law. Tacitus writes of this in Chapter 19,2:

> 'A guilty wife is summarily punished by her husband. He cuts off her hair, strips her naked, and in the presence of kinsmen turns her out of his house and flogs her all through the village.'

The punishment-theory covers both sexes. The women executed need not all be *corpore infamis*; they could equally well have been executed for offences which have nothing to do with decency and honour. It also supports the punishment-theory that the bodies are often short-haired and naked, and that cropping and stripping were marks of disgrace, not for unfaithful wives alone. Criminals were hauled to and from the place of exe-

Fig. 4. The big piece of cloth from Borremose II set up as a man's cape. The wear-marks fall on the right shoulder and by the left arm.

cution on a cow-hide, because cultivated land must not be defiled by them. The medieval corpse from Skjoldehamn lay on a reindeer skin and was enveloped in a blanket (G. Gjessing 1938 p. 28), a feature in common with many corpses from prehistoric times. The tumbril later substituted the cow-hide. That the bodies are found in raised bogs might be explained through these being agriculturally useless, and that by depositing the delinquents in a bog one did not defile the valuable arable land.

It may seem marvellous that the same punishment was meted out from the early Iron Age to the late Middle Ages. But society was static, and great changes did not happen. Many legal provisions proceed from the district-laws to the Jutish Law, and thence on to Christian V's Danish Law of 1683.

Translated by John Hines

Elisabeth Munksgaard, The National Museum, Prehistoric Dept., Frederiksholms Kanal 12, DK-1220 Copenhagen.

NOTES

1. Unpublished report from Karen-Hanne Nielsen whom I should like to thank for permission to quote the results of her analysis of the cloak/skirt from Borremose II.
2. Tacitus, *Germania*: N.W. Breum and A. Lund, *Tacitus Germania* I–II, Aarhus 1974. – English edition by J.H. Sleeman, Cambridge 1939.

REFERENCES

BREUM N. W. & LUND, A. 1974: *Tacitus Germania* I–II. Aarhus 1974.

DIECK, A. 1965: *Die Europäischen Moorleichenfunde.*

FERDINAND, J. & K. 1961: Jernalderofferfund i Valmose ved Rislev. *Kuml.* Aarhus.

GJESSING, G. 1938: Skjoldehamndrakten. *Viking.* Oslo.

GLOB, P. V. 1965: *Mosefolket.* Copenhagen.

KUNWALD, G. 1970: Der Moorfund im Rappendam auf Seeland. *Prähist. Zeitschrift.*

LUND, ALLAN 1976: *Moselig.* Aarhus.

MUNKSGAARD, E. 1974: *Oldtidsdragter.* Copenhagen.

– 1976: Frisurer fra ældre jernalder. *Aarbøger for nordisk Oldkyndighed og Historie.* Copenhagen.

SANDKLEF, A. 1937: The Bocksten Find. *Acta Etnologica.* Copenhagen.

STRUWE, K. 1967: Die Moorleiche von Dätgen. *Offa* Bd. 24. Neumünster.

TAUBER, H. 1979: Kulstof-14 dateringer af moselig. *Kuml.* Aarhus.

THORVILDSEN, E. 1952: Menneskeofringer i oldtiden. *Kuml.* Aarhus.

– 1947: Moseliget fra Borremose i Himmerland. *Fra Nationalmuseets Arbejdsmark.* Copenhagen.

Journal of Danish Archaeology vol. 3, 1984, pp. 124–134

North European Textile Production and Trade in the 1st Millenium AD

– A Research Project

by LISE BENDER JØRGENSEN

Owing to the fact that an outstanding collection of prehistoric textiles has been preserved in the country, Danish archaeology has a long tradition of textile studies. At the National Museum in Copenhagen are preserved no less than seven complete costumes of the Early Bronze Age – something no other European museum can rival. In addition many Iron Age garments have been found in bogs, giving altogether an unequalled wealth of these highly perishable and therefore very rare objects. They are not only the best possible show-pieces, but also are an important source of information on prehistoric weaving and textile production.

The prehistoric costumes found in Denmark have been thoroughly published. No less than three volumes of the series *Nordiske Fortidsminder* are largely devoted to the description and evaluation of textiles (Broholm and Hald 1935, 1939; Hald 1950). The important textile collections of Sweden, Norway, and north Germany are in the same position (Geijer 1938, Hougen 1935, Schlabow 1976). Nevertheless our knowledge of the overall development of prehistoric cloth production and trade has been rather limited. The Egtved, Huldremose or Thorsbjerg costumes, to name only a few of the most famous, are beautiful and important pieces, but their value as archaeological sources is limited so long as we cannot relate them to the normal textiles of the time

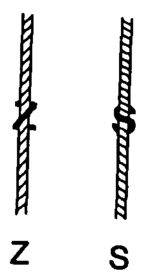


Fig. 1. S- and Z-spinning.

Fig. 2. The Huldremose peplos. National Museum photo.

and area. This defect is illustrated by the small importance attributed to textiles and textile production in most archaeological survey works. One often finds pictures of the complete garments used to illustrate how the people of the period looked, but that is usually all in spite of the fact that textile production must have been one of the most important industries of any prehistoric society.

In an attempt to supply the missing background material, the present author some ten years ago started to catalogue the many often very small textile remains that can be found encrusted on metal artefacts from inhumation graves. These pieces rarely give any information on the style of dress, but reveal much about the weaving technique, spinning, the number of threads per cm (i.e. the quality), and sometimes of borders and selvedges of the fabrics. These tiny fragments have two major advantages – there are plenty of them, and they can usually be very closely dated as they are found in direct contact with brooches and other easily datable artefacts. By using this material, it has been possible to build up a textile chronology that in the Danish material extends from the Early Bronze Age to the Viking Age or from soon after 2000 BC to AD 1000, with only one badly illuminated area – the Late Bronze Age/Pre-Roman Iron Age, i.e. the 1st Millenium BC, when cremation graves predominated so that only a few textiles remain. All of the 1st Millenium AD, however, is solidly documented, and this material has recently been enlarged with a substantial comparative material from Sweden, Norway, Great Britain, Ireland, the Netherlands and North West Germany, so that the present paper is based on no less than 2000 grave finds from Northern Europe (1).

This large and well-dated material gives new possibilities of defining cloth types and studying their development and distribution, and in some cases even of outlining an early cloth trade. In the following pages a short summary of the main results will be presented.

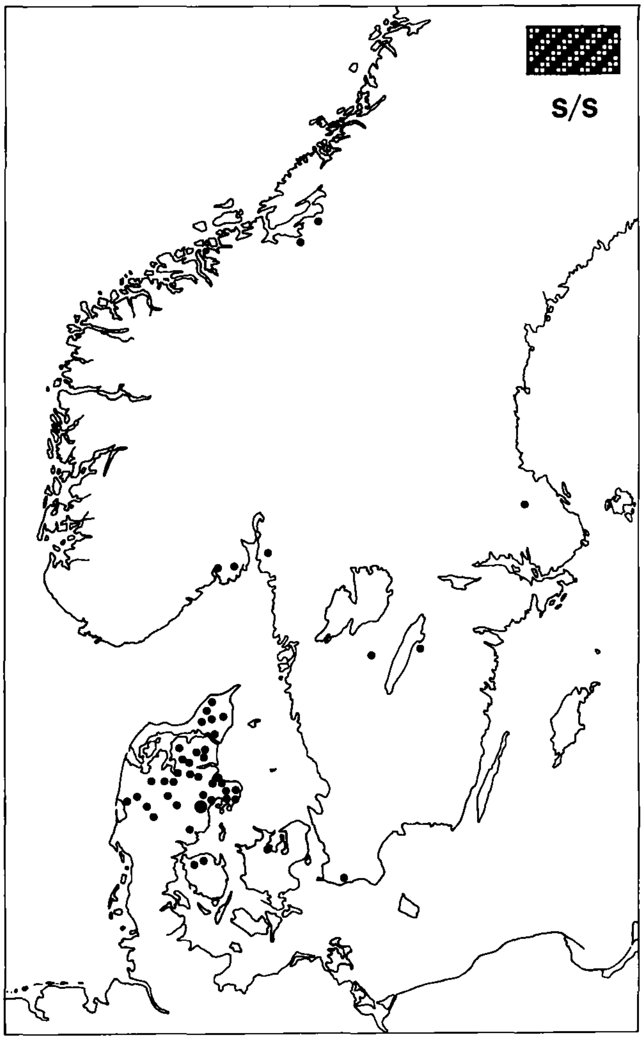


Fig. 3. Distribution map of the Huldremose type during the period 500 BC – AD 200.

During the Early Iron Age, i.e. the Pre-Roman and Early Roman Iron Age, two main cloth types can be distinguished in Northern Europe:

1) A Scandinavian type, called the *Huldremose type*, characterized by plain 2/2 twills of a medium quality (10–14 threads/cm) and the use of *S-spun yarn* in both warp and weft (cf. fig. 1). These fabrics never show any evidence of the use of the warp-weighed loom, as there are no starting borders, and furthermore no loom weights have been found in the many houses of the period excavated in Denmark – despite the very favourable conditions offered by some of the houses excavated by G. Hatt (1938). As some of the well-preserved garments belonging to this type (e.g. the Huldremose *peplos*, fig. 2) furthermore show definite evidence of the use of a *tubular loom*, we may conclude that this loom was in general use in Scandinavia during the Pre-Roman and Early Roman Periods, while the warp-weighted loom was unknown in this area (Hoffmann 1964).

2) A North German/South Jutish type, the *Haraldskjær type*, characterized by the same weave and quality as the Huldremose type, but with *Z-spun yarn* in both warp and

Fig. 4. Textile fragment of the Huldremose type from Borremose with warp-lock. Vesthimmerlands Museum photo.

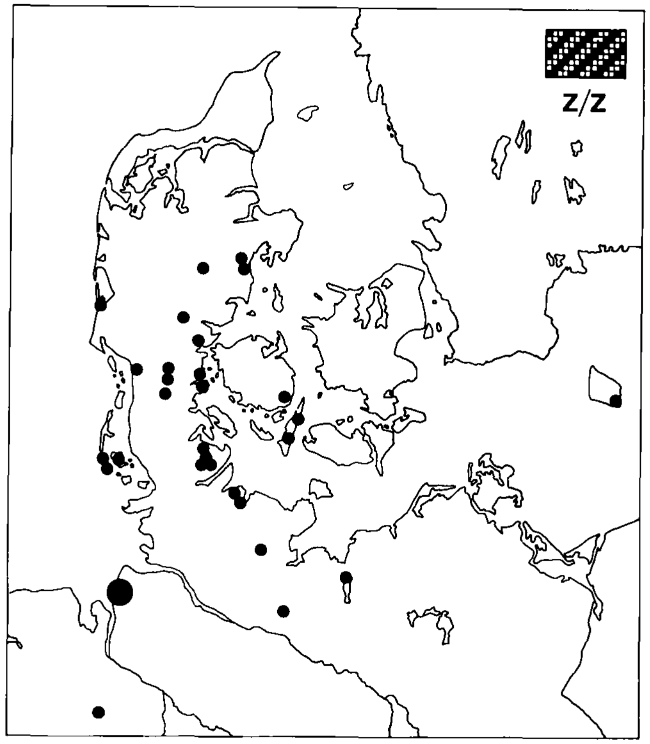


Fig. 5. Distribution map of the Haraldskjær type during the period 500 BC – AD 100.

weft (cf. fig. 1). Specimens of this type have starting borders, and as there are many finds of loom weights in the area (e.g. at the settlement Feddersen Wierde) we may argue that the Haraldskjær type was produced on a warp-weighted loom.

Thus two different textile traditions, or textile technologies, can be observed in Northern Europe during the period from 500 BC to AD 200 – the border between them running roughly between the Danish towns Vejle and Varde (compare figs. 3 and 5). This border is also observable in Pre-Roman Period pottery (Becker 1961, p. 249ff), and during the Early Roman Period the boundary between the predominance of inhumation graves and cremation graves runs approximately along the same line. A number of other differences can also be observed (see e.g. Hedeager & Kristiansen 1981).

During the late part of the Early Roman Period the Haraldskjær type was spreading northwards, and from the beginning of the Late Roman Period it had spread to all of Scandinavia, while the Huldremose type had disappeared. To this corresponds the sudden occurrence of loom weights in Late Roman Period settlements, even if the house remains are more poorly preserved than those of the earlier period. We may conclude that a kind of technical revolution must have taken place, with the warp-weighted loom replacing the tubular loom in Scandinavia. After AD 170–180, S/S-spun fabrics are only seen as very rare exceptions in Scandinavian finds.

In addition to these two cloth types, both of which must be considered as local production, two or three other cloth types can be observed.

One of these, the *Virring type*, is characterized by either 2/2 twill or the twill variants herringbone or diamond twill, by generally being of higher quality than the two local types (i.e. 14–20 threads/cm), and by the use of mixed spinning, i.e. Z-spun warp and S-spun weft (fig. 7). Furthermore, these fabrics often have starting borders, which is evidence of the use of the warp-weighted loom.

Virring type fabrics show up in Scandinavia from phase 1 of the Early Roman Period, always in rich, sometimes even princely graves, and occur together with Roman imports like bronze or glass. They occur

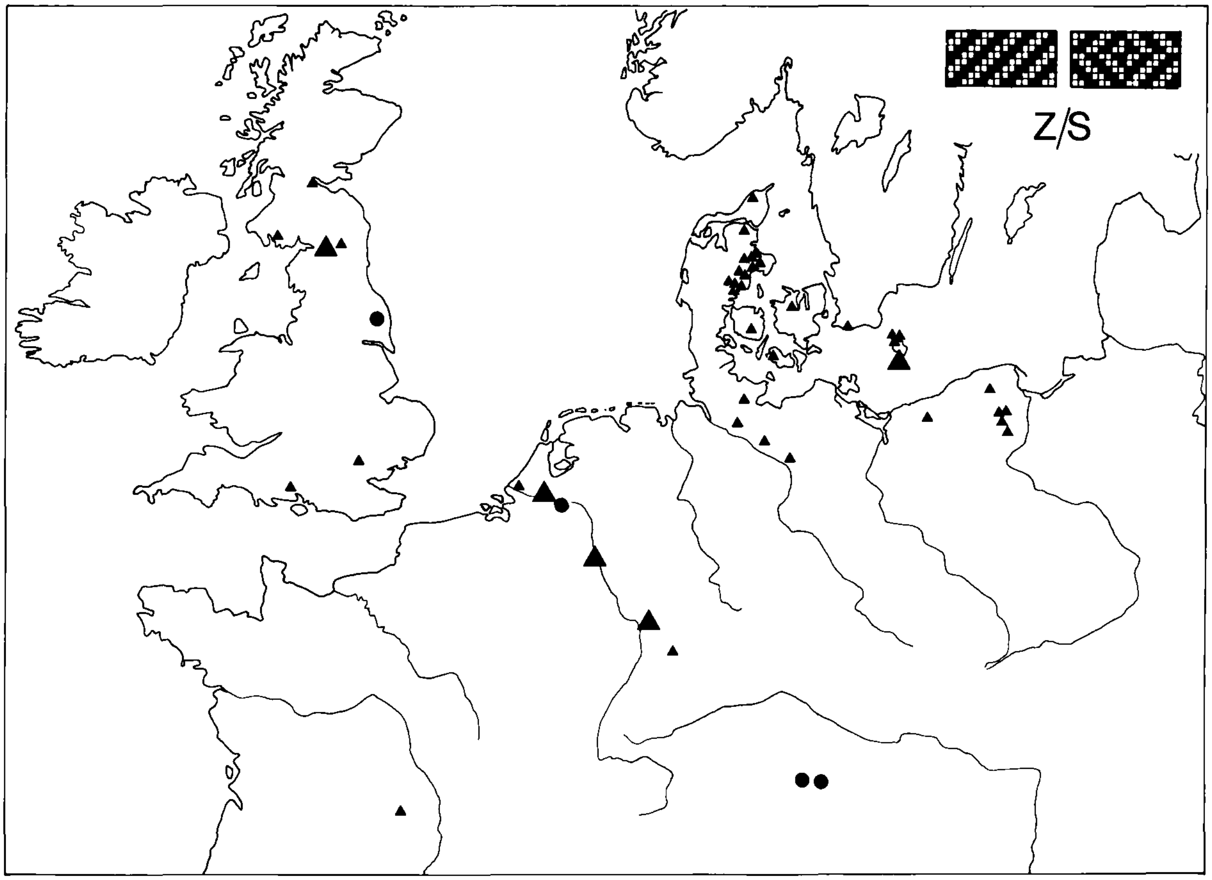


Fig. 6. Distribution map of the Virring type. Point: Hallstatt/La Tène. Triangle: Roman Period.

first in eastern Denmark, Zealand, Funen and East Jutland, then on the island of Bornholm, in Scania and Lolland and after the beginning of the Late Roman Period they are known in all of Scandinavia. This means that these fabrics, which are clearly produced on a warp-weighted loom, are found first in the area of the Huldremose type, i.e. where it was just argued that the tubular loom was used, a thing which emphasises their foreign character. Furthermore, they disappear totally from Scandinavia after the end of the Roman period and are unknown in the 5th and 6th Centuries AD.

Outside Scandinavia, fabrics closely corresponding to the Virring type are found along the Roman frontier, in Germany, the Netherlands and Britain, and also in several finds from behind the frontier, e.g. in a grave near Clermont-Ferrand in France (fig. 6). Moreover a small group of finds seems to show that corresponding fabrics can be traced back into the Hallstatt and La Tène Periods, suggesting that this cloth type may originally have been Celtic (2). It is well known both from contemporary sources and from more recent research that the Gallic cloth industry was well developed at the time of the Roman conquest, and that the Romans soon started to use the products of the Gallic weavers (3).

It is therefore tempting to argue that the fabrics of Virring type were produced in the former Celtic, Northern Roman Provinces, and when found in Scandinavian graves may be considered Roman imports along with the terra sigillata, glass, and bronzes which also to a great extent were produced in the Northern Provinces. This interpretation is emphasized by the fact that this type continues in the former Roman provinces during the 5th, 6th, 7th, 8th and 9th Centuries, while, as said, they disappear from Scandinavia during the Migration Period, only returning in very limited quantities in the 7th–10th Centuries.

Another cloth type found in Scandinavia during the Late Roman Period is characterized by the use of spin

Fig. 7. The Thorsbjerg tunic, a sample of the Virring type (after Engelhardt 1863 Pl. 1).

patterns, i.e. patterns obtained solely by the use of differently spun yarn. The most common variety is called *dog's tooth twill* (fig. 8), and show a distinct West Scandinavian distribution (fig. 9). The origin of this type cannot at the present stage of research be safely determined – arguments can be adduced both for a local and for a foreign origin. So long as virtually no comparative material from this period (3rd and 4th Centuries) is known outside Scandinavia, especially in NW Europe, any interpretation is hazardous. Like the Virring type, the dog's tooth twills disappear from Scandinavia after the end of the Roman Period.

During the Early Iron Age, we can thus distinguish 3 main areas each with their characteristic cloth types: Scandinavia, South Jutland/North Germany (The Jastorf Culture), and Central Europe (Hallstatt/La Tene, later the Northern Roman provinces). Some of these cloth types can be followed into the Late Iron Age, i.e. the Migration/Merovingian Periods.

During the Migration Period (here used of the 5th/6th Centuries, or Early Germanic Iron Age) virtually only one cloth type is found in the Scandinavian graves, namely the Haraldskjær type, which constitutes almost 90% of all textiles of this period. Only from the beginning of the Late Germanic, or Merovingian, or Vendel Period, do other cloth types show up in Scandinavia.

In the former Northern Roman Provinces, which soon were transformed into the Frankish Kingdom, a series of cloth types are found, some of these going back into the Roman, or as argued above, even into the Celtic Period. Five main cloth types can be listed: 1) Plain Z/Z-spun tabbies, often in linen, which are found all over the area and which as a type had existed since the Hallstatt Period. – 2) Spin patterned tabbies, which also often have been shown to be linen. These fabrics are mainly found within the borders of present-day Germany. There are only a few finds from the eastern Netherlands, and they are seemingly rare in North Germany as well. No finds from the present DDR have been published, so no border can be drawn to the east. This type seems to be new in the Migration Period. – 3) Fabrics of a type called *Rippenköper*, established by H.J. Hundt in a number of Alamannic graves and only very rarely found north of the river Main (fig. 11). Also this type is new in the Migration Period. 4) Plain Z/Z-spun twills like those of the Scandinavian Haraldskjær type, but usually a little coarser, with a count of 8–10 threads/cm. This type, like type 1), is found all over the Frankish

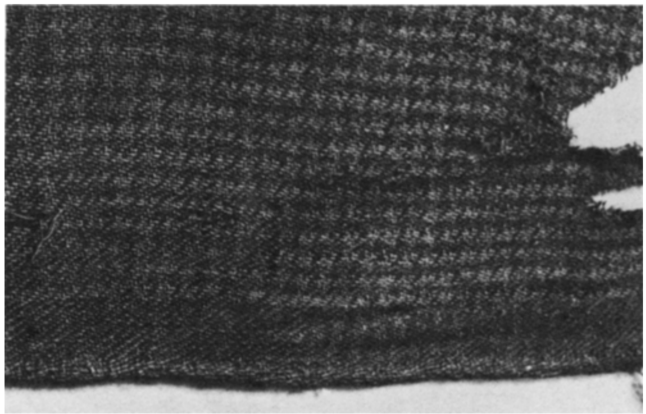


Fig. 8. Dog's tooth twill from Donbæk, North Jutland. National Museum photo.

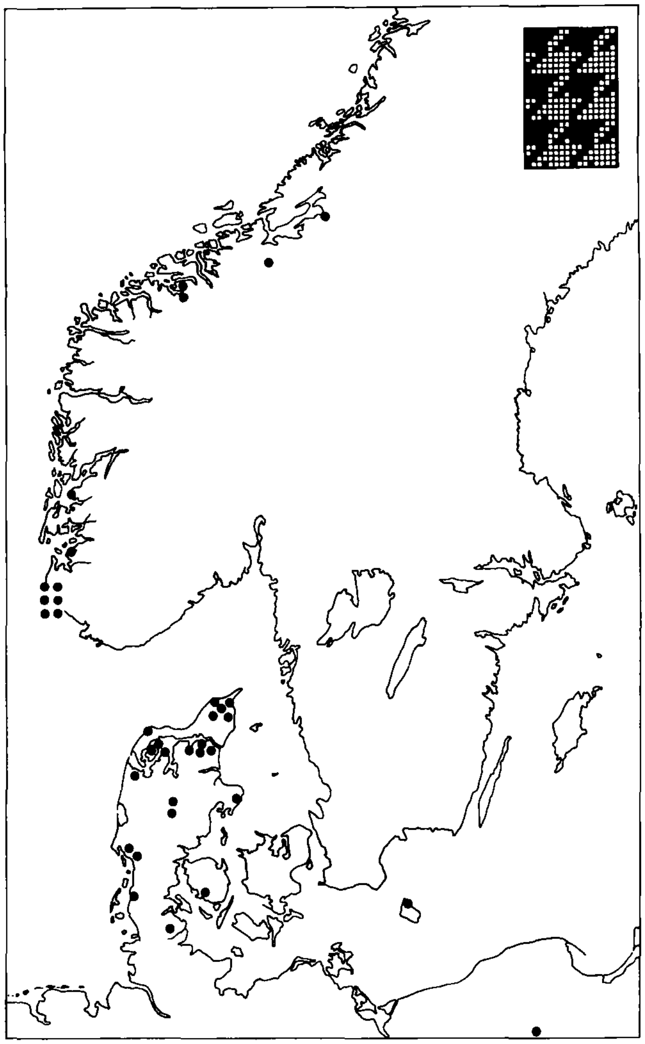


Fig. 9. Distribution map of dog's tooth twill.

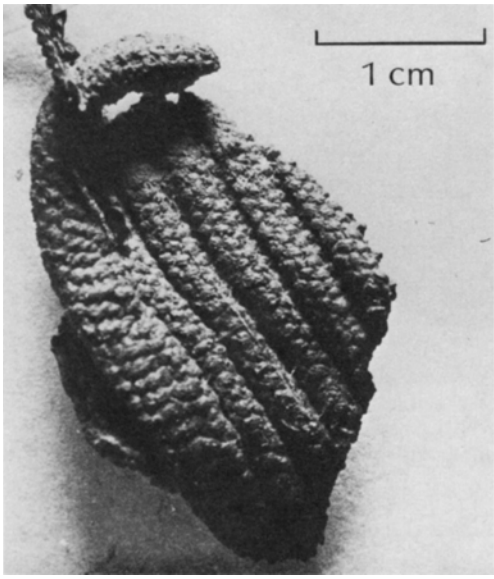


Fig. 10. Rippenköper from Bækkegård, Bornholm. LBJ photo.

area and likewise goes back to the Roman and Celtic periods. – 5) Z/S-spun diamond twills with the pattern unit 20/18, closely corresponding to the Virring type of the Roman Period. This type is found all over the Frankish area, and in the big settlements along the coast (like Hessens & Elisenhof) this type usually constitutes the most common cloth type. It is also found in southern England, while northern England, like Scandinavia, mostly favoured simple Z/Z-spun twills of the Haraldskjær type. The Virring type (or Hessens/Elisenhof type as it may be called in this late context) is found in 3 general qualities: a coarse one of around 10 threads/cm, a medium one of some 16 threads/cm, and a luxury quality of 25–35 threads/cm. The two first qualities are common, the last one is only found in a handful of graves – the most prominent being the ship burial of Sutton Hoo and the Princess's grave from the Cathedral of Cologne (4). Because it is found in the right areas and in several, seemingly standardized qualities, it is

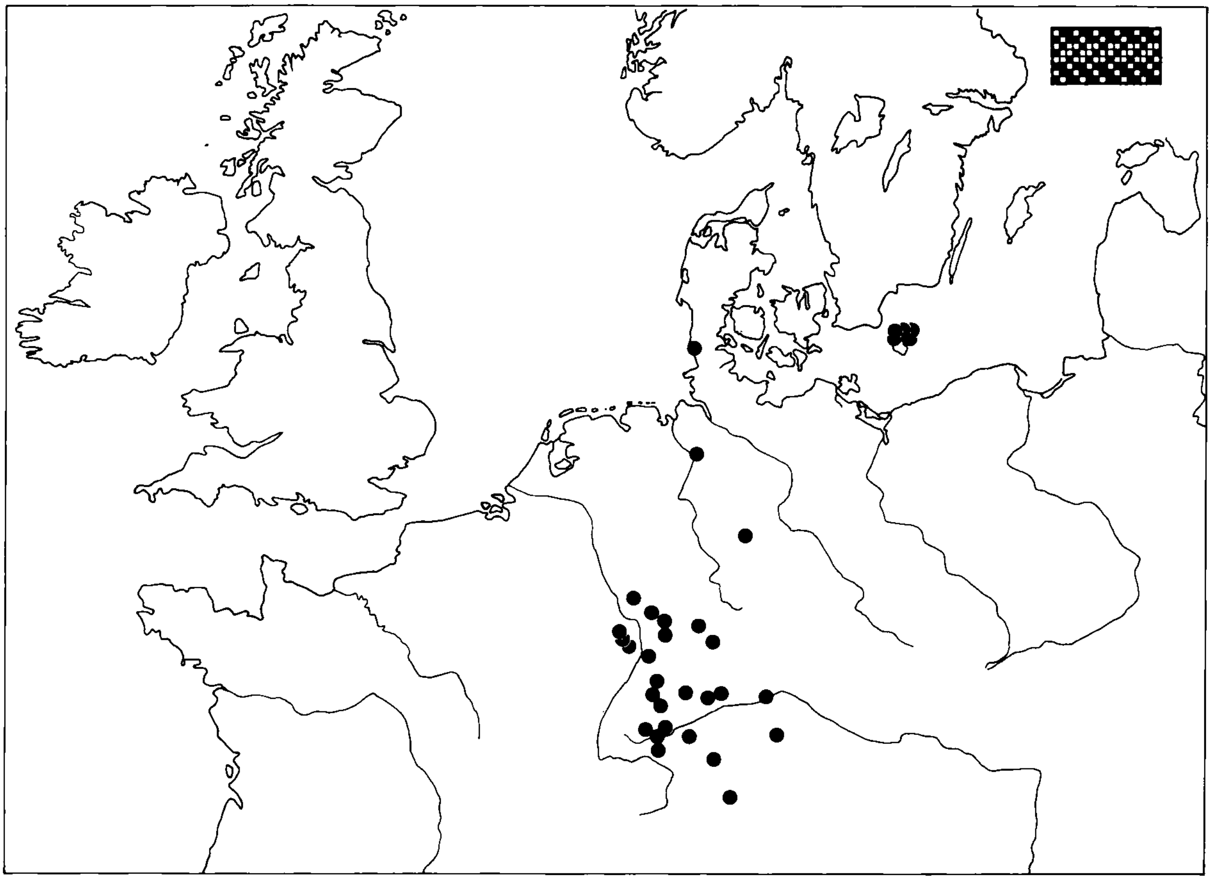


Fig. 11. Distribution map of the Rippenköper (5th–7th centuries).

tempting to identify this cloth type with the *pallium fresonicum* or Frisian cloth mentioned in several contemporary sources (5) (fig. 12).

In Scandinavia, the transition between the Early and Late Germanic Periods is emphasized by a major change in the cloth types, i.e. by a general change of fashion. Instead of the plain, woollen twills of the Haraldskjær type, suddenly (and almost for the first time) linen tabbies appear in Scandinavian graves, after being a very common feature in Central and North West Europe for centuries. The change is so definite that the Haraldskjær type almost totally disappears, at least from the Danish material, and in the Viking Age it is only found in Norway and on Gotland. Instead plain Z-spun tabbies make up about 75% of the Viking Age textiles from Denmark, and 40–50% of the Swedish and Norwegian material. Along with this change a number of characteristic Frankish cloth types are now found in Scandinavia, especially along the Baltic. This goes for spin patterned tabbies, *Rippenköper* and a few other patterned fabrics (6) which are found in a group of 7th Century graves on Bornholm (fig. 10), and at the Vendel and Valsgärde cemeteries in Uppland. In one of these graves, Valsgärde 7, a piece of Z/S-spun diamond twill 20/18 was found, i.e. the Virring type, in the same luxury quality as that from Sutton Hoo and Cologne cathedral. From the 8th–10th Centuries, only a few of the Frankish cloth types are found in Scandinavia, except for plain Z/S-spun twills which become a fairly common feature of Scandinavian Viking Age graves.

During the 8th–10th Centuries, a characteristic cloth type can be traced in a large number of Scandinavian graves. This type, a fine worsted diamond twill Z/Z-spun and with a standard pattern unit of 20/10, was first demonstrated in the textile material from Birka, and may thus be called the *Birka type*. In her original presentation of the Birka material, A. Geijer suggested an identification with the *pallium fresonicum* (Geijer 1938, p. 46). Later, this identification was questioned, and ori-

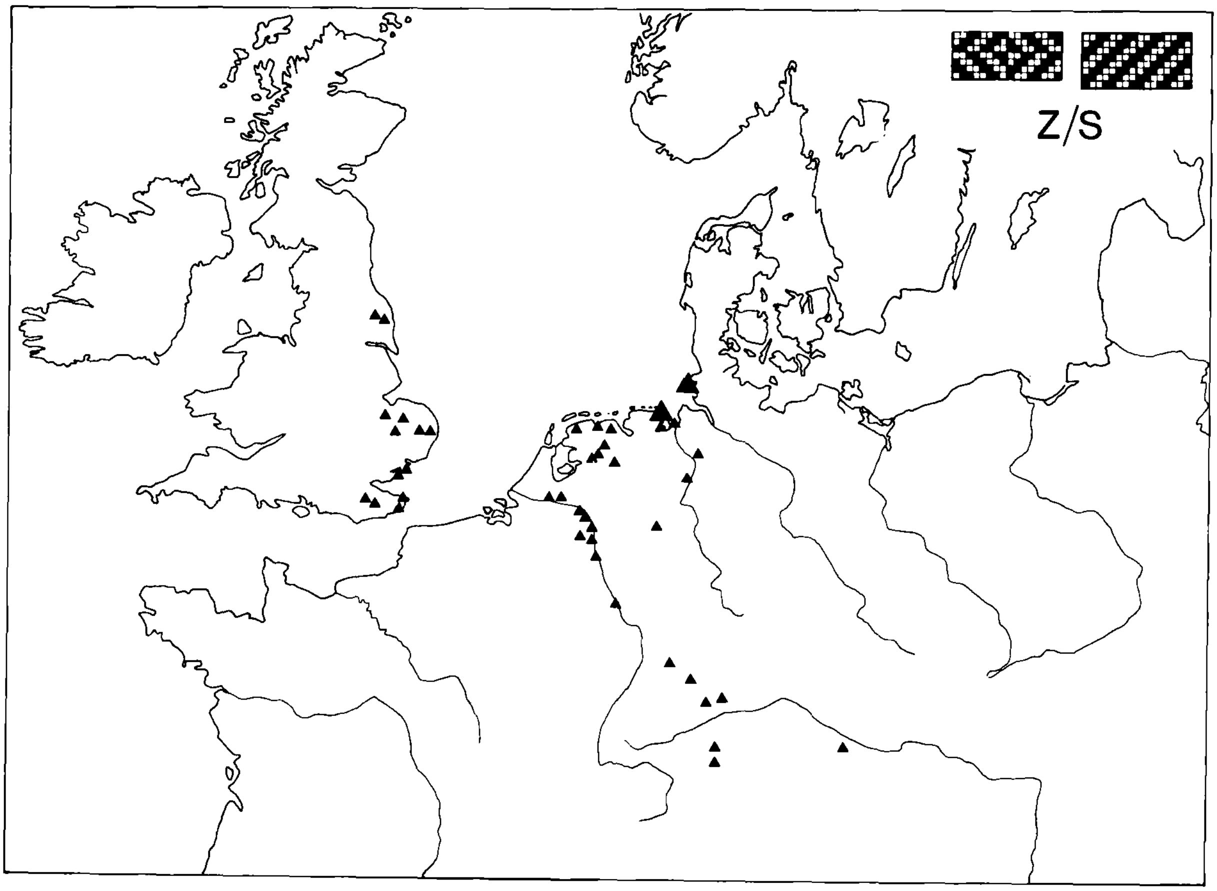


Fig. 12. Distribution map of the Virring or Hessen/Elisenhof type in the post-Roman period (5th–8th centuries).

gins as different as Syria and England/Ireland have been suggested (Hald 1950, p. 202–03, Hoffmann 1964 p. 229–57, Geijer 1965, Carus-Wilson 1969, Ingstad 1979). Now, for the first time, a large body of North European grave finds with textiles can be used in this discussion. The distribution map, fig. 13, based on 149 Danish, 83 Swedish and 136 Norwegian Viking Age Graves (to which can be added the large material from Birka) show a marked concentration in the trading centres Birka, Hedeby, and Kaupang, in the Norwegian Royal graves, and especially along the Norwegian West Coast, while only very few Danish, Swedish and East Norwegian graves contain this cloth type. Outside Scandinavia, only a few graves from the cemetery of Dunum in Ostfriesland (Tidow & Schmid 1979) and a single, undated piece from Orkney (Henshall 1954) can be listed. This distribution seems to exclude all the interpretations listed above, and instead suggests a West Norwegian origin for these fabrics. A Frisian origin is excluded because the Birka type is almost unknown in the Frisian area and indeed in the whole Frankish realm. As argued above, another cloth type with some of the same main characteristics, but with distinct differences, is abundant in these regions and consequently fits far better to the title *pallium fresonicum*. The theory of Syrian origin is based on only 4 fabrics which are half a millenium older, and which furthermore as Z/Z-spun are uncharacteristic of the East Mediterranean area where the textiles usually are S/S-spun – and if the Birka type really were of East Mediterranean origin we would expect to find it in the Frankish area as well. An Anglo-Irish origin seem unlikely as a body of 32 viking graves with textiles, found in Scotland and Ireland, did not contain a single piece of the Birka type (7). Finally an East European origin must also be considered unlikely, as it would leave unexplained the strong concentration in West Norway opposed to the scarcity of these fabrics in Sweden outside Birka. Several arguments favor a west Norwegian origin of the Birka type. Firstly, the strong concentration in this area (one out of every three graves with textiles); secondly the existence of 3 qualities of the Birka type in western Norway but only the better two of them in Birka; and thirdly the fact that Norwegian women usually were buried with a complete loom (loom weights, weaving sword, wool combs), something that suggests that one of the housewife's most important tasks was weaving.

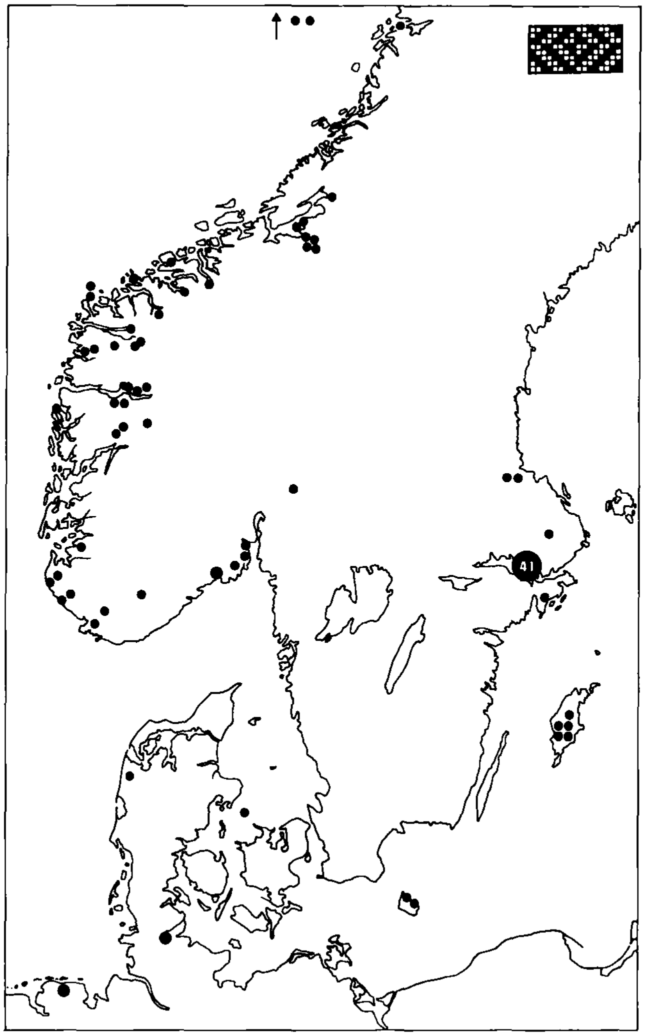


Fig. 13. Distribution map of the Birka type (Viking Age).

From this short summary of the conclusions that can be reached from a quantitatively collected textile material it is evident that textiles, like any other group of archaeological artefacts, can be sorted into types with distinct distribution patterns. As shown above, most of the cloth types can be attributed to certain cultural groups like the Jastorf culture, the Hallstatt/La Tene culture etc, and thus it is possible to distinguish between local production and imported cloth. The evidence of the textiles from the Roman Period suggests a well-developed cloth trade at this early stage. Indeed a few pieces, like the typical Hallstatt fabric found in a grave at Haastrup on Funen and dated to the Final Bronze Age (Albrectsen 1951, Munksgaard 1974), or an equally typical Hallstatt fabric from a *ciste a cordoni* found at Luttum in Niedersachsen (8), suggest an even earlier cloth trade. Textiles are well suited for long-distance trade: they are light and fairly solid, and just as today must be considered among the most important status symbols. In the Middle Ages wool and cloth were among the most important trade items – e.g. the British lord Chancellor is still sitting on a wool sack to remind everybody of what was the foundation of the British Empire, and it seems a safe assumption that cloth production and cloth trade also in Prehistory was a very important feature.

The investigation of prehistoric textiles presented here started with a relatively small body of Danish Roman Period textiles (Bender Jørgensen 1980), which already at that stage showed interesting features. The far larger material now studied has clarified many of the problems that could not be safely explained at that time, but many problems still remain. The author has up to now studied material in Scandinavia, the British Isles, the Netherlands and northwestern Germany. Next step is DDR and Poland, which would complete most of the *Germania Libera*, and among other things might answer the question whether there are differences between Frankish and Slavonic cloth types. Other questions, that would require similar registration work in central and southern Europe and in the Near East, would be to determine which cloth types are North European and which belong to the Mediterranean area – and in what manner these cloth types occur in the different periods as a result of political developments such as the Roman conquests, the rise of the Frankish and Arab empires, etc. Only when this work is done, for both the Prehistoric and the Medieval material, will we have the necessary background to write the history of European textiles.

Lise Bender Jørgensen, Institute of Prehist. Archaeology, University of Copenhagen, Vandkunsten 5, DK-1467 Copenhagen.

NOTES

1. The following museums have been visited:
   Denmark: The National Museum, 1st Dept., Copenhagen. Bornholms Museum. Lolland-Falsters Stiftsmuseum. Fyns Stiftsmuseum. Langelands Museum. Vendsyssel Historiske Museum. Aalborg Historiske Museum. Museet for Thy og Vester Hanherred. Vesthimmerlands Museum. Kulturhistorisk Museum, Randers. Viborg Stiftsmuseum. Holstebro Museum. Ringkøbing Museum. Silkeborg Museum. Forhistorisk Museum, Moesgaard. Haderslev Museum.
   Sweden: Lunds Universitets Historiska Museum. Statens Historiska Museum, Stockholm.
   Norway: Universitetets Oldsakssamling, Oslo. Arkeologisk Museum, Stavanger. Historisk Museum, Bergen. Videnskabsselskabets Museum, Trondheim.
   Great Britain: The National Museum of Antiquities of Scotland, Edinburgh. York Archaeological Trust. The Yorkshire Museum. The Ashmolean Museum, Oxford. The University Museum of Archaeology and Anthropology, Cambridge. Dept. of Medieval & Later Antiquities, The British Museum, London. Museum of London. Ipswich Museum.
   Ireland: The National Museum of Ireland, Dublin.
   The Netherlands: Groninger Museum. Drents Museum, Assen. I.P.P., Amsterdam. Velouws Museum Nairac, Barneveld, Rijksdienst voor Oudheidkundig Bodemonderzoek, Amersfoort. Rijksmuseum van Oudheden, Leiden.
   Germany: Schleswig-Holsteinisches Landesmuseum, Slesvig. Niedersächsisches Landesmuseum, Hannover. Westfälisches Museum für Archäologie, Münster. Römisch-Germanisches Museum, Köln. Erzbischöfliches Diözesan-Museum, Köln. Rheinisches Landesmuseum, Bonn.
   The author wishes to thank the directors and staff at all the visited museums for their practical help and permission to study the textile material. The financial foundation for the research project here presented has been secured by a Research Fellowship at the University of Copenhagen. The many travels have been paid partly by the University of Copenhagen, partly by *Dronning Margrethe II's Arkæologiske Fond*. The author is greatly indebted to both these institutions for their generosity.
2. Z/S-spun twills and diamond twills corresponding to the Virring type have been found at the following sites:
   Hallstatt/La Tène Periods: Dürrnberg, Hallein (Hundt 1974), Hallstatt (Hundt 1960), Oss, Noord Brabant in Nederland (Rijksmuseum v. Oudheden inv. no. K 1933/7,19). Burton Fleming, Yorkshire (unpublished report by Miss Elisabeth Crowfoot).
   Roman Period: Mainz (Wild 1970, B 53, 57, 76, 77, 78), Limeskastell Walldürrn (Hundt 1978), Köln (Schleiermacher 1982, kat.no. 17, 22, 23, 25, seen by the author 1983), all from Germany. Valkenburg, Zuid Holland (I.P.P. X, 3882/55, seen by the courtesey of drs. S.Y.Vons-Comis) in the Netherlands. Les Martres-des-Veyre (Audollent 1923) in France. Vindolanda (Wild 1977), Corbridge (Wild 1970, A48), Verulamium (Wild 1970, A49), Balmaclellan (Wild 1970, A45), Camelon, Stirlingshire (National Museum of Antiquities of Scotland FX 362–66) and Lankshill (Crowfoot 1979), all in Great Britain.
3. The Roman author Strabo says in his Geography (IV: 197) of the Gauls: "Their flocks of sheep ... are so very large that they supply an abundance of the *sagi* (i.e. Gallic cloaks) ... not only to Rome, but to most parts of Italy as well.« For more recent research, see Wild 1970, 1977, 1982.
4. The textiles of both Sutton Hoo and the Cathedral of Cologne are as yet unpublished. The Sutton Hoo textiles are being published by Miss Elisabeth Crowfoot, but through the kindness of her and of Mrs. Leslie Webster, the British Museum, the author has been able to examine the fabric in question (SH 1). The textiles from the

Cathedral of Cologne were investigated by the author in the Erzbischöfliches Diözesan-Museum, Köln, through the kindness of Pater Dr. Schulten. The textiles are going to be published presently in the Kölner Domblatt.

5. *Pallium fresonicum* is first mentioned by Ermoldus Nigellus in the late 8th Century. He tells that Frisian merchants in Elsass traded cloth and amber for wood, wine and corn. The Monk from St.Gallen mentions it several times: first as one of the gifts that Charlemagne sent to Harun al-Rashid, later that Louis the Pious gave his courtiers of highest rank valuable foreign clothes, those of second rank cloaks of coloured Frisian cloth. *Pallium fresonicum* has been the subject of discussion among both historians and archaeologists for almost a century. An excellent survey of the discussion can be found in A.S. Ingstad 1979.
6. E.g. fabrics with a weft-float pattern like honeycomb-weave (or as H.J. Hundt calls it: Wabengewebe), see Hundt 1980, and Arwidsson 1954, p. 101.
7. The 32 Viking graves have been examined by the author in the National Museum of Antiquities of Scotland, and in the National Museum of Ireland.
8. Inv.no. 5458 in the Niedersächsisches Landesmuseum, Hannover.

REFERENCES

ALBRECTSEN, E. 1951: En gravhøj fra Haastrup. *Fynske Minder* I. Odense.

ARWIDSSON, G. 1954: *Valsgärde 8.* Uppsala.

AUDOLLENT, A. 1923: *Les tombes Gallo-Romaines a inhumation des Martres des Veyre.* Mémoires presentés par divers savants a l'académie des inscriptions et belles-lèttres de l'Institut de France, XIII. Paris.

BECKER, C.J. 1961. *Førromersk jernalder i Syd- og Midtjylland.* Copenhagen.

BENDER JØRGENSEN, L. 1980: Cloth of the Roman Iron Age in Denmark. *Acta Archaeologica* vol. 50, 1979. Copenhagen.

BROHOLM, H.C. & HALD, M. 1935: *Danske Bronzealders Dragter.* Nordiske Fortidsminder II, 5–6. Copenhagen.

– 1939: *Skrydstrupfundet.* Nordiske Fortidsminder III, 2. Copenhagen.

CARUS-WILSON, E. 1969: Haberget: A Medieval Textile Conundrum. *Medieval Archaeology.*

CROWFOOT, E. 1979: Textile Remains. In G. CLARKE: *The Roman Cemetery at Lankshill.* Oxford.

GEIJER, A. 1938: *Birka III. Die Textilfunde aus den Gräbern.* Uppsala.

– 1965: Var järnålderns "frisiska kläde" tillverkat i Syrien? *Fornvännen.*

HEDEAGER, L. & KRISTIANSEN, K. 1981: Bendstrup – en fyrstegrav fra ældre romersk jernalder, dens sociale og historiske miljø. *KUML* 1981. Århus.

HALD, M. 1950: *Olddanske tekstiler.* Nordiske Fortidsminder V. Copenhagen.

– 1980: *Ancient Danish Textiles from Bogs and Burials.* Copenhagen.

HATT, G. 1938: Jernalders Bopladser i Himmerland. *Aarbøger for nordisk Oldkyndighed og Historie.* Copenhagen.

HENSHALL, A. 1954: Early Textiles found in Scotland. *Proceedings of the Society of Antiquaries of Scotland* LXXXVI.

HOUGEN, B. 1935: *Snartemofunnene.* Norske Oldfunn VII. Oslo.

HOFFMANN, M. 1964: *The Warp-Weighted Loom.* Oslo.

HUNDT, H.J. 1960: Vorgeschichtliche Gewebe aus der Hallstätter Salzberg. *Jahrbuch RGZM* 7.

– 1974: *Die Textilfunde aus den Gräbern vom Dürrnberg. Dürrnberg II.* Münchner Beiträge zur Vor- und Frühgeschichte Bd. 17.

– 1978: Gewebeabdruck auf der Innenseite eines Tubulus. in: D. Baatz: Das Badegebäude des Limeskastell Walldürrn (Odenwaldkreis). *Saalburg-Jahrbuch* XXXV.

– 1980: Textilreste aus dem frühgeschichtlichen Kriegergrab von Sievern, Kr. Wesermünde. *Studien zur Sachsenforschung* 2.

INGSTAD, A.S. 1979: "Frisisk klede"? En diskusjon omkring noen fine tekstiler fra yngre jernalder. Viking 1979.

MUNKSGAARD, E. 1974: En kipervævning fra Haastrup. *Fynske Minder.*

SCHLABOW, K. 1976: *Textilfunde der Eisenzeit in Norddeutschland.* Göttinger Schriften zur vor- und Frühgeschichte, bd. 15.

SCHLEIERMACHER, M. 1982: Römische Leder- und Textilfunde aus Köln. *Archäologisches Korrespondenzblatt* 12.

TIDOW, K. & SCHMID, P. 1979: Frühmittelalterliche Textilfunde aus der Wurt Hessens (Stadt Wilhelmshaven) und dem Gräberfeld von Dunum (Kr. Friesland) und ihre archäologische Bedeutung. *Probleme der Küstenforschung im südlichen Nordseegebiet* Bd. 13.

WILD, J.P. 1970: *Textile Manufacture in the Northern Roman Provinces.* Cambridge.

– 1977: The Textiles from Vindolanda 1973–75. *Vindolanda III.*

– 1982: Some New Light on Roman Textiles. In BENDER JØRGENSEN & TIDOW (eds.) 1982: *Textilsymposium Neumünster. Archäologische Textilfunde.* Neumünster.

Journal of Danish Archaeology vol. 3, 1984, pp. 135–163

Prehistoric Field Boundaries in Eastern Denmark

by VIGGO NIELSEN

INTRODUCTION

In 1949 Gudmund Hatt completed 20 years' surveying and planning of Danish prehistoric fields with the publication of his work »Oldtidsagre«. These investigations were carried out in northern and western Jutland. Through the efforts of Gudmund Hatt himself, his co-workers such as Axel Steensberg, C.G. Feilberg and Johannes Humlum, and information from others interested in the work, it was possible to gain an impression of settlement and agriculture in those parts of the country, where the fossil landscape had been preserved in uncultivated heathland. Through planning and excavation it became clear that the groups of boundaries were field systems proper, divided into two main types. One had more irregular square fields, the other long, rectangular, and sometimes very narrow fields. These types dated overwhelmingly from the earlier Iron Age, and within that principally the Pre-Roman Iron Age. No attempt was made to use aerial photographs, despite Gudmund Hatt's awareness of the remarkable results obtained by English colleagues as early as the 1920's. The material Hatt put forward has been added to, and indeed through aerial photography multiplied many times (Jansson 1963, Harder Sørensen 1982), but even so does sum up the main features of the areas cultivated in the Iron age in the investigated regions.

Evidence outside northern and eastern Jutland, from the generally more fertile eastern parts of the country, appeared on the other hand only very sporadically. This difference was because western Jutland formed much the best work area, both because it was there that numerous settlements and house remains from the earlier Iron Age now began to be discovered, and also because field boundaries in the heathlands were easily accessible, simple to recognize and straightforward to plan. Similar traces of fields were much more difficult to find in eastern Denmark, because no corresponding open areas were present.

In general, the chances of observing early topographic features such as field boundaries depend on the area in question not having been too intensely cultivated in more recent times. In a heavily cultivated country such as Denmark, such fossil land surfaces exist only to a limited degree. The huge areas of heathland that covered most of Jutland in around 1800, and in other parts of the country the large grazing and woodland areas that were part of the agricultural system until that time, are now virtually all cultivated fields. Only a few fragments of the grazing land remain in the holdings of a few estates. In eastern Denmark there is also some woodland covering relatively undisturbed land surfaces. They make up, however, only a limited area.

Woodlands were also affected by the structural agricultural revolution that took place in Denmark in the last decades of the 18th century (Danmarks natur vol. 6). A continual reduction and impoverishment of the woodland surviving from the medieval period had been taking place, not least because of the various rights to woodland exercised by owners and users. Now common access to woodland ended at the same time as communal use of the agricultural land. This happened first in crown woodlands, and in 1805 also for private woods and resulted in a parcelling up and fencing off of defined woodland areas and the end of more dispersed woodland growth. At this time woodland covered only 4 % of the country, and was a particularly east Danish phenomenon.

Later – mainly in the second half of the nineteenth century – large areas of heath and grazing land were planted with woodland. The total area of Denmark covered by woods now amounts to about 12 %. This planting took place mainly in Jutland and on the island of Bornholm. The present percentages of woodland for Bornholm (20.9 %), Zealand (11 %), Funen (9.2 %) and Lolland-Falster (9.2 %) indicate roughly (with the subtraction of a few percent) what the percentage of wood-

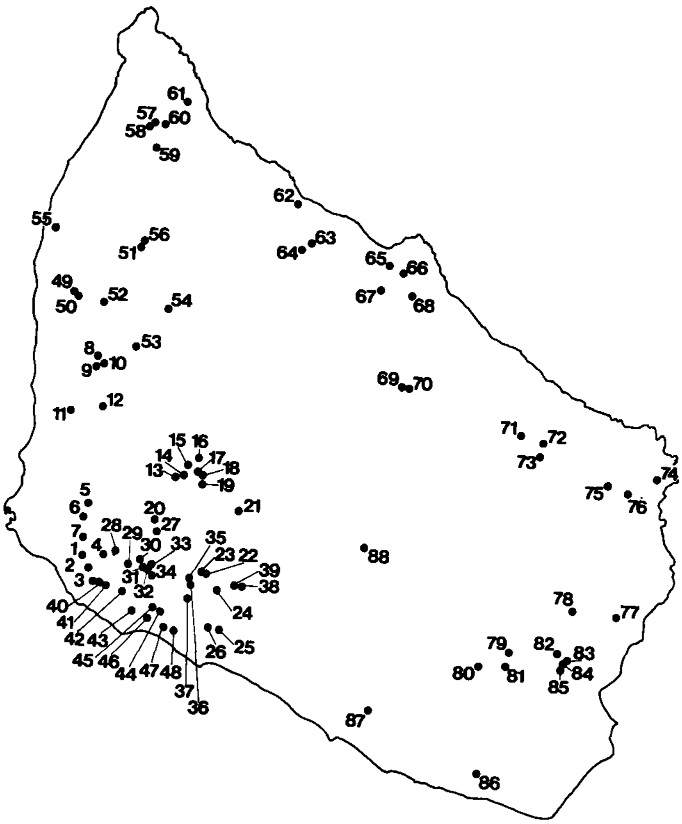


Fig. 1. Occurrences of prehistoric field boundaries in Bornholm.

land was in 1805. Thus the geographical representativeness of the old east Danish woodlands is limited. To this must be added the fact that these woods tend to be located on soils which are more difficult to cultivate. On Bornholm, most of the woodland lies in the high central part of the island where bedrock is close to the surface, and other woodlands on former heaths. Many woods in Zealand, Funen and eastern Jutland are in areas where the soil is gravel or sand, often in hummocky or hilly ground moraine landscapes with wet hollows in between. On Lolland-Falster many woods are on damp soils.

In general, therefore, areas of old woodland do not cover a representative sample of soils. Some of Zealand's most productive districts now have relatively small areas of woodland on their fringes. On the other hand the ancient woodlands do cover a wide range of variation of soil types, including some of the best quality.

Morphologically, the land under the woods will be most strongly affected by the most recent and intensive activites. Where deep ploughing was used to break up the surface of heathland prior to planting, all earlier traces will have vanished. On the other hand, there are areas of woodland that show no traces of ever having been cultivated. This is the case for a number of hilly or gravelly localities, and for some areas of the above-mentioned hummocky ground moraine with wet hollows.

Modern forestry can resemble other types of cultivation, so that ploughing and harrowing can cause the deterioration or disappearance of earlier features; use of modern machines such as tractors, and the establishment of roads and paths, also cause much degradation of older landscape features.

Despite this general diminishing of observational potential, it is still in many cases possible to recognize traces of former cultivation. When areas were enclosed due to among other things the forestry laws of 1805, a number of areas of existing cultivation were included and made over to woodland. This included a number of areas with ridge and furrow fields. The extent of these inclusions can be seen from maps of the change in settlement and land use that took place in the decades after 1781. Earlier on, cultivated areas with ridge and furrow were covered with woodland due to the appearance of large estates or the abandonment of arable land. Early medieval field traces in the form of rows of stones cleared from the fields can also be seen in the landscape. In many cases field boundaries, banks and lynchets can be seen, evidence of agricultural use of the land, which usually dates from the earlier Iron Age.

Many old woodlands contain visible remains of graves dating from the Neolithic or Bronze Age, without the landscape showing any traces of cultivation. The landscape was evidently clear at the time, and must have been used for grazing or a cultivation system that has not left traces in the terrain.

In several cases subsequent cultivation has not been able to destroy earlier traces, so that a kind of landuse stratification is visible. Borup Riis on Zealand is an example of this, with megalithic graves, remains of Iron Age fields, of fields dating from the Viking or early Medieval period, and finally of ridge and furrow cultivation (Steensberg 1983), which were apparently abandoned in the beginning of the 14th century.

With a rough idea of what the woodlands might conceal, and after preliminary discussions with Gudmund Hatt and Axel Steensberg, I embarked in 1953 on a pro-

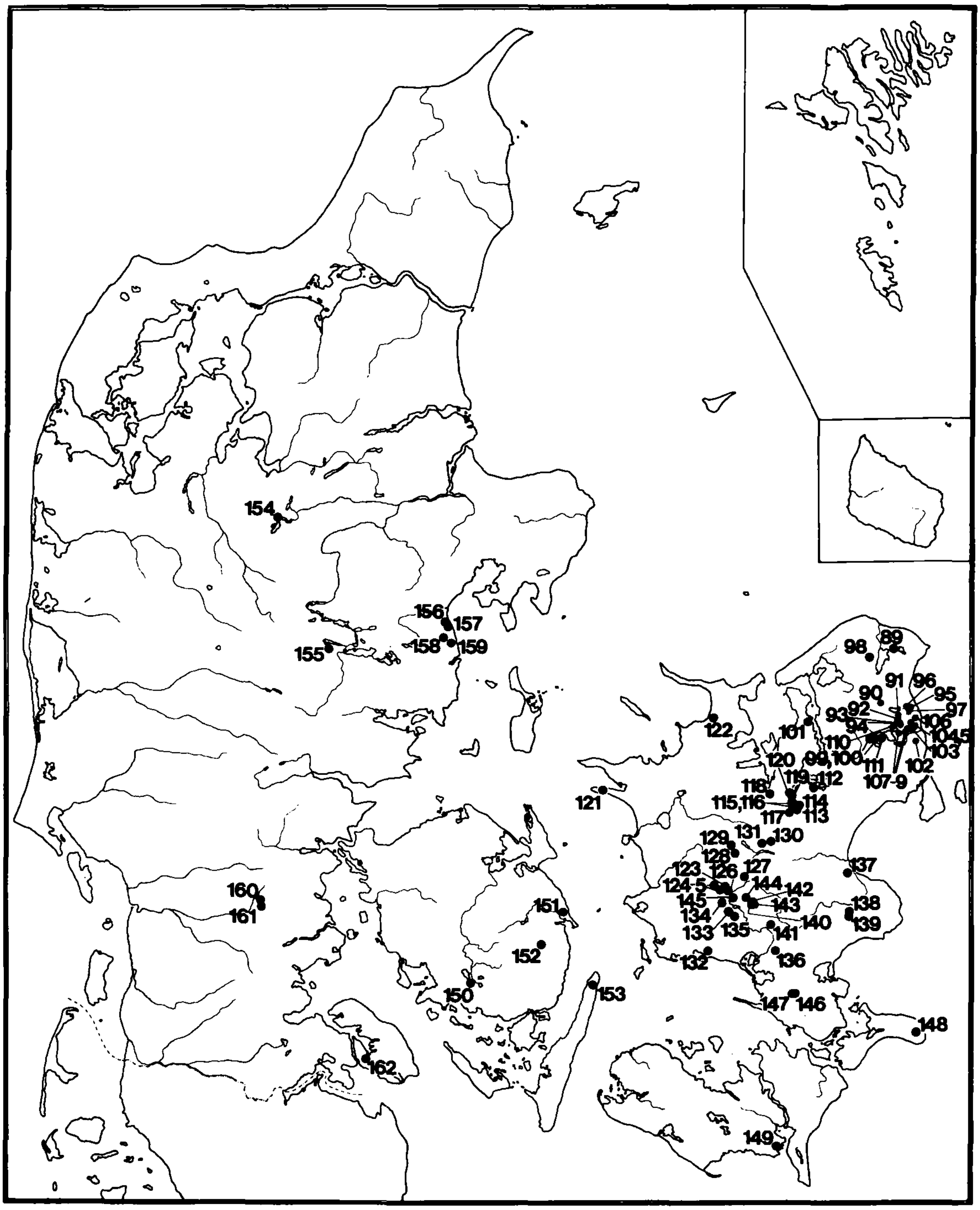


Fig. 2. Occurrences of prehistoric field boundaries in Eastern Denmark, except Bornholm.

ject to record, plan and investigate east Danish occurrences by means of a systematic search of the areas of older woodland. The aims included examining whether cultivation and settlement patterns had the same nature, extent and form in different areas, and whether the better quality soils had supported a more longlived cultivation from back into the Bronze Age and forward into the later Iron Age.

For the next 30 years, although with the main part of the work being done between 1953 and 1963, the woodlands of East Denmark were searched with varying degrees of intensity. Aerial photography was occasionally used as a supplement.[1] (Figs 1 and 2).

Tree growth makes the searching of woodlands difficult. Limited visibility, particularly in new plantation, makes it difficult to see field boundaries, and much more difficult to gain a coherent view of the overall plan. The terrain must therefore be very intensively walked. Lack of visibility also presents problems at the planning stage, which involves much more work in woodland than in open country. The tree growth also means that investigations cannot be made over wide areas, but only at particular points. The recognition of settlements normally has to be done by means of soil analysis, and traces of houses and settlement types can only be examined to a limited degree.

In connection with the survey, a series of plans 1:1000 were made, using a plane table. The plans were drawn up according to the same system used for Gudmund Hatt's maps, in which Axel Steensberg participated: contour lines at 1 m intervals, and symbols for boundary banks and lynchets that contain information about their height and breadth (appendix II). In the period from the first planning of Blemme Lyng in 1953 up to the planning of Næsbyholm Storskov in 1961–64, the planning methods unterwent a continual development. A polygonal pattern of stations was laid out using a theodolite, and planning was based on this. Towards the end, points would be refound to the nearest 10 cm, but such accuracy was not attained in the earlier stages.

In connection with the planning, investigations were made in and outside the field boundaries with a view to dating them and discovering their structure and formation. The dates provided by the material from these excavations are, however, only of limited applicability. They provide information that people lived on the spot at a particular time, but can give only a limited answer to the questions of when the field boundaries and systems were established and when they were abandoned. The potential for geobotanical determinations is thus of decisive importance for understanding developments on a particular site. The Geological Survey of Denmark has carried out such determinations on the two Zealand sites of Geelskov and Næsbyholm Storskov (Andersen S. Th. et al. 1983, figs. 5 and 6). Excavations such as those at Geelskov and Rønne Plantage on Bornholm have also concentrated on areas that were threatened by building and raw material removal respectively.

Because the occurrences are found in woods of very different sizes, the notion of an "occurrence" is relative. It may refer to a few remains of field boundaries in a small woodland; or to one or perhaps several adjoining but geographically bounded field systems within the same large forest.

The work was supported by a series of grants from the former Danish State Research Foundation. In connection with the plannings and investigations a number of unemployment arrangements were organized in cooperation with the National Museum, the Prehistoric Museum at Århus, and Bornholms Museum. During planning and excavation I received help from my wife, Gudrun Nielsen, who among other things undertook most of the planning in Næsbyholm Storskov, and also from a series of assistants, among them for a long period the American student Jonathan Gell.

SURVEY OF FIELD BOUNDARIES IN EASTERN DENMARK

The catalogue follows the normal Danish topographical schemes as used in J.P. Trap: *Danmark* 5. edition with the exception that Bornholm is counted first in order to lead the reader from the east to the west. Consequently no regard is taken of the municipality reform in 1970, where the number of the counties and the municipalities were diminished and a regrouping took place.

As abbreviations are used:

a. – amt, Danish county, h. – herred, Danish district, s. – sogn, Danish parish.

Place names are recorded in Danish. Note the generics – bakke and bjerg = hill, – bæk = brook, – gård = farm, – hegn = enclosure, – kirke = church, – skov = wood or forest, and – å = stream (proper rivers do not exist in Denmark).

The enumeration is continual and indicates all occurrences in each parish. This means that when an occurrence in a few cases reaches over more than one parish, it should be counted more than once.

BORNHOLM

Bornholm a.

Vester h.

1. (1) *Rønne Plantage*, the plantation area west of Onsbæk-Robbedale. Prominent field boundaries with many stones covering

Fig. 3. Rønne Plantage. Cairn situated in boundary bank with ploughmarks.

about 5 ha around the Tornhøj barrow. Naturally limited to the NE by a meltwater valley, and to the E by the brook Onsbæk.

2. (2) *Rønne Plantage*, an area of 50–60 ha in the central part of the plantation area, formerly heathland, bounded to the N by hills and a meltwater valley, to the S and SW by the slopes of a late glacial river bed. The soil is light sandy moraine on top of sand or clay. Plans and investigations 1955–57. Plans were supplemented by aerial photographs. The fields are mainly broad and rectangular, apparently with some regular patterns. The field boundaries are mainly banks about 4 m wide and c. 10–15 cm high. Spread over the terrain are stone clearance cairns, graves in the form of cairns and barrows, and stones with cup marks. The excavations showed settlement traces and plough-marks in the NE-most part, in connection with cairns and lynchets (fig. 3). The area was used in the Late Bronze Age from about 1040 BC (K 2403–05). The ploughmarks and field boundaries are younger than about 620 BC (K 2402) (Appendix I).

3. (3) *Rønne Plantage*, SE part, E of the meltwater valley containing the brook Hakkedam Bæk, and bounded to the S by an erosional slope. This is the W-most part of a large occurrence, topographically clearly bounded, which continues E into Nylarsker s. (see no. 40).

4. (4) *Blemme Lyng*. This site begins S of the NE angle of the parish boundary, bounded to the S by the scarp that delineates the sandstone area. The main part of this site lies in Nylarsker parish (see no. 28).

Knudsker s.

5. (1) Aerial photographs of the area 600 m SSW of Knuds kirke show a 3 ha area where paler lines in the soil form a regular rectangular pattern oriented NNE – SSW. The field area could have been bounded to the NW by cliffs now destroyed by quarrying, and to the S by the By-å and the slopes down to it.

6. (2) *Kanegård skov*. On the slopes of By-å in a 5 ha wood are lynchets and banks with many large stones. A few cairns are placed in connection with the boundaries. Probably connected with site no. 5.

7. (3) Aerial photographs of the area c. 2 km S of Knuds kirke and W of the house Skovhave show a 4 ha area of rectangular fields. It does not continue into the adjoining wood to the N, and presumably extended further W and S.

Nyker s.

8. (1) *Bukkegårds skov*. Banks and lynchets oriented ESE-NNW and NNE-SSW occur in the S part of the 5 ha wood, 50 m N of Bukkegård.

9. (2) In a wood 1.5 ha in size and c. 350 m S of n. 8 is a boundary bank aligned ESE-WNW, with lynchets running across it.

10. (3) In a wood 3 ha in size 200 m E of n. 9 are 4 lynchets aligned ESE-WNW at 40 m intervals.

11. (4) *Blykobbe skov*, a 5 ha wood 150 m N of the farm Blykobbegård, contains lynchets and banks, some of which have single large stones placed in rows.

12. (5) Aerial photographs of the area 1000 m N of Nykirke, N of the Nyker-Blykobbe-Rønne road, show boundaries visible

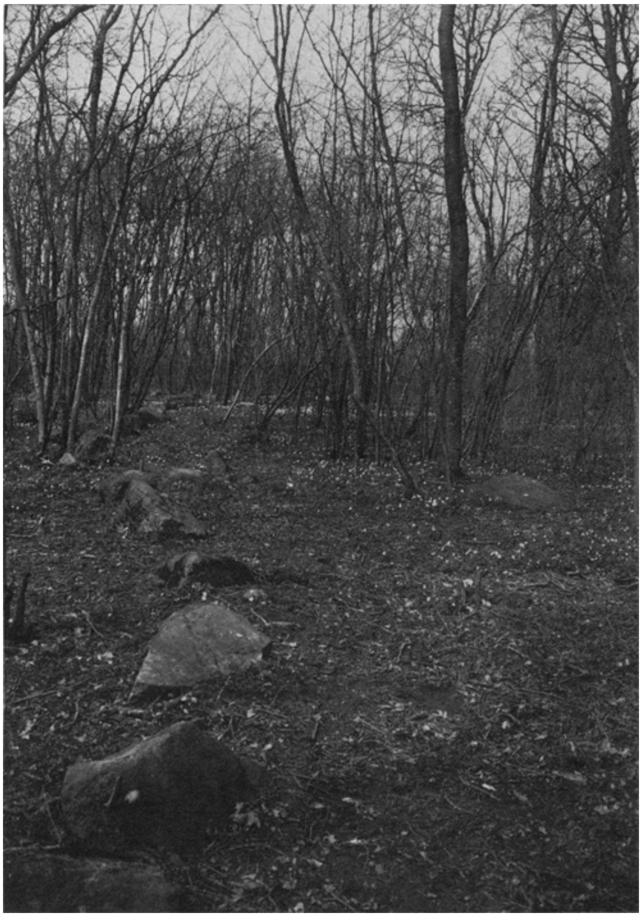


Fig. 4. Curved stone row with a boundary bank running into it at right angles. In the boundary bank a cup-marked stone. Køllergård Stations skov no. 32.

as pale lines, among others a group of relatively small, rectangular fields oriented ESE-WNW, several of them 30 × 40 m.

Vester Marie s.
13. (1) Woods on both sides of the Svanekevej road W of St. Bjergegård. In the W and N parts of this is a c. 8 ha area of banks and lynchets, bounded to the N and NE by a steep narrow valley containing a tributary of Tingsted å. The boundaries reach lengths of up to 150 m, the fields widths of c. 30 m.

14. (2) Woods E of the steep narrow valley mentioned in 13 contain another 8 ha area of banks and lynchets. To the N it abuts Tingsted å, and is bounded to the E and S by wet areas. Rows of large stones occur in several of the banks. The fields area mainly oriented NNE-SSW. Widths of various examples are 20, 25, 27 and 30 m.

15. (3) In the wood from the house Bjergly N to Tingsted å are stone rows and lynchets. This could be connected with the group mentioned in no. 14.

16. (4) The wood belonging to St. Bjergegård contains in its W part a single stone row. In the SE part of the wood are a number of parallel stone rows and a lynchet.

17. (5) The wood SW of St. Bjergegård towards the parish road contains 2 lynchets.

18. (6) The wood S of St. Bjergegård and S of the Svanekevej road contains stone rows and lynchets.

19. (7) The patches of woodland 4–500 m N of Vester Marie church contain a boundary bank with stone rows and lynchets covering several ha. The W part of the wood is wet.

20. (8) *Blemmelyng.* Parts of the E most section of the big, formerly heath section of the area used to have stone-filled lynchets and numerous cairns (Parish Inventory 123, Vedel p. 27).

21. (9) *Højlyngen.* In the parts now under cultivation were formerly many cairns, also stone-filled lynchets »up to 100 feet long, but only 6 feet wide ... In some place these ... are not straight, but almost form an angle« (Parish Inventory 56).

22. (10) The wood of 3 ha size immediately N of Lobbæk contains banks, lynchets and stone rows. The latter seem to be at least in part later, because they are not aligned with the straight banks (fig. 4). The fields are regular rectangles oriented NNE-SSW. Examples of field sizes are 30 × 80 and 40 × 60 m. Planned 1955.

23. (11) Aerial photographs of the land W and NW of the wood in no. 22. show paler lines forming rectangular fields.

24. (12) The 5 ha wood S and SE of Lobbæk has boundary banks and lynchets comprising parts of 9 fields. Oriented NNE-SSW.

25. (13) *Longerne*, a 10 ha wood near Sose, has boundary banks in its W part, which in many cases have single rows of large stones, and lynchets.

26. (14) Aerial photographs of the area W of Longerne towards the farm Dalbygård reveal traces of rectangular fields oriented NNE-SSW.

Nylarsker s.
27. (1) *Fynegårds skov* on the NE part of Blemmelyng contains over 4 ha of boundary banks, which enclose irregular rectangular fields. Planned in 1953 by O. Klindt-Jensen (Klindt-Jensen p. 134 ff, with a sketch).

28. (2) *Blemmelyng.* In the central and S part of this former heath area is a 40 ha area containing about 100 fields, bounded to the S and SE by the sandstone escarpment (see also no. 4), but with no clear boundary on the flat, wet and stony terrain to the N and NW. New plan and investigations 1953–58 (fig. 5). Earlier noted and partly sketched (P. Thorsen 1931). Aerial photographs of the area immediately N-NW of the wood show pale lines oriented NNE-SSW like the boundary banks in the wood.

The fields are mainly oriented NNE-SSW, although inclining more towards N-S further to the E. The banks form straight lines up to 300 m long. Examples of field sizes are 25 × 150 m, 20 × 60 m and 55 × 120 m. The banks are often massively stonefilled (fig. 6). The subdivision of a field is shown by among other things a different stone content in the primary

Fig. 5. Prehistoric field systems in Blemme Lyng, no. 28. Cairns are marked by star-dots. The numbers indicate excavation localities.

Fig. 6. Blemme Lyng. Stone-filled boundary banks, running into each other.

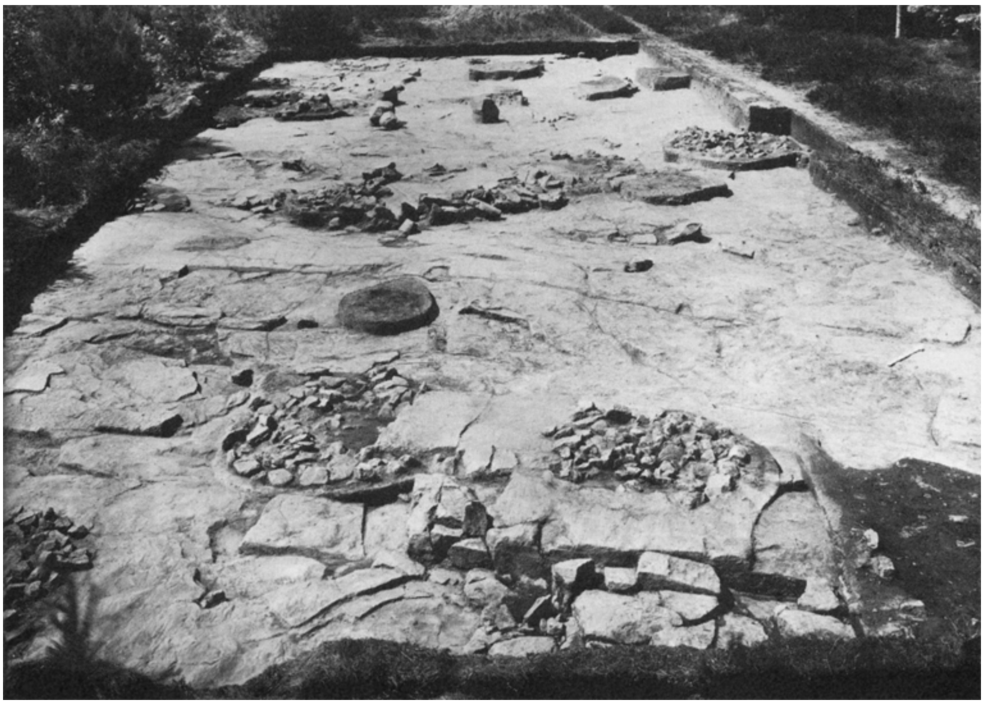


Fig. 7. Blemme lyng. Ditch and fireplaces in the thin cultivation layer over the sandstone rock. The excavation area traversed by a boundary bank.

and secondary banks. The area contains about 200 stone clearance and funerary cairns of various sizes. The phosphate analyses and about 40 excavations in the area reveal a settlement area in the S-central part. Ditches and fireplaces were found (fig. 7), indicating occupation around 1000, 850, 770, 410, 210 and 200 BC (K 2406 – 11). A grave dated to 410 BC is interpreted as contemporary with a nearby lynchet, while a fireplace dated to 200 bc lay beneath a boundary bank.

29. (3) *Hyldebrandsgård skov* is c. 2 ha in size and lies 300 m E of no. 28 on the other side of a marked dip in the landscape. There are boundary banks tightly packed with stones and heaps of stones (fig. 8). Planned and investigated 1959.

30. (4) *Wood near Langensgård.* A 3 ha wood, 400 m E of no. 29 contains banks, running N-S.

31. (5) *2 small woods near Uglegård,* 100 m S of no. 30, contain boundary banks. A well dug in the clay close to the N corner of one of the woods contained pottery dating from the 1st century AD. Planned and investigated 1960.

32. (6) *Køllergård station skov,* a 3 ha wood belonging to Dammegård 200 m E of no. 31, contains boundary banks with stones up to a metre across. Under a bank a pit with bronze age pottery. A dip containing a stream to the E, and Vellensby å to the S, could have formed the boundaries of this field unit. Planned and investigated 1956–57.

33. (7) Aerial photographs reveal fields immediately N of no. 32, covering about 3 ha, and oriented NNE-SSW and WNW-ESE, the same as the fields in the wood.

34. (8) Aerial photographs from S of Vellensby å reveal c. 1 ha of fields between the river and the road. Lighter coloured lines enclosing regular rectangular fields are oriented NNW-SSE and WSW-ENE, i.e. on a different alignment to no. 32–33. One field measures 40 × 50 m.

35. (9) *Nylars Præsteskov* (Præstebysket) lies c. 200 m NE of Nylars church, is 7 ha in size, and contains boundary banks and lynchets. The system is bounded to the S by a depression containing a tributary of the Præsteå, and to the east by water meadows. General orientation is WNW-ESE and NNE-SSW. A number of stone clearance or funerary cairns lie in the area. The field shapes and the course of the banks are irregular. The banks and lynchets contain many stones, some very large. (fig. 9) Planned and investigated 1955–57. (Brøndsted 1960, p. 98 ff).

36. (10) Aerial photographs show paler coloured lines between the stream forming the S boundary of no. 35 and the stream Præsteå. They run NNE-SSW and form a strictly rectangular pattern with some smaller fields. The pattern is not similar to no. 35.

37. (11) Aerial photographs show an 8–10 ha area of pale lines forming rectangular fields 300 m S of no. 36.

38. (12) A wood 1.5 ha in size N of Engegård has boundary banks throughout its area. They are oriented NNE-SSW and WNW-ESE and contain large stones up to 1 m across, sometimes arranged in rows. There is a rectangular enclosure, 10 × 5 m, divided off by stone rows, in a corner between two banks.

39. (13) Aerial photographs show pale lines in the area c. 100 m N and NE of (12) forming rectangular fields oriented NNE-SSW and WNW-ESE, covering 9 ha.

Fig. 8. Hyldebrandsgård skov. Stone-filled boundary bank uncovered.

40. (14) On the parish boundary with Rønne, the *Rønne plantage* system (see no. 3) crosses into Nylars s., bounded by the valley containing the Hakkedam brook.

41. (15) *Hjortheskov* and *St. Myregård skov* contain 6 ha of banks and lynchets forming broad, square fields generally oriented NNE- SSW. On the neighbouring fields, aerial photographs show pale lines forming square fields which to some degree join up with the fields in the woods. The system crosses the parish boundary and enters Rønne Plantage: it is topographically bounded to the W by the Roelsdal meltwater valley, to the E by Vellensby å, to the S by the slope of a late glacial meltwater river, and to the W by the meltwater valley containing the brook Hakkedam bæk. Along the northern edge of the area are several graves, including 3 large barrows. Planned and investigated 1953–60.

42. (16) A wood 0.5 ha in size S of Vellensby å S of Vestergård has a lynchet running WNW-ESE, and a bank at right angles to it.

43. (17) *Lille Myregård skov,* 2 ha in size, contains a lynchet with a few large stones lying singly.

44. (18) *Skyttegård skov,* c. 3 ha in size, contains banks and lynchets grouped on each side of a depression.

45. (19) *Lobberne,* c. 3 ha in size, under St. Myregård farm, has in its S part two powerful banks.

46. (20) A wood 0.5 ha in size 500 m W of St. Myregård contains banks.

47. (21) A wood 2 ha in size under St. Strandbygård contains large boundary banks and lynchets.

Fig. 9. Nylars Præsteskov no. 35. Stone-filled lynchet.

48. (22) A wood c. 1 ha in size under Lille Strandbygård contained »curious stone rows« noted by the teacher J.A. Jørgensen. They were about 30 m apart, and were cleared along with two bronze age cairns to allow cultivation in 1892–94.

Nørre h.
Hasle s.
49. (1) Aerial photographs of the area 200 m SSW of Julegård show lighter coloured lines, forming fields oriented NNW-SSE and ENE-WSW. The system continues E into Klemensker parish.

Klemensker s.
50. (1) See Hasle s. no. 49.

51. (2) Aerial photographs of c. 30 ha area between Øster Rosendale and Skrubbekrak show pale lines forming rectangular fields aligned NNW-SSE and WNW-ENR. Most of the system lies in Rutsker s. (no. 56), a smaller part in Klemensker.

52. (3) A wood under *Pilegård*, 4.5 ha in extent, has lynchets in the NE and SW.

53. (4) *Galtebuske*, a c. 2 ha wood under Ladegård, has several lynchets.

54. (5) Aerial photographs show destroyed boundaries as pale lines at Bækkegård.

Rutsker s.
55. (1) Aerial photographs of a c. 5 ha area E of the road from Hasle to Allinge, N of the side road to Helligpeder, show paler lines forming broad rectangular fields oriented N-S and E-W.

56. (2) See Klemensker s. no. 51.

Olsker s.
57. (1) *Blåholt skov*, c. 1.5 ha in size, has well-marked lynchets and banks in its N part.

58. (2) Aerial photographs of the W-facing slope of a steep valley c. 300 m SW of no. 57 reveal over 2 ha of dark lines forming broad, rectangular, rather small fields.

59. (3) *Stenløse skov* contains over 2–3 ha of field boundary banks, lynchets and stone rows. Aerial photographs of the area outside the W edge of the wood show over 2 ha pale lines, forming rectangular fields aligned NE-SW.

60. (4) *Vanddale skov* has a few lynchets oriented NNE-SSW in its W part.

61. (3) *Storløkkebakke* S of Allinge rises to 68.5 m. Aerial photographs show a c. 20 ha area of lighter coloured lines, forming rectangular fields oriented (with a little variation) N-S.

Rø s.
62. (1) *Dynddaleskov* contains c. 5 ha of boundary banks and lynchets in its E part on the slope down to the Dynddale å.

63. (2) *Rø Præsteskov* contains over 4 ha of banks and lynchets aligned NNW-SSE and ENE-WSW. An adjoining wood to the N has a single boundary bank. Planned 1960.

64. (3) *Skovholm.* In a 1.5 ha wood under the farm are banks and lynchets. Planned 1960.

Øster h.
Østerlarsker s.
65. (1) *Stokkeland skov*, 6–7 ha in size, contains boundary banks and lynchets. Some of the banks have rows of single stones.

Risen

Østermarie Sogn, Øster Herred, Bornholms Amt.

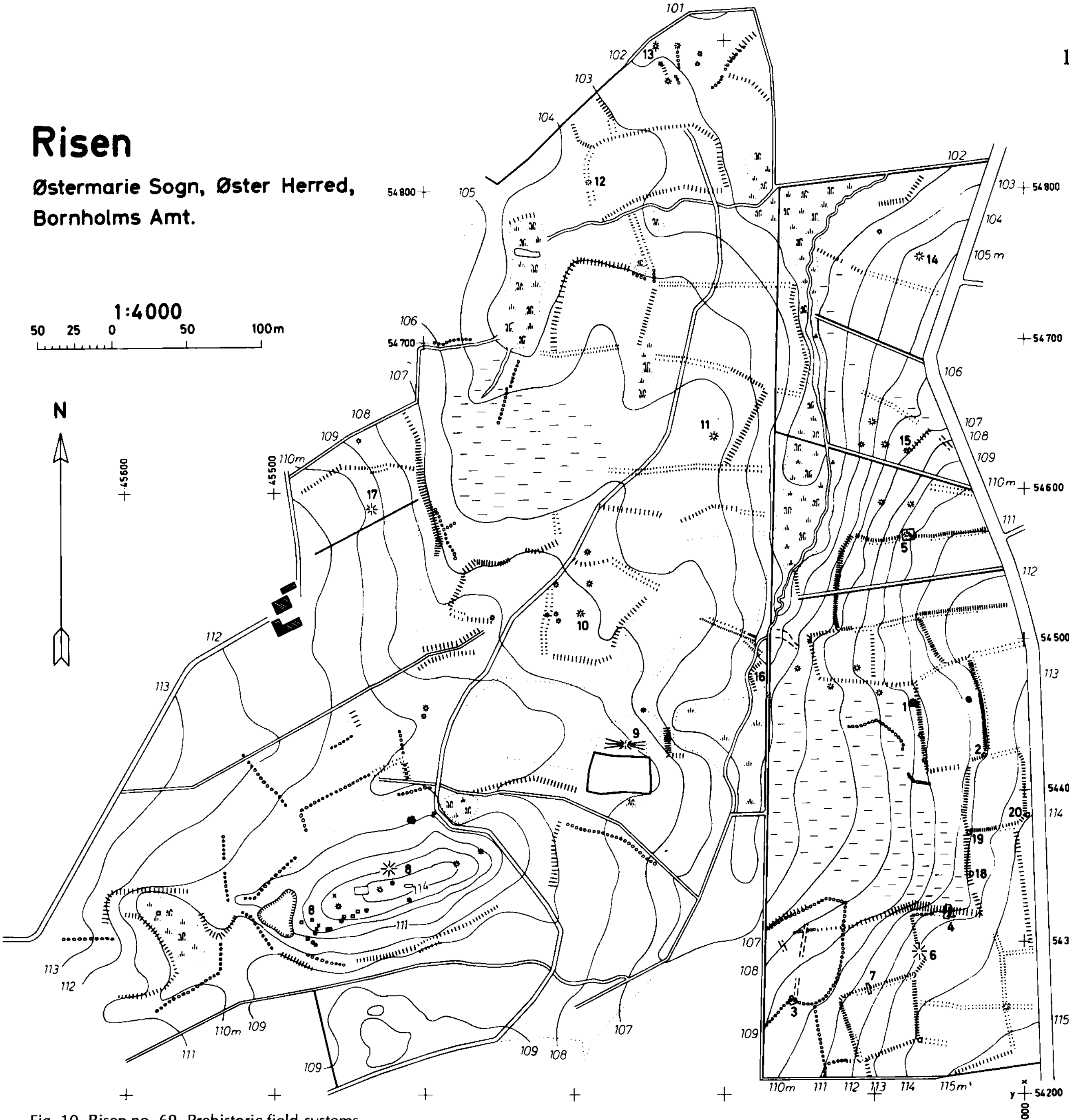


Fig. 10. Risen no. 69. Prehistoric field-systems.

66. (2) Aerial photographs show c. 4 ha of pale lines forming regular, rectangular fields about 500 m SE of no. 65.

67. (3) *Lensgård skov* has a single lynchet in its S part.

68. (4) *Højskov* under Damaskegård has two lynchets in its W part.

69. (5) *Risen* under Risenholm is the W part of a 20 ha wood lying E of the parish road running S from Østerlars Stationsby, and of which a little part is in Østermarie s. no. 70. The wood is situated on both sides of a stream almost following the parish boundary and contains banks, lynchets and stone rows. The hill cemetery, Bøgebjerg, which has graves from the earlier Iron Age through to the Viking period, (Klindt-Jensen 1957, a.o.p. 233), lies in the W part of the area. The area also contains stone clearance and funerary cairns. The boundaries appear to derive from 2 phases: an older, with rectangular fields delineated by boundary banks and lynchets, and a younger formed by stone rows, some of which have a curved and irregular character. – Planned and investigated 1960–61 and 1966. (fig. 10).

Østermarie s.
70. (1) *Risen*, see Østerlarsker s. no. 69.

71. (2) *Stamperelund*, 2 ha in size, has banks and lynchets throughout.

72. (3) *Lyrsby skov*. An outlying parcel of this wood N of the Gyldenå has 5 boundary banks aligned NNE-SSW, 150 m from the big group of standing stones at Louisenlund.

73. (4) *Lyrsby skov*. In this 18 ha wood, bounded to the N by the Gyldenå and cut through by a tributary of it, are widespread, well-marked, boundary banks and lynchets forming rectangular fields aligned NNE-SSW or WNW-ESE.

Ibsker s.
74. (1) A wood 2–3 ha in size S of Frennegård contains a few banks aligned E-W.

75. (2) *Stenskov*, 2 ha in size and with a W point abutting the churchyard of Ibs Kirke, the church of St. Jacob, has boundary banks and lynchets throughout, aligned NNE-SSW or ESE-WNW, forming rectangular fields.

76. (3) A wood of 20 ha 500 m E of Mandhøj under Skovsholm contains in its W part boundary banks surrounding broad rectangular fields.

Sønder h.
Neksø s.
77. (1) Aerial photographs of the gently sloping S and E facing terrain which forms the *Neksøvang field* show over 100–140 ha paler lines, forming rectangular fields. The fields are mainly oriented ESE-WNW. Several subdivisions can be recognized, e.g. the E part, which has trapeze shaped areas 200 m N-S and 100 m wide. These are divided into fields 30–40 m across aligned ESE-WNW. Sample sizes of other fields are 80 × 45 m and c. 120 m × 40 m.

Some dividing lines can be followed over considerable distances. One runs c. 450 m E-W, and another cuts this at right angles and is c. 320 m long. Field shapes and sizes are similar from one end of the area to the other. In the S part of the area the main orientation changes somewhat, so that it runs E-W or ENE-WSW.

Bodilsker s.
78. (1) Aerial photographs of the S and E facing slopes W of Tornegård near the cemetery hill Slamrebjerg, show c. 10 ha pale lines forming rectangular fields. They are bounded to the N and W by the cliffs and rocks of Slamrebjerg. The main orientation is ESE-WNW. The rectangular pattern is strictly adhered to. Examples of field sizes are c. 85 × 30 m and 45 × 30 m.

79. (2) A wood under *Julsgård* N of Sejersminde, N of and up to the road from Bodilsker to Pedersker, contains a few faint boundary banks on a flat area of clay soil sloping to the S.

80. (3) *Brandskov* has in its W part faint traces of banks and lynchets on a flat area of clay soil. In several places the banks have rows of single, large stones.

81. (4) A wood under Skovshøj S of Julsgårde lies on flat clay soil. Clear boundary banks and lynchets are present throughout.

82. (5) Under *Gadegård* is a 4 ha wood on even S sloping terrain. A few boundary banks and lynchets are the remains of at least 6 fields.

83. (6) *Soneskov*, 6 ha in size, is near Store Kannikegård immediately S of no. 82. It contains several lynchets and boundary banks. Because of the terrain these are relatively irregular.

84. (7) Aerial photographs show pale lines forming rectangular fields mainly oriented N-S and E-W in the area SW of Soneskov, no. 83.

85. (8) *Jomfruskov* near St. Kannikegård has a few boundary banks and lynchets in a 1.5 ha area in its N part.

Poulsker s.
86. (1) A small wood W of Dammegård farm has a few boundary banks and lynchets in its W part.

Pedersker s.
87. (1) Aerial photographs show light coloured lines covering c. 12 ha of the even, S facing land S of and running up to the Rønne-Pedersker road. They form a rigid geometric system of regular rectangular fields. To judge from the extent of the lines, the system extended in all directions.

Åker s.
88. (1) On *Åker heath* are "long heaps of stone, sometimes straight, sometimes bent or angled", in connection with some cairns (Vedel p. 27, Parish Inventory 142).

ZEALAND
Frederiksborg a.
Lynge-Kronborg h.
Tikøb s.
89. (1) *Horserød hegn* has c. 20 ha of boundary banks and lynchets in its SW part. The area of cultivation is bounded to the N by the bog Stone Svends mose and Ellingekær, to the E and SE by Gurre sø or the slopes running down to it, and to the S by uneven terrain with depressions and boggy areas. It might have extended a little further to the W. The area is hummocky, with a varied but mainly gravelly soil cover. The whole area has about 80 stone cairns or graves, mainly small and in the S part of the area. Only a few of the c. 30 field areas are fully surrounded by boundary banks. Most are, due to the uneven terrain, irregularly rectangular, only a few being regular. – The area was planned and investigated in 1956. Finds of a firedog, querns and hammerstones suggested cultivation in the earlier Iron Age.

Blovstrød s.
90. (1) *Tokkekøb hegn* has 8–10 ha of boundary banks and lynchets in its SW part. They form broad rectangles. The surface of the area is even in contradiction to the often more hummocky parts of the wood.

Birkerød s.
(1)–(4): *Rude skov* has many areas of boundary banks and lynchets. The landscape is very uneven, and broken up by many meltwater valleys, lakes, bogs and hills, including Mag-

lebjerg, the highest point in N Zealand. There are several, partly interconnected areas:

91. (1) In the N part of the wood banks and lynchets cover about 50 ha, mainly on 6 hills but interconnected to a degree. Planning was begun in 1983.

92. (2) A separate 6 ha area occurs in the central part of the wood.

93. (3) There is a c. 3 ha area in the east central part of the wood.

94. (4) The S area contains a 3 ha system.

Hørsholm s.
(1)–(3): *Folehave* with Sandbjerg Østerskov has 3 areas of clear boundary banks and lynchets. They are separated from one another by meltwater valleys which are partly filled by bogs.

95. (1) The E part of the wood has a system stretching 1 km N-S, about 200–300 m wide.

96. (2) The N central part of the wood has a 15 ha group.

97. (3) The S part of the wood, called Sandbjerg Østerskov, has a group over 1000 m long from N-S, and 300 m wide in the centre.

The pattern seems to be regular, broad rectangles. In all three cases Bronze Age barrows predate the boundary banks.

Holbo h.
Esbønderup s.
98. (1) *Ostrup Kobbel* in Gribskov has over c. 3 ha of lynchets in its western part, immediately W of the road from Nødebo to Esbønderup. They are aligned E-W and N-W. One can be followed over 80 m. 3 funerary cairns are associated. The system is partly bounded by ridge and furrow cultivation to the W.

Ølstykke h.
Ganløse s.
(1)–(2): *Ganløse Ore.* The wood contains c. 30 ha of boundary banks and lynchets, divided into 2 main parts:

99. (1) the eastern encompasses c. 8 ha, and lies on an area of high ground which is bounded by steep drops towards bogs to the S and E and meltwater channels to the W and SW. Only a few of the 12 or 13 field areas are bounded on all sides, so that only a few are of known area. Most of the lynchets are aligned WSW-ENE, but others follow the terrain. In the N part, 2 small barrows abut against a N-S bank. Planned 1960.

100. (2) The western part has a c. 1500 × 250 m area of boundary bank and lynchets on a steep S facing slope overlooking a bog. Wet and uneven areas form the N edge. Orientation is generally WSW-ENE. Immediately to the N are barrows of Bronze Age type.

Horns h.
Dråby s.
101. (1) *Færgelunden's* middle section has a few boundary banks and lynchets on the E-facing slope.

København (Copenhagen) a.
Sokkelund h.
Lyngby s.

102. (1) *Jægersborg dyrehave* has a few parallel lynchets in its S part, on the S facing slope towards Fuglevangs road.

Søllerød s. (note 2)
(1)–(3). *Jægersborg hegn* has ridge and furrow fields in its NW and SE parts, and in its E section several areas with boundary banks and lynchets divided from each other by tunnel valleys and meltwater valleys.

103. (1) The southernmost occurrence is seen N of Rådvad, covering c. 8 ha. It is probably connected with a 15 ha area to the NE which is bounded to the N by the valley containing Skodsborg lake.

104. (2) An area of c. 12 ha runs from the N edge of the Skodsborg valley as far as Bøllemosen.

105. (3) A few rectangular fields can be seen between Bøllemosen and the N edge of the wood.

The usually regular, broad rectangular fields in all 3 areas are generally oriented roughly E-W, between WNW-ESE and ENE-WSW. Only a few field areas are fully bounded, so sizes cannot be determined. Early Bronze Age barrows are present in all 3 areas, and no. 103 and no. 105 also have barrows from the Late Bronze Age.

106. (4) *Trørød skov* includes much of a morainic area surrounded by meltwater valleys. Areas of boundary banks and lynchets are found in the S part, and in a belt on and over the slopes to the NE and NW. These areas form limited sections each of about 5 ha. The preserved boundaries seem to frame regular rectangular fields. The 3 or 4 areas with boundaries could all belong to the same field system. There are about 30 Bronze Age barrows in the area, ranging in size from small to large. Some are used as primary marker points for the field boundaries. Pottery and flint of Late Bronze Age type has been found in the S part.

(5) and 6): *Geelskov*, a large hilly area, up to 50 m in altitude, is bisected by a meltwater channel running NW-SE. The S and W area has an 85 ha field system with natural boundaries almost all the way round (Geelskov I). The NE area has a 30 ha area (Geelskov II). Both were planned and investigated 1954–56 and 1960 (fig. 11).

107. (5) *Geelskov I*, the larger of these field systems has about 100 fields. By virtue of its size alone this is one of the most important sites in east Denmark. Also this area includes the remains of megalithic graves, and particularly along the S section there are a number of barrows dating from the Bronze Age, and a number of stones with cupmarks.

The area is, as mentioned, naturally bounded by slopes and valley bottoms, which would have been difficult or impossible to cultivate. To some extent these could have been grazing areas, possibly also used by neighbouring villages. There would also have been grazing on the promontory in Furesø, at Dronninggård and Næsseslottet, because the terrain and moisture content would not have been suitable for cultivation there either.

Within the field system, on the other hand, the fields are packed closely together (fig. 12), and difficult terrain or water conditions seem to have prevented cultivation in only a few

Fig. 11. Geelskov I and II, no. 107 and 108. 1:10.000.

places. This was the case with a shallow depression running N-S, which still contained a couple of areas of standing water at the time of the investigation, and in a narrow and somewhat steep sided valley running E-W from the SE corner of the Vejlesø into the higher Geelsbakke area. The bottom of this, although surrounded by lynchets, seems itself never to have been cultivated. Finally, further to the S is a single area, partly filled by a small lake and partly with very uneven terrain, which would not have been suitable for cultivation.

Within the complete system, few fields are completely surrounded by boundaries and so of clearly determinable size. It is evident that most of the fields belong to a rectangular type, of which the ratio of the long to the short sides can vary between 1:2 and 1:6, typical field sizes being 140×40 m and 155×30 m. Wider fields appear furthest to the W in Tyvekrogen, e.g. 100×65 m and 70×50 m, and also furthest to the N and S. In other words, it seems that the narrower fields are concentrated in the S central area, where a settlement is documented.

The orientation of the fields on the S part of the hill is mainly N-S, with a slight turn towards NNE-SSW, although in some cases the terrain causes an E-W alignment. On the N part of the hill, where the system has been severely damaged by among other things sunken roads of later date, the general orientation is E-W, although with N-S aligned fields furthest to the N. In the central part, the fields are fairly clearly grouped in pairs, with one of them being rather larger, e.g. by a factor of 5–10%, than the other. Such paired fields can appear either as a very long field divided more or less across the middle, or as a wider field divided parallel to its long axis. This subdivision seems to be a primary feature of the field system.

As mentioned, the field boundaries are complete in only a very few cases. Not only may they have been destroyed, they may indeed never have existed in complete form. In this connection it can be mentioned that most fields have openings or breaks in the boundary banks in the corners. Exact calculation of the areas of individual fields is therefore difficult and problematic.

Phosphate analyses in the W and central parts of the field system have generally given low phosphoric acid levels. Excavations in areas with abnormally high values on the S facing slope produced a Bronze Age pit with pottery dating from around 1150 BC (K 2308–09) (fig. 13). Further under a boundary bank a Pre-Roman Iron Age fireplace appeared to be from about 360 BC (K 2313–14).

The Geological Survey of Denmark, through its Geobotanical Department undertook investigations in a small wet hollow. (*Journal of Danish Archaeology* 1983, p. 190f). Two phases of deforestation were visible, the earlier a grazing horizon with bracken growth, and, after a woodland regeneration, a later one with large open areas. After this the woodland regenerated, dominated by beech.

Archaeological investigations have been carried out in about 50 locations in the W and central parts of the wood, the results of which may be linked with the vegetational history shown by the pollen. Neolithic occupation parallelling the visible megalithic remains has been demonstrated by finds of pottery, and charcoal has been dated to c. 3000 BC (K 2306–07). This could correspond to the first clearance phase. Cultural remains are thereafter absent – and the woods thus able to regenerate – until the Bronze Age barrows were erected and the above-mentioned pit dating from 1150 BC was dug; this was in the Middle Bronze Age. There is a series of radio carbon dates for this second clearance phase: 1040 BC (K 2318); 810 BC (K 2317); 780 BC (K 2310); 530 BC (K 2311); 510 BC (K 2312); 430 BC (K 2303); 410 BC (K 2304); 380 BC (K 2313); and 340 BC (K 2314). These supplement the archaeological observations.

Fig. 12. Geelskov, no. 107. Boundary banks in the central part of the wood.

The great regularity of the field system suggests that it must have been laid out on cleared land. It probably belongs quite late, because the dates of 430, 410, 380 and 340 BC come from e.g. charcoal from fireplaces lying under lynchets and boundary banks. The abandonment of cultivation and the transition of the area to beech forest and the subsistence practices connected with this, takes place after the introduction of rye. Later activity in the area is shown by a fireplace dated to the 12th or 13th centuries (K 2315–16), and by the many medieval sunken roads which cut down through and destroy parts of the earlier field system in the E part of the area.

108. (6) *Geelskov II.* N and E of the steep sided valley forming the E boundary of the Geelskov I field system is the 30 ha area comprising Geelskov II. It is bounded to the NW by Søllerød lake, to the W and SW of steep valleys, and to the SE of a small meltwater valley. The landscape suggests it could have continued beyond the present Søllerød village (see no. 109).

The preserved section encompasses about 40 distiguishable fields, of which most are broad irregular rectangles. Orienta-

Fig. 13. Geelskov I. Bronze Age vessel from pit.

tion, partly determined by the landscape, is mainly E-W, different from Geelskov I. There is also a difference in the patterning, as the paired fields seen in Geelskov I do not appear in Geelskov II, which seems however to have groooups of 3 or more similar fields belonging together. Planned 1960. On the edge of the field system are 2 small barrows.

109. (7) *Søllerød kirkeskov* is on very uneven terrain, bounded to the N by a steep-sided meltwater valley containing Søllerød lake, and further S by a side branch of this. In the S part of the wood are wellmarked lynchets and boundary banks. This system could theoretically belong with no. 108, as there is no particular natural dividing line in the 800 m of land in between.

110. *Frederikslund skov* has a single lynchet facing W, which can be followed N-S for about 70 m, in the E part of the wood E of a hollow filled with water.

Smørum h.
Værløse s.

111. (1) *Ryget* and *Præsteskov* form the E and W portions of a woody area S of Farum lake, and occupy a considerable part of a promontory almost completely surrounded by Tunnel valleys (Larsen 1965). The more level, upper part of the promontory has a 15–20 ha area of boundary banks and lynchets. They form apparently regular rectangular fields oriented NE-SW and WNW-ESE.

Sømme h.
Roskilde s. (formerly Skt. Jørgensbjerg s).

112. (1) *Boserup skov* has boundary banks and lynchets in large sections of its S part. The system is bounded to the E by a small meltwater valley, and seems to have included the central part of a promontory (almost an island) surrounded on all sides by Roskilde Fjord or by streams running into the fjord. The boundaries are scattered over c. 80 ha. They have the usual orientation, and seem to have enclosed broad, rectangular fields. Within the field system are two large Bronze Age barrows, and in its S part 3 low barrows.

Voldborg h.
Allerslev s.

113. (1) *Oren.* The NW part of the wood has an area of boundary banks and lynchets measuring 300 m by 50–100 m, above and on a steep N and NW facing slope. The boundaries do not appear to have crossed onto areas on the other side of the low-lying terrain, so the field system must have been of very limited size. A small barrow lies immediately N of the area. In the S part of the wood is a group of 7 barrows, and to the E the small cemetery hill, Vettenbjerg with barrows and stone arrangements.

114. (2) *Møllesø skov* lies on the slope running down into the meltwater valley containing the stream Lejre å. In the widest part of the wood is a flatter area with a 300 × 100 m area of boundary banks and lynchets. They form broad, rectangular fields. To the N they stop at the edge of the wood, and could therefore have continued further to the NW.

115. (3) *Hulegårds skov* contains a large barrow on top of an even area of high ground. There are lynchets around the barrow and below the high ground. Definite fields cannot be made out.

116. (4) *Røgerup skov* has an area of S and SW facing slope in its E part, surrounded on all sides within the wood by depressions with lakes or watercourses. On this slope are several boundary banks and lynchets, some linking up with 2 large barrows. The field system could have continued to the NE.

Hvalsø s.

117. (1) *Storskov* has a few boundary banks and lynchets from 2 or 3 fields in its SE part, connecting with a barrow.

Såby s.

118. (1) *Åstrup skov* has in its N part, Hestehaven, a c. 20 ha area of boundary banks and lynchets. The field system lies on the W and S slopes of a hill, on top of which are 2 Bronze Age barrows. The banks are wide, c. 6 m. They enclose broad rectangular fields, one of which measures 70 × 47 m. Within the area is a stone with cupmarks. The terrain has been heavily cut up by sunken roads.

Gevninge s.

119. (1) *Overdrevsskoven* lies on the N facing slope of a hill which is naturally bounded by the slopes of watercourses except to the S. It contains c. 6 ha of boundary banks and lynchets. These must all form one complex, and enclose 8 visible fields. These are of broadly rectangular shape and generally aligned E-W with the slope (fig. 14). N of the field system are 7 large barrows. – Planned 1978.

120. (2) *Borrevejle skov* has some barrows in its W part, in connection with which are a few lynchets scattered over 1–2 ha. In the central part of the wood there are also a few lynchets and boundary banks.

Holbæk h.
Årby s.

121. (1) *Vesterskov* on Asnæs has a few boundary banks and lynchets in its E part, some connecting up with a Bronze Age barrow.

Ods h.
Vig s.
122. (1) *Jyderup skov* has uncertain traces of a few banks and lynchets among stone cairns in its S part.

Sorø a.
Alsted h.
Lynge s.
123. *Broby Vesterskov* lies partly in Lynge s. S of the road. In this part are c. 10 ha of boundary banks and lynchets. The field system lies on a promontory bounded to the E, S and W by slopes, and by the Tamose bog near the stream Suså to the SV. Its broad rectangular fields do not seem to have extended to the N.

124. (2) *Suserup skov* has a few lynchets in its N part in an area showing evidence of later cultivation in the form of ridge and furrow fields.

125. (3) *Topshøj skov* contains the 7 ha field system planned and described by Gudmund Hatt (Hatt 1949, p. 117 ff). The field system lies on a S facing slope, and is bounded by among other things a hill to the N, a slope to the W and a bog to the SE. The boundaries have an irregular course. The fields, which are not bounded on all sides, are equally irregular and of different form. The terrain has many stone cairns, and the boundaries are full of stones.

Broby s.
126. (1) *Broby Vesterskov* contains c. 8 ha of lynchets and boundary banks, in the S part of the wood on the upper part of the slope down to the stream Suså.

Alsted s.
127. (1) *Alsted skov* has two lynchets around a small barrow in its E central part.

Gyrstinge s.
128. (1) *Lille Bøgeskov* has a few boundary banks and lynchets in its SE part, which due to the natural boundaries on the terrain could have enclosed a few fields only.

129. (2) *Lille Bøgeskov*'s NW central part has boundary banks and lynchets covering several ha.

Ringsted h.
Haraldsted s.
130. (1) *Langebjerg skov* in the W part of Vesterskov has c. 8 ha of boundary banks and lynchets. One side encompasses a hilly area, which is sharply bounded to all sides except the E by slopes down to wet areas. The fields are broad and rectangular.

131. (2) *Kærstrup skov*, the SW part of Allindelille Fredskov, has a few lynchets and boundary banks. On the top of a S facing hill is a small barrow.

Vester Flakkebjerg h.
Holsteinborg s.
132. (1) *Rude skov* has a few boundary banks in connection with 2 barrows in its SE part.

Øster Flakkebjerg h.
Gunderslev s.

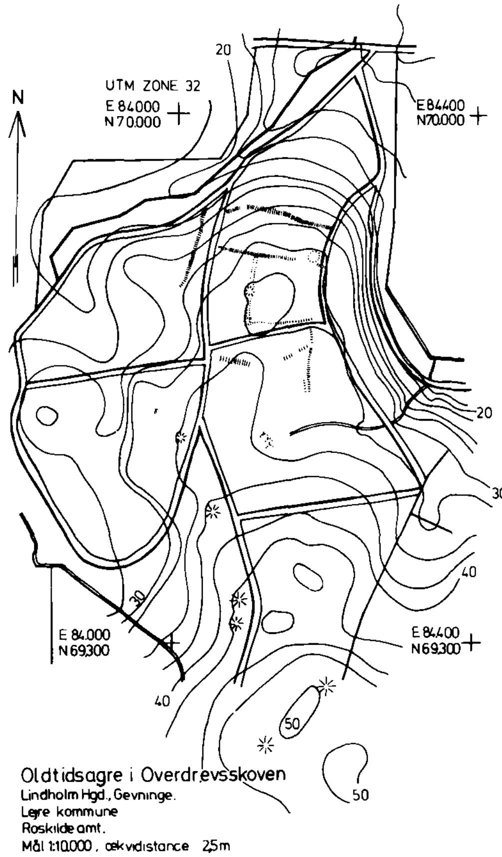


Fig. 14. Overdrevsskoven no. 119. 1:10.000.

133. (1) *Borup Ris* is grazing land and wood containing early and later medieval fields (see p. 136). Within these are several flattened lynchets. A hypothetical reconstruction of the earlier c. 40 ha big system has been published by Axel Steensberg (Steensberg 1983, P. 22).

134. (1) *Dyrehaven's* W section has a few boundary banks and lynchets.

135. (3) *Tvede Vænge* has a few lynchets in its northern part.

Herlufsholm s.
136. (1) *Kalby Ris* has in its eastern part traces of ridge and furrow fields and in the NW (on a N slope) a series of 3–4 weak lynchets with stones.

Bjæverskov h.
Valløby s.
137. (1) The wood Purlund has on a N slope down to a depression opposite the neighbouring Pramskov, a few lynchets and a single boundary bank.

Præstø a.
Fakse h.
Karise s.
138. (1) *Tokkeskov* has 7 ha of boundary banks in its S part, bounded to the N by watercourses. They form several broad

rectangular fields, mainly aligned WNW-ESE. To the NE are later traces of ridge and furrow fields. Planned and investigated by Axel Steensberg in 1944 (Steensberg 1951 p. 241 ff).

139. (2) *Karise Hestehave* has a few banks.

Tybjerg h.

Herlufmagle s.

140. (1) *Glumsø Østerskov* has several ha of strong lynchets on a S facing slope in its SW part.

Fensmark s.

141. (1) *Stenskov* has c. 20 ha boundary banks and lynchets on the S and W slopes of the hilly area, which forms the NE part of the wood and with Vesterhøj as its highest point. The banks are full of stones and form broad rectangular fields.

Glumsø s.

142. (1) *Glumsø Østerskov* has about 10 ha lynchets and banks in its N part. The field system lies on the top of a N facing slope and is bounded by a steep slope to the NE. The prominent lynchets are aligned WNW-ESE.

143. (2) *Østerskov* has lynchets in its SE part which continue in Herluflille Bøgede.

144. (3) *Glumsø Vesterskov* has c. 10 ha lynchets and banks in its S part. The field system covers the N slope of Hejrebjerg hill and the S slope of a hill to the N. The fields are broad and rectangular, and are oriented WNW-ESE.

Bavelse and Næsby s.

145. *Næsbyholm Storskov* is a 550 ha forest which with its N section Enemærket has lynchets and boundary banks throughout. The wood is bounded to the N by the small stream Suså, to the W and SW by Tystrup lake, and partially to the NE by steep slopes. The natural boundaries in some cases extend outside the wood. Areas of hills, slopes and wet areas form natural dividing lines in several places within the large woodland area. The field areas seem to be divided up by these into several sections, although these divisions do not seem to be total. Some of the sections seem to be characterised by long throughgoing boundaries.

The entire forest has been searched for field boundaries, barrows, stones with cupmarks and querns in connection with the planning which was carried out in 1960–65 by the author and his wife. Phosphate sampling was systematically carried out and a few excavations made. At the same time the Geological Survey of Denmark made a surface map of the area. The same body's Geobotanical Department carried out pollen analyses in 1982, particularly at one point in the S part of the area.

The boundaries were overwhelmingly made up of lynchets. Besides these, 280 barrows or other graves were mapped including several megaliths, 33 stones with cupmarks and 8 querns. The phosphate analyses showed a number of concentration. Several of them, mainly along the lake shore, were of very limited size and can be regarded as hunting or fishing sites. Larger ones away from the lake lie in the various areas of fields. One cannot automatically assume a connection with the field systems, however, as the phosphate concentrations presumably reflect 3000 years of settlement between the neolithic in about 3000 bc and the Roman Iron Age.

The section which is most topographically separate is *Enemærket*, the N part of the wood, bounded to the N by the Suså, to the W by Tystrup lake and to the S by a depression with a stream; to the E the system could have continued a bit beyond the woodland edge (fig. 15). Field boundaries cover here about 20–25 ha of land gently sloping down from a hill with a large Bronze Age barrow on top. Field sizes and shapes are difficult to determine, because only a few fields are completely surrounded by field boundaries, but a number of irregular, broad rectangular fields can be recognized aligned E-W and N-S. Some fields run almost onto the lake shore. The visible boundaries – the lynchets – formed as a result of agricultural activities, and generally merge with the landscape without the soil suggesting any continuation. On this background it is characteristic that in several cases the fields have access ramps which in this gentle terrain shows that the fields were basically closed, without this having left any direct trace. 20 small barrows, presumably Middle or Late Bronze Age, lie on hills between the field system and the Suså. The highest phosphate values were in the centre of the field system around the large barrow on the hilltop. In this area were surface finds of flint and pottery of Bronze Age character.

The second section encompasses the *middle part of the forest* as far as to the old parish boundary between Næsby and Bavelse, an area measuring c. 1.8 km NE-SW, and c. 0.8 km wide. The area contains 119 Bronze Age barrows, mostly small or medium in size, but a few of them large. They are scattered throughout the field system, but round the edges are several groups of 5–10 barrows, on the hills or promontories that form the limit of the cultivation area. In only a few cases are the barrows included in the boundary system, so they can be regarded as predating it. In most cases the barrows are set inside the actual fields, sometimes taking up a large part of the area of a field.

Most of the fields are completely irregular. Their sides are often curved, sometimes strongly so, a.o. according to features of the terrain. Often it can thus be difficult to speak of regular shapes as such. Indeterminate rectangles, rhomboids, trapezes, triangles, kidney shapes and semicircles appear everywhere. A special feature is that several of the barrows are situated inside quite small fields with powerful lynchets. With the reservations about determining field size just mentioned being taken into account, sizes vary between ca. 300 m^2 and 9000 m^2. Some difference in shape and orientation can, however, be discerned between the fields in the very uneven W areas and the more even terrain to the E. The latter area is cut across by a 500 m lynchet aligned NNE-SSW, and several of the fields are straight sided and uniformly oriented NNE-SSW. Fields of less definite shape seem to be secondary additions onto the straight field boundaries.

Phosphate values are high in several places. This was the case in the N central part of the field system, and at 3 locations in the S part near more regular fields. In one of the areas of high phosphate values were sherds apparently of Pre-Roman Iron Age date. An Early Roman Iron Age settlement deposit

Fig. 15. Næsbyholm storskov no. 145. North part of the wood, lynchets with access ramps are seen in the middle of the picture.

was excavated on the slope of a steep gravel bank in one of the others. This dated to the 1st century AD. Besides such pottery, about 15000 bone fragments were recovered. These have been examined by Dr. Ulrich Møhl. The animal life they represent reflect a grazing countryside with woodland close by, and also lake or riverine exploitation for fish.

The eastern part of the forest forms a third unit. This is bounded to the NW and W by steep slopes, and to the S by small bogs and low areas, though the system extended further NE and E. The fields are rather scattered, because the landscape is hummocked and has lowlying areas. There are about 25 barrows spread along the S fringe. Down towards this area inside the field system is a high phosphate area. The countryside in the S and SW part of the forest is cut through by many hills, slopes and bogs, although groups of fields cannot be distinguished as separate units.

Great variation in size and shape is also here evident within the various field groups. Orientation is normally N-S and E-W, but many exceptions can be seen in the often curved boundaries. One notable feature is the presence of some very small fields of 145, 160 and 170 m^2 abutting against much larger fields. The grouping of Bronze Age barrows on several of the high areas seem to be connected to groups of fields.

In the eastern part there are several places of high phosphate values, including the areas furthest to the NE and SE, and to the SW next to a bog. This part also contains several megaliths, dolmens and a passage grave. The settlement areas giving rise to the high phosphate values could thus derive from different times within a long timespan.

In one of the small kettle holes, one side of which was formed by a lynchet and which lay close to irregular fields and some barrows, was deposit suitable for pollen analysis. The analysis has not been completed. A few radiocarbon determinations have been made. Provisional results (note 3) from the Geobotanical Department of the Geological Survey of Denmark suggest that the pollen diagram covers the whole of the postglacial period. It shows two periods of human activity belonging to the Neolithic (older than 2400 BC, calibrated C14 years). The earliest shows the burning of the original lime forest (which also contains oak and hazel). Only the lime itself

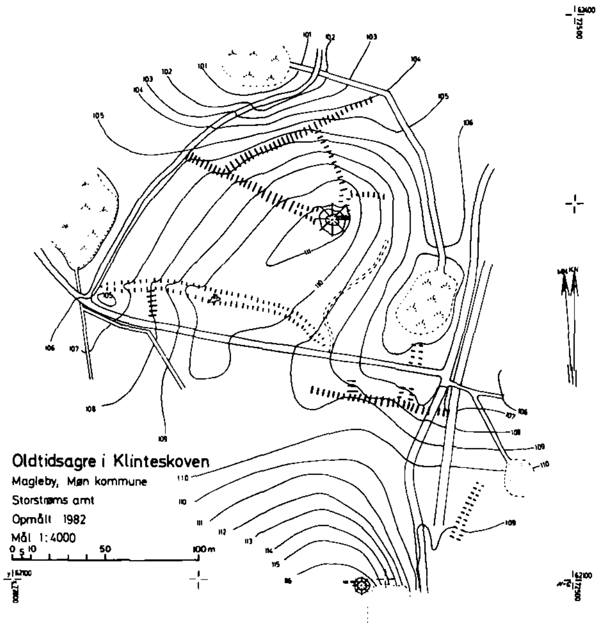


Fig. 16. Klinteskov, Plantehaverne no. 148.

escaped this fate, possibly because of its usefulnes as leaf fodder. During the later phase the area was used for grazing (oak, alder, ash and hazel woods with glades containing grasses, plantain and bracken). It is not known how long these periods lasted, but they must be some hundreds or thousand of years long.

From some time in the Neolithic until c. 1200 BC the area was abandoned, and lime forest (lime, oak and ash) regenerat- After 1200 BC forest clearance and cultivation took place again, and only a few limes survived this. Weeds were common (grasses, plantain, sheep's sorrel, mugwort, knotgrass, various composites). Cultivation stopped before 160 AD (calibrated C14 date). Grazing took place thereafter for about a century (oak, hazel, a little beech and lime, with clearings containing grass). Then the area was abandoned and was overgrown with beech woods.

The megalithic graves and neolithic finds can be fitted into the first clearance phase of the development. The appearance of the many Bronze Age barrows fits with the cultivation phase after 1200 BC. Linked with this cultivation is at least the lynchet at the investigated kettle hole. The planned field system, which must in large measure be described as amorphous, could thus belong to this period. In suppport of this is the fact that the barrows do not, as they usually do, appear as elements predating the field systems. The existence of the excavated settlement layer from the 1st century AD and not least the faunal material does not conflict with the cessation of cultivation shortly before 160 AD.

Bårse h.
Beldringe s.
146. (1) *Dyrlev skov* has several ha of boundary banks and lynchets in its central part W of Highway 2. One of the banks has stones set into the ground bearing cupmarks. This system crosses into Udby s.

Udby s.
147. (1) see Beldringe s. (no. 146).

MØN
Møn h.
Magleby s.
148. (1) The *Plantehaverne* section of *Klinteskov* contains c. 4 ha boundary banks and lynchets (fig. 16). The system is bounded on most sides by kettle holes containing small bogs, and to the SE by a hill slope on top of which are 12 small barrows. Hills further N and NE have more barrows, including some small ones presumably dating from the Late Bronze Age. Within the field system, a barrow is used as the starting point of a field boundary in the WNW and the N. Field shapes are diffuse. Only one, more or less triangular, is completely delineated by boundaries. It is estimated that there cannot have been more than 8 fields. – Planned 1981.

LOLLAND
Maribo a.
Musse h.
Nysted s.
149. (1) *Roden skov* has several ha boundary banks and lynchets, some with stones, in its SW part immediately E of the Forest Supervisor's house. The boundaries enclose rectangular fields of e.g. 30 m breadth, aligned E-W.

FYN
Svendborg a
Salling h.
150. Brahetrolleborg s.
(1) *Brahetrolleborg Storskov*, in its central part near *Store Tangbakke*, has 8 ha boundary banks and lynchets (fig. 17). The field system is bounded to the E by St. Tangbakke, and elsewhere by wet areas. To the W it is touched by the path of the former railway from Nyborg to Svendborg. During the middle ages the area was used for cultivation with long, narrow fields. Stone rows in the furrow boundaries between them were located by probing. In the S part these were aligned NNNE-SSSW, in the centre NW-SE, and formed at least 8 parallel fields forming a 125 m wide band. The prehistoric system was damaged by the later cultivation, so that evaluating the fields' shapes and areas is difficult. In particular, the extent of several powerful lynchets shows that the system must originally have consisted of 15–20 fields, which were mainly irregular squares. – Planned 1960.

Vindinge h.
Avnslev s.
151. (1) *Skemark skov* under Juelsberg contains 4 ha boundary banks and lynchets. The system is bounded by bogs on several sides, and within it are two Bronze Age barrows.

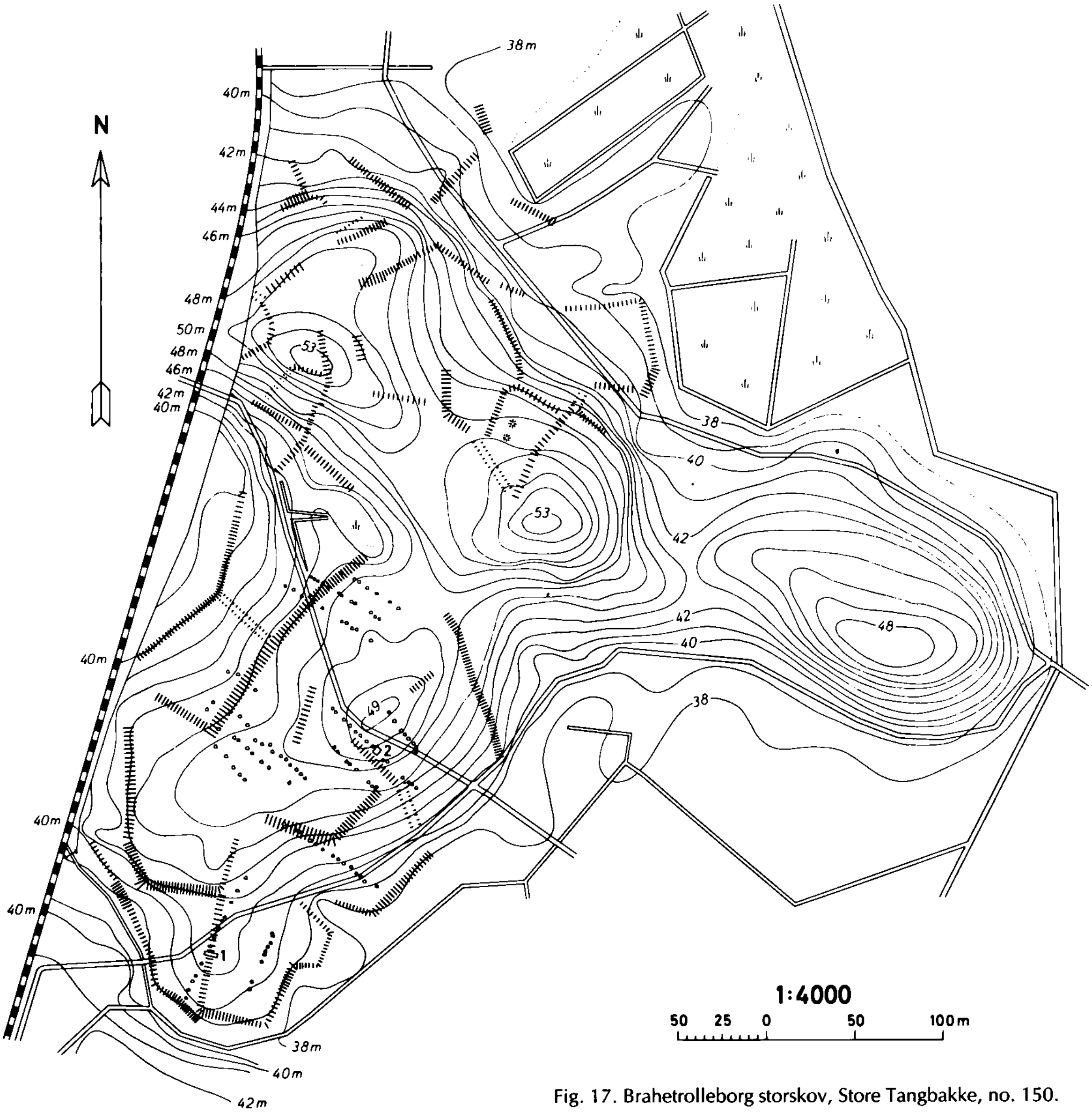


Fig. 17. Brahetrolleborg storskov, Store Tangbakke, no. 150.

Ørbæk s.

152. (1) *Dyrhave* under Ørbæklunde has c. 8 ha boundary banks and lynchets on a hill surrounded by hollows.

LANGELAND

Langelands Nørre h.

Hov s.

153. (1) *Østre og Vestre Stigtehave skov* has 10–15 ha banks and lynchets surrounded by hollows in its central part on Alexander bakke and further NE. There is no natural boundary to the W outside the wood. Also a level area in Østre Stigtehave further E bounded by wet hollows has c. 10 ha banks and lynchets forming broad rectangular fields. In the SE part of the wood on hills 3–5 ha banks and lynchets. In Østre Stigtehave were found settlement remains from the older Iron Age.

JUTLAND

Viborg a.

Nørlyng h.

Dollerup s.

154. (1) *Hald Egeskov* has c. 5 ha boundary banks and lynchets in its S part (fig. 18). The system is bounded to the N by enclosed land and to the E and S by slopes and depressions, but could have extended further to the W where it is cut by a railway. About 30 fields can be discerned, some of them relatively small. The fields are irregular squares or, depending on the

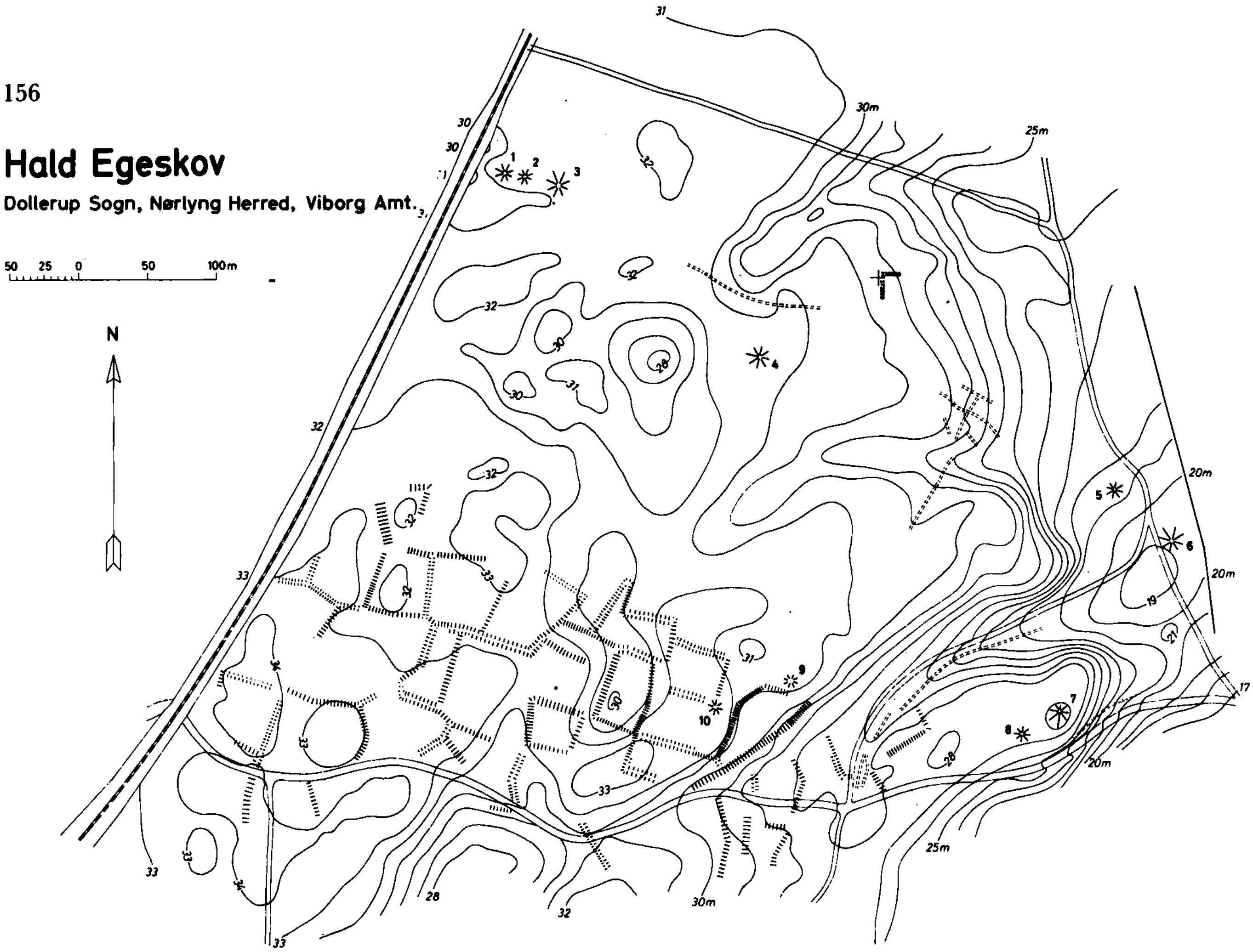


Fig. 18. Hald Egeskov, no. 154. 1:5000.

terrain, wholly irregular. Within the wood but N of the field system are some burial mounds, and others lie up against the field system. – Planned 1956 and 1965.

Århus a.

Tyrstrup h.

Sønder Vissing s.

155. (1) *Addit skov* has c. 25 ha boundary banks and lynchets. The system is naturally bounded to the W, N and E by slopes, but could have continued to the S. The fields are irregular squares. There are many stones in the field boundaries, and stone clearance cairns dotted about the area. Planned in 1877–78 by N.F.B. Sehested (Sehested 1884, p. 117–18, Hatt 1949 p. 6).

Viby s.

156. (1) *Hestehave* N of Skambæk has c. 3 ha of scattered lynchets and banks surrounding broad rectangular fields in its NE part (Laursen 1982 pp. 98 ff and 114).

Holme s.

157. (1) *Thorskov*'s W part contains c. 20 ha boundary banks and lynchets (fig. 19). The field system is naturally bounded more or less on all sides: to the W and NW by steep slopes down to Skambæk, to N and NE by uneven terrain towards the sea S of Århus, to the S and SE by more uneven terrain, and to the S by hills and small bogs.

The relatively more even terrain containing the field system has varied but generally sandy or gravelly soil cover. There are some stones in the field boundaries. Only a few of the fields are completely enclosed, most being roughly rectangular and N-S or E-W oriented, but many are irregularly square or have completely different shapes determined by the terrain. The backbone of the system is a 300 m lynchet with groups of fields on each side of it. There are some cairns and barrows in the area, mainly placed on hilltops just outside or on the edges of the field system. Phosphate analyses produced an area with high values in the southern part of the system. – Planned and investigated 1958–59. The Prehistoric Museum, Århus, also undertook investigations in the area at a later date. The finds belong to the Late Bronze Age or the earliest Iron Age.

Mårslet s.

158. (1) *Hørret skov* has c. 15 ha lynchets with many stones, in

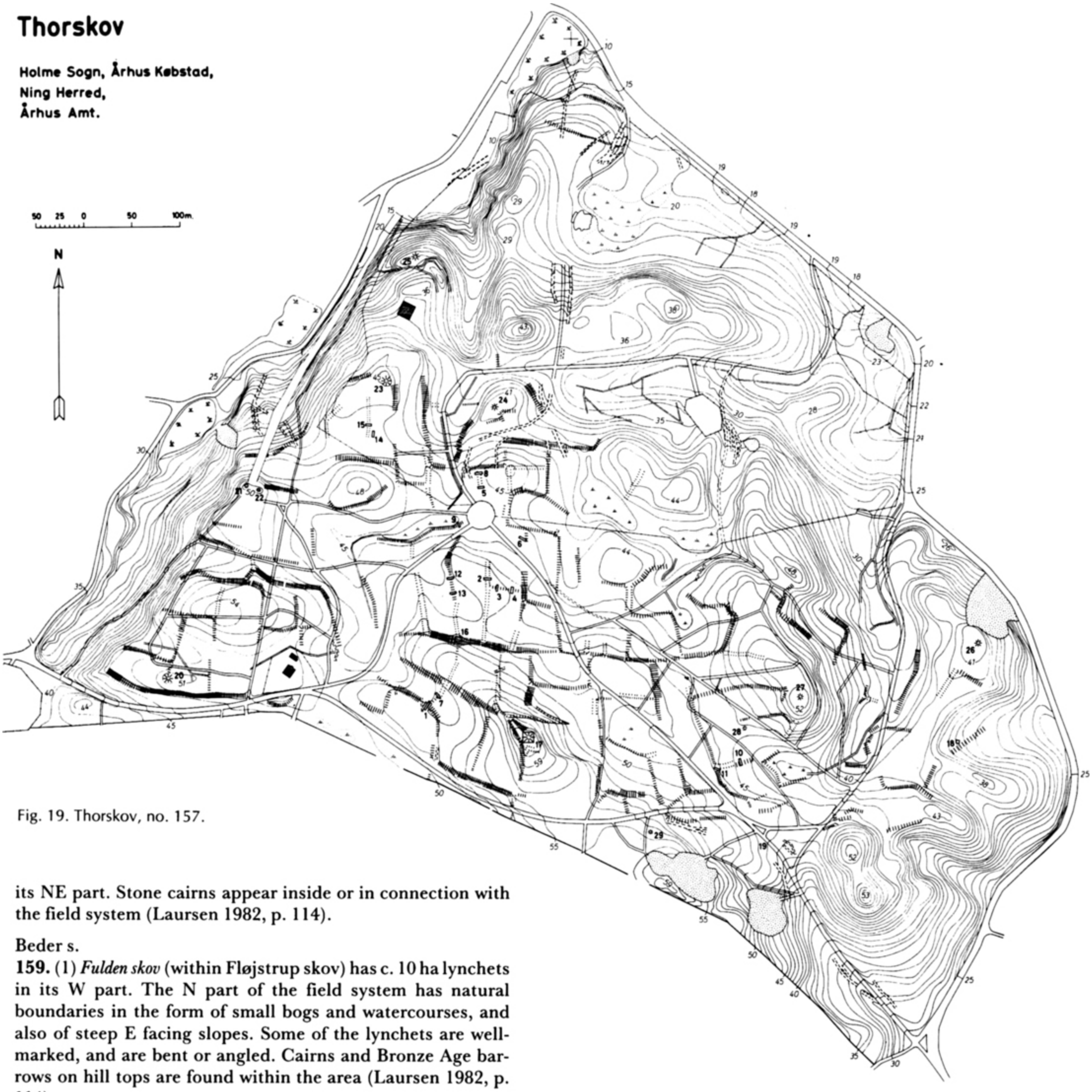


Fig. 19. Thorskov, no. 157.

its NE part. Stone cairns appear inside or in connection with the field system (Laursen 1982, p. 114).

Beder s.
159. (1) *Fulden skov* (within Fløjstrup skov) has c. 10 ha lynchets in its W part. The N part of the field system has natural boundaries in the form of small bogs and watercourses, and also of steep E facing slopes. Some of the lynchets are well-marked, and are bent or angled. Cairns and Bronze Age barrows on hill tops are found within the area (Laursen 1982, p. 114).

Haderslev a.
Tyrstrup h.
Sommersted s.
160. (1) *Revsø skov* has several ha boundary banks and lynchets in its E part (Müller-Wille 1965, p. 147).

161. (2) *Sommersted skov* has boundary banks and lynchets.

ALS
Sønderborg a.
Als Sønder h.
Ulkebøll s.
162. (1) *Sønderskov* has in its central part c. 10–15 ha boundary banks and lynchets. The field system is naturally bounded by watercourses and small bogs.

CONCLUSIONS

This review of the finds of prehistoric field boundaries in eastern Denmark and particularly in the old woodland areas shows that some 80 finds are known from Bornholm, c. 60 from Zealand, 1 on Møn, 1 on Lolland, 3 on Funen, 1 on Langeland, 1 on Als and a few in Jutland. These totals must be compared with the approximately 100 finds Hatt made in Jutland (fig. 20), but which today with the help of aerial photographs number many hundreds and cover enormous areas. The east Danish totals lead to a number of questions: How representative are they with regard to their various areas, and thus to attempting a general view of the east Danish situation? Do the field systems illustrate or merely supplement the settlement picture already available? Analysis of the individual systems adds the questions of whether they result from a similar subsistence economy to that of western Denmark and whether there are variations in the systems themselves or in the forms of the fields and their boundaries. All these questions must be reviewed against the available dating evidence, limited in quality and quantity though this is.

An estimation of the representativeness of the available material, the density of the finds etc. must be evaluated regarding the intensity of research.

On *Bornholm*, the town of Rønne was used as the starting point for the work, and the many finds in SW Bornholm suggest that this may have had an influence. On the other hand the whole island has been closely searched also by local people in a series of campaigns, so the picture is unlikely to be altered through future finds of further major field systems.

On *Zealand*, it is similarly noticeable that a large number of finds concentrate in the E, around Copenhagen and Roskilde. Work was not, however, limited to a particular geographical region. In general, the picture in these areas may be supplemented to some degree by future finds, but it is not likely that major hitherto unknown finds will appear to substantially alter the pattern revealed.

On *Møn*, all woods were searched, on *Lolland* and *Falster*, a significant proportion; it is not impossible that further finds will come to light.

On *Funen*, searches by the author and others have been made of woods in the N and E parts of the island, and of estate woodlands round the island, particularly in the S. Many of these contain ridge and furrow, and so were cultivated within the period from the middle ages to the dispersal of nucleated villages at the end of the 18th century. Further finds could supplement the 3 now known. The searches of the woods of Funen undertaken in recent years in connection with settlement pattern surveys do not, however, seem to have located more prehistoric fields.

Most of the woods on the island of *Langeland* have also been searched, many of them containing ridge and furrow fields. Further finds than the single one known may appear, but this is not likely. On the island of *Tåsinge* all woods were visited, several of them had ridge and furrow fields.

Eastern Jutland should perhaps not qualify as part of eastern Denmark. In earlier times the heathland stretched in several areas all the way to the east coast (Hatt 1949, p. 6 and n. 7–9 and 51–54), so soil conditions were similar to those further W. The basis of the present surveys was the older woodlands within the areas under ice during the last glaciation.

Eastern Jutland has not been searched as thoroughly as the other areas. It has thus only been possible to survey superficially the major forest complexes such as Rold Skov, Frijsenborg skovene and Løvenholm skovene. Recent examinations of the woods around Århus undertaken by the Prehistoric Museum, Århus, has located additional sites to those discovered by the earlier work of the author (Laursen 1982). Finds may also have been made by others in other parts of eastern Jutland. For the time being, however, so many East Jutish woods have been searched that the main features are firmly established – e.g. it seems that on *Als* only one field system exists (the one in Sønderskov no. 162) despite the large areas of woodland on the island. Several of these, furthermore, contain later ridge and furrow. The same applies to many of the other woods in the S part of S Jutland, the opposite to what appears to be the case in Angel on the other side of the frontier to Germany, where H. Jankuhn has published many examples of prehistoric field systems (Jankuhn 1957).

It can, therefore, be said in general terms that the material now available is total or nearly so for some areas of eastern Denmark, and sufficiently representative in others, as far as the number of existing examples is concerned. On the other hand, it is equally clear that, except perhaps for Bornholm, the material is not representative with regard to the areas cultivated within the various regions. The very limited areas covered by old

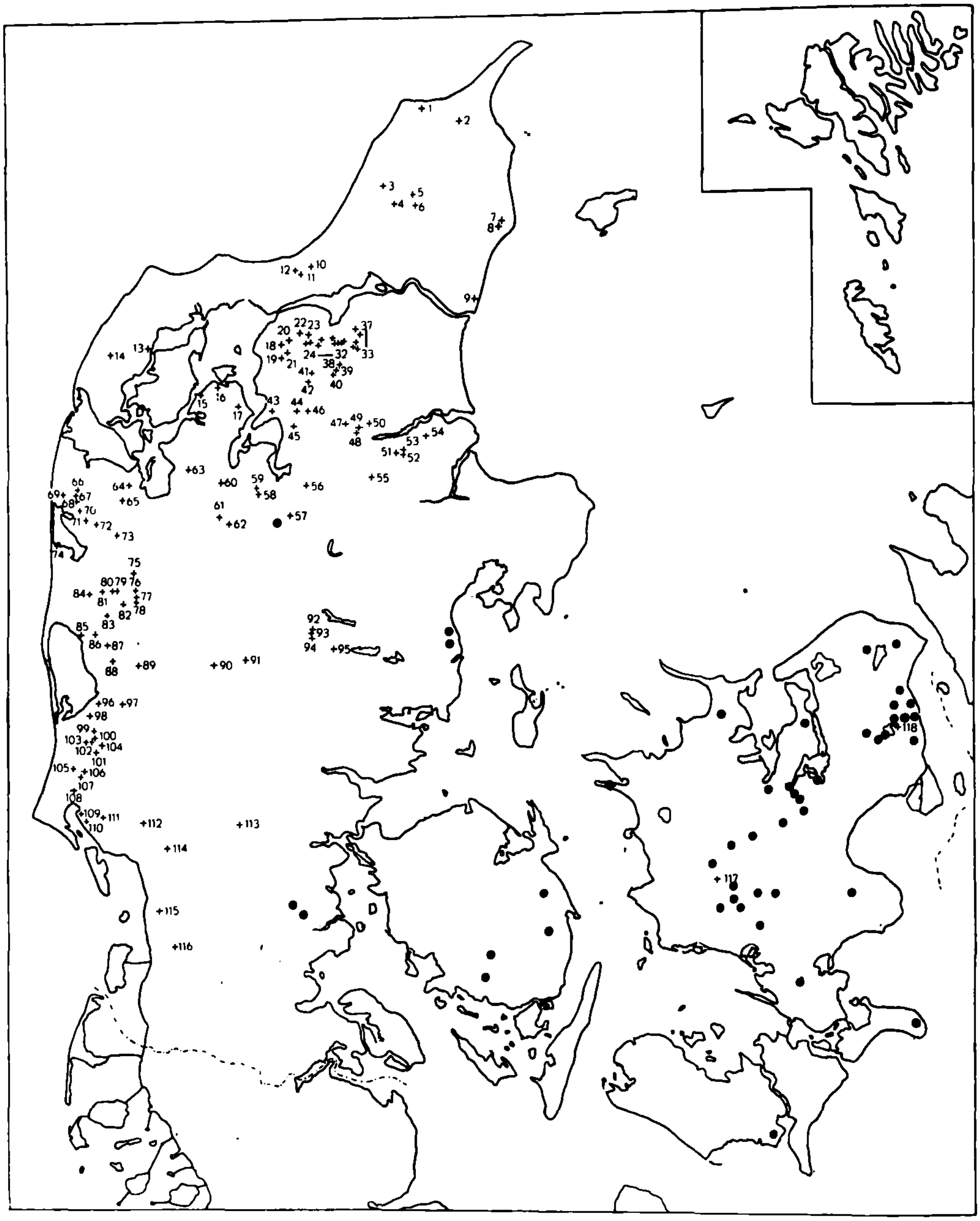


Fig. 20. Map fig. 2 seen in connection with the occurrences given by Hatt.

woodland in Denmark means, as mentioned above, that they must to an extent be regarded as marginal areas. The main areas of cultivation would also in the prehistoric period have been the more useful or better soils, which either were cultivated at some later period in history or have continued in cultivation until the present day.

The finds put forward here do, however, show areas settled and cultivated at the time. On Bornholm, this corresponds to the settlements and finds from the Late Bronze Age and Earlier Iron Age (Becker 1975, p. 6.). It can also be said that the material adds a little to the picture, both for poorer soils formerly covered by heath, and for the better soils. It seems that both the poorest heathland and the heavy clay soils were acceptable. The finds therefore give an impression of a comprehensive and closely spaced system of cultivation which filled all parts of the island which were not too rocky (as the centre was).

Such a clear picture of settlement in the Late Bronze Age and Earlier Iron Age is not available for Zealand. The c. 60 finds are relatively so few that by themselves they cannot show the full nature of Late Bronze and Early Iron Age settlement on the island. They do, on the other hand, make an important contribution to our understanding of the extent of this settlement. In eastern Zealand, proximity to water could have been an important factor influencing settlement. This is the case for finds in the parishes along Øresund, and on the major waterways in E and central Zealand. Apart from the normal water supply, location near water offers potential for adding to the food supply by means of fishing, and also a means of communication.

The few finds on Møn and Lolland can tell us nothing about the nature or density of settlement on the two islands. They do lie close to (but not immediately next to) the coast. The same is the case with the occurrence in the island of Langeland. Nor do the finds on Funen add much to the previously known pattern of settlement and finds. They appear to reflect settlement of the interior. The finds in eastern Jutland agree with the distribution of finds from the earlier Iron Age. They tend to be located near to water, but usually separated from it by lying in the lee of higher ground.

In general, soil cover does not seem to have been of decisive importance regarding location, except where soils are extremely bad (as in parts of Bornholm). Other factors, such as terrain, water supply and not least drainage, were what determined settlement location. The long-term use of very poor soils suggests that manuring was of decisive importance within the agricultural system.

The review makes clear that on Bornholm and Zealand as in eastern Jutland there are many large cultivation units, separated into what might be village areas by natural boundaries such as very uneven ground, slopes, steep valleys, watercourses or lakes. Within or close to several of these units there also seem to have been uncultivated areas, e.g. in the boundary regions between them. The boundaries of the settlement units are not always very clear. It is e.g. hard to make out the various units that must have made up the 550 ha area in Næsbyholm (no. 145).

The sizes of the field systems at e.g. Geelskov (no. 107) correspond to the wellknown field systems in western Jutland such as those at Skørbæk heath and Øster Lem heath.

What appears special and at the same time very characteristic for eastern Denmark is, however, the very limited size of some of the field systems. It can of course be difficult to decide whether a system is in fact completely naturally bounded, but in some cases the topographic features leave little room for doubt. The picture thus seems to emerge that many of the field systems only comprised about 10 ha, and some, such as Klintholm on Møn (no. 148), Lindholm on Zealand (no. 119) and Juelsberg on Funen (no. 151), only a very few ha; and that these lay like islands in uncultivated terrain, which was – as also the barrows suggest – open grazing land. In these cases the subsistence economy must thus have been different to what is assumed to have characterized the areas where the field systems were much larger.

As far as the field systems themselves are concerned, it is typical of Bornholm that they are generally fairly regular, with groups of fields of traditionally rectangular or less regular square shape. This regularity seems greater on some of the sites, such as that at Neksø (no. 77), which are only visible on aerial photographs. The dated examples on Bornholm, which in a few cases show a secondary subdivision within the field system, belong according to the radiocarbon dates to the Pre-Roman Iron Age – perhaps the middle of this period.

A few field systems have other plans and field shapes. the system in Nylars Præsteskov (no. 35) has very irregular field shapes, and the boundaries do not completely surround the fields. This primitive type is not dated. Finds from beneath the lynchets date to the Bronze Age.

A completely different system of subdivision appears in the Risen system (no. 69), which apparantly has a traditional Iron Age system with rectangular fields, onto which has been imposed a second system with curving stone rows, which pays little or no attention to the earlier boundaries. It is not really possible to make out a regular division into fields in the later boundaries. The later system seems to reflect a different subsistence economy combining cultivation and grazing. Similar economic change has been noted on Gotland (Lindquist 1974). This later use of an area cultivated in the earlier Iron Age parallels what can be observed regarding even later cultivation systems. This can be seen at

Store Tangbakke on Funen (no. 150). The long, narrow fields divided by stones bear no relationships to the earlier boundaries.

Because of the relatively few large areas planned, it is difficult to draw general conclusions about the system of subdivision within the individual systems. This is also because many of the fields are not bounded on all sides. In many cases it must therefore involve an estimate of the original size of the single fields.

Geelskov I (no. 107) is among the examples where an evaluation of the subdivision can be made. In many cases the fields appear to be paired, without this apparently being the result of secondary subdivision. In Rønne Plantage (no. 3 and 40) consistent patterning seems to be replicated within trapeze shaped groups of fields.

On Blemme Lyng (no. 4 and 28) are field groups each marked by the inclusion of a very small field. Investigation of one of these revealed that the boundary of the smaller field was later than the boundary of the field into which it was fitted.

In Næsbyholm Storskov (no. 145) a certain grouping of the fields can be observed. In a few cases subdivisions can be demonstrated, but for the most part the field system is strongly determined by the terrain, and only to a limited extent deliberately structured.

In Næsbyholm (no. 145) and other systems such as in Thorskov (no. 157) boundaries can be followed over hundreds of metres. They appear to form axes, with groups of fields on each side of the line.

As far as the structure of the field systems and their subdivisions is concerned, eastern Denmark can be shown to have cases corresponding to the west Jutland examples such as Skørbæk heath and Øster Lem heath. There are, however, no cases in eastern Denmark of systems of advanced type with large groups of long, narrow fields, similar to Byrsted heath in Jutland. As a particular feature of the east Danish material (apart from the small area of many of the systems), mention can be made of the larger, fairly unstructured groups of fields such as those in Næsbyholm skov.

As mentioned, the shapes of individual fields are in most cases difficult to determine. This can be shown by e.g. the plan of the Klintholm skov group (no. 148), where only one of the fields is fully bounded, so that size can be determined in this one case only. In cases like Rønne Plantage (no. 3 and 40), Geelskov (no. 107) and Thorskov (no. 157), the field shapes do not differ from earlier known examples. They are regularly rectangular or at least four-sided fields, the dimensions predominantly corresponding to those for fields in western Denmark (Eir 1980, p. 19).

There are, however, two ways in which shapes are different. The first is the appearance, particularly in mid Zealand, of what are here described as amorphous fields (e.g. in Næsbyholm Storskov, no. 145), which include all manner of geometric shapes such as triangles, ovals etc. The other (also exemplified by Næsbyholm) is the appearance of some very small fields, at times no more than 2–300 m^2 in extent, and sometimes in association with Bronze Age barrows. These tiny fields do not seem to be later additions.

The field boundaries themselves are of the same dimensions but still in several ways different from those in the sandy parts of Jutland. Very characteristic is that in some places such as Næsbyholm, almost only lynchets are seen as boundaries. At the same time, the presence of access ramps shows that the fields were not open and immediately accessible (Danmarks Natur 8, p. 19). There must have been some form of boundary which has left no trace, either fences or some kind of hedge. It is also characteristic of East Danish field boundaries that they were used as zones where the stones cleared from the fields were dumped. In the particularly stony regions of Bornholm the boundary banks appear as low linear heaps of stones, and the lynchets can be carpeted with stones. Investigations have shown that these stone-filled banks are the accidental result of many successive dumpings of stone. The stones lie with large and small mixed together without any deliberate system. Rows of larger stones sometimes occur in the boundary banks or on the top edges of lynchets. At Risen (no. 69) on Bornholm some corners seem to be marked by raised stones. On Blemme Lyng (no. 4 and 28) regular menhirs are erected on the field boundaries.

The overall picture derived from the material presented here, on the basis of limited dating evidence but supported by the archaeological material, is of an agricultural development around 1200 BC as seen on Bornholm, and on Zealand in Geelskov (no. 107) and Næsbyholm Storskov (no. 149). This cultivation phase could have left evidence in the form of some of the boundaries around the amorphous fields in Næsbyholm. The establishment of the larger, well organized field system, such as those in Geelskov and on Blemme Lyng (no. 4 and

28) seems on the other hand first to have taken place in the Pre-Roman iron Age in the period 500–300 BC.

It is furthermore clear that, as far as Geelskov (no. 107) and Næsbyholm (no. 145) are concerned, the field systems were abandoned around 200 AD. In the former area there was a subsequent period of grazing in woodland, in the latter beech woodland regenerated which was economically linked to animal production and not least to pig rearing.

In no other cases is there any evidence that the field systems were in use at a later period, except that at Risen (no. 69) on Bornholm there is material suggesting a use at least into the Later Roman Iron Age. The upper limit of the use of the traditional prehistoric field systems has not yet been established.

Translated by Peter Rowley-Conwy

Viggo Nielsen, The National Agency for the Protection of Nature, Monuments, and Sites, *Fredningsstyrelsen*, Amaliegade 13, DK-1256 København K.

Appendix I

Survey of the Carbon-14 datings in connection with examinations in Geelskov, Rønne Plantage and Blemme Lyng.

Test	*Locality*	*Conv. C-14 b.c. and A.D.*	*Calibrated dating (Clark) B.C. and A.D.*
K-2304	Geelskov	310 ± 100 b.c.	410 B.C.
K-2305	Geelskov	350 ± 100 b.c.	430 B.C.
K-2306	Geelskov	2390 ± 100 b.c.	3080 B.C.
K-2307	Geelskov	2320 ± 100 b.c.	2990 B.C.
K-2308	Geelskov	910 ± 100 b.c.	1120 B.C.
K-2309	Geelskov	950 ± 100 b.c.	1180 B.C.
K-2310	Geelskov	580 ± 100 b.c.	780 B.C.
K-2311	Geelskov	470 ± 100 b.c.	530 B.C.
K-2312	Geelskov	460 ± 100 b.c.	510 B.C.
K-2313	Geelskov	270 ± 100 b.c.	380 B.C.
K-2314	Geelskov	240 ± 100 b.c.	340 B.C.
K-2315	Geelskov	1100 ± 100 A.D.	1180 A.D.
K-2316	Geelskov	1250 ± 100 A.D.	1320 A.D.
K-2317	Geelskov	610 ± 100 b.c.	810 B.C.
K-2318	Geelskov	860 ± 100 b.c.	1040 B.C.
K-2402	Rønne Plantage	510 ± 100 b.c.	620 B.C.
K-2403	Rønne Plantage	590 ± 100 b.c.	790 B.C.
K-2404	Rønne Plantage	700 ± 100 b.c.	880 B.C.
K-2405	Rønne Plantage	860 ± 100 b.c.	1040 B.C.
K-2406	Blemmelyng	660 ± 100 b.c.	850 B.C.
K-2407	Blemmelyng	310 ± 100 b.c.	410 B.C.
K-2408	Blemmelyng	820 ± 100 b.c.	1000 B.C.
K-2409	Blemmelyng	190 ± 100 b.c.	200 B.C.
K-2410	Blemmelyng	200 ± 100 b.c.	210 B.C.
K-2411	Blemmelyng	570 ± 100 b.c.	770 B.C.

Appendix II

Scale for Signatures for width and height of boundary banks and lynchets established and used first by Axel Steensberg planning prehistoric fields for Gudmund Hatt. Ratio 1 : 1000.

Distance between the marks		Boundary banks: Fall in cm height per m. half width Lynchets :fall in cm. height per m. width	Relation between half width and height.
	10 cm on 5 m		1:0,02
	10 cm on 4 m		1:0,025
3 mm	10 cm on 3 m		1:0,033
	20 cm on 5 m		1:0,04
	10 cm on 2 m,	20 cm on 4 m	1:0,05
2¾ mm	30 cm on 5 m		1:0,06
	20 cm on 3 m		1:0,066
	30 cm on 4 m		1:0,075
2½ mm	40 cm on 5 m		1:0,08
	10 cm on 1 m,	20 cm on 2 m, 30 cm on 3 m, 40 cm on 4 m, 50 cm on 5 m	1:0,10
	60 cm on 5 m		1:0,12
	50 cm on 4 m		1:0,125
2¼ mm	40 cm on 3 m		1:0,133
	70 cm on 5 m		1:0,14
	30 cm on 2 m,	60 cm on 4 m	1:0,15
	80 cm on 5 m		1:0,16
2 mm	50 cm on 3 m		1:0,166
	70 cm on 4 m		1:0,175
	90 cm on 5 m		1:0,18
	20 cm on 1 m,	40 cm on 2 m, 60 cm on 3 m, 80 cm on 4 m, 100 cm on 5 m	1:0,2
1¾ mm	90 cm on 4 m		1:0,225
	70 cm on 3 m		1:0,233
1½ mm	100 cm on 4 m,	50 cm on 2 m	1:0,25
	80 cm on 3 m		1:0,266
	30 cm on 1 m,	60 cm on 2 m, 90 cm on 3 m	1:0,3
1¼ mm	100 cm on 3 m		1:0,333
	70 cm on 2 m		1:0,35
	40 cm on 1 m		1:0,4
1 mm	90 cm on 2 m		1:0,45
	50 cm on 1 m,	100 cm on 2 m	1:0,5
¾ mm	60 cm on 1 m		1:0,6
	70 cm on 1 m		1:0,7
½ mm	80 cm on 1 m		1:0,8
	90 cm on 1 m		1:0,9
¼ mm	100 cm on 1 m		1:1

NOTES

1. The basis for this for Bornholm was a systematic photographing by the Geodetic Institute starting in 1967. Stored by Bornholm County Council, Section for Conservation.
2. Several occurrencies in Søllerød s. are mentioned by Avnholt (1945) and Knudsen (1982).
3. Given in a letter from the leader of the department, Dr. phil. Sv. Th. Andersen.

REFERENCES

ANDERSEN SV. TH., AABY B. og ODGAARD B.V., 1983: Environment and Man. Current Studies in Vegetational History at the Geological Survey of Denmark. *Journal of Danish Archaeology*. Vol. 2, Odense.

AVNHOLT, A., 1945: Oldtidsminder og Oldtidsfund i Søllerød Kommune. *Søllerødbogen.*

BECKER, C.J., 1975: Bornholms Oldtidshistorie. *Bornholmske Samlinger*. Rønne.

BOWEN, H.C., 1961: *Ancient Fields*. London.

BRØNDSTED, JOHS., 1960: *Danmarks Oldtid* III, *Jernalderen*. Copenhagen.

EIR, B., 1980: Måleenheder i oldtidsagre. *Aarbøger for nordisk Oldkyndighed og Historie*. Copenhagen.

HARDER SØRENSEN, P., 1982: The use of Air Photographs in Celtic Field Studies. *Journal of Danish Archaeology*, Vol. 1. Odense.

HATT, G., 1949: *Oldtidsagre*. Det kgl. danske Videnskabernes Selskab, arkæologisk-kulturhistoriske skrifter, Bd. II, no. 1. Copenhagen.

JANKUHN, H., 1957: Ackerfluren der Eisenzeit und ihre Bedeutung für die frühe Wirtschaftsgeschichte. *37–38. Bericht der Römisch-Germanischen Kommission, 1956–57.*

JANSSON, N.R., 1963: Fossila Åkrar i Himmerland – en flygbildinventering. *Svensk geografisk Årbok.*

KLINDT-JENSEN, O., 1957: *Bornholm i folkevandringstiden*. The National Museum Monographs II. Copenhagen.

– 1958: Udgravninger på Bornholm 1816–24. *Bornholmske Samlinger* XXXVI. Rønne.

KNUDSEN, SV. AAGE, 1982: *Landskab og oldtid*. Atlas over Søllerød og Lyngby-Tårbæk kommuner. Copenhagen.

LARSEN, K.A., 1965: Naturparkens oldtidshistorie. *Naturparken mellem Farum og Slangerup*. Copenhagen.

LAURSEN, J., 1982: *Fortidens spor i Århusskovene*. Århus.

LINDQUIST, S.-O., 1974: The Development of the Agrarian Landscape on Gotland during the Early Iron Age. *Norwegian Archaeological Review* vol. 7:1, pp. 6–32.

MÜLLER-WILLE, M., 1965: *Eisenzeitliche Fluren in den festländischen Nordseegebieten*. Landeskundliche Karten und Hefte der geographischen Kommission für Westphalen. Reihe: Siedlung und Landschaft in Westphalen. Münster.

NIELSEN, V., 1981: Agerlandets Historie. *Danmarks Natur* 8. *Agerlandet*, Copenhagen.

PEDERSEN, L., 1983: *Bornholm i Oldtiden*. Rønne.

STEENSBERG, A., 1952: Hustomter under Pebringegården. *Bondehuse og Vandmøller i Danmark gennem 2000 år*. Copenhagen.

– 1983: *Borup AD 700–1400*. Copenhagen.

THORSEN, P., 1931: En gammel dyrknings- og Begravelsesplads samt et stednavn. *Festskrift til M.K. Zahrtmann*. Rønne.

VEDEL E., 1886: *Bornholms Oldtidsminder og Oldsager*. Copenhagen.

Journal of Danish Archaeology vol. 3, 1984, pp. 164–169

Gudmund Hatt –

The Individualist Against his Time

by STEFFEN STUMMANN HANSEN

On occasion of the 100 year anniversary of Gudmund Hatt the editors have asked Steffen Stumann Hansen to present a biographic survey of Gudmund Hatt and his role in the history of Danish archaeology. This is to stress the debt that modern settlement research owes to Gudmund Hatt.

The History of Danish archaeology usually concentrates on outstanding representatives of the discipline. This is understandable to a certain degree, but unfortunately it has also meant that the history of archaeology is seen as a unilateral and rather harmonious process. Progress has thus been linked with personnel replacements in key positions in the archaeological world.

According to this approach, Danish archaeologists have endeavoured to represent a uniform tradition stretching from C.J. Thomsen (1788–1865), J.J.A. Worsaae (1821–1885) and S. Müller (1846–1934) to J. Brøndsted (1890–1965). However, Brøndsted's opus on Danish prehistory, "Danmarks Oldtid I–III" (1), is certainly not the result of one man's work, and probably the most impressive chapter in the book is the one about the Early Iron Age, and to a large extent based on the work of Gudmund Hatt (1884–1960).

Gudmund Hatt has never occupied a sufficiently prominent position in the annals of Danish archaeology, although everyone seems to accept that his work revolutionized our conception of the Iron Age, and introduced new perspectives to archaeological research. It is striking, then, that there seems to be little room left for Hatt even in the recent debates between respectively the exponents of the so-called "traditional" and "new" archaeology (2).

Characteristically, C.J. Becker in a recent work on the history of Danish archaeology dedicates the final pages to Hatt alone: "His research in this field (field-systems and settlements; present author) was entirely his own work; therefore it would be difficult to fit it into a description of the history of Scandinavian archaeology at the University (of Copenhagen), and hardly anywhere else, even though he worked in collaboration with the National Museum, although more distantly with the years. If, in this connection, a name should be mentioned it is the Carlsberg Foundation, whose grants supported both his excavations, studies and the following publications." (Becker 1979b, p. 196ff.)

During my investigation into the role of Gudmund Hatt in Danish archaeology (3), I have come to the conclusion that he deserves a much more central position among archaeologists than has so far been allotted him. In his conception of research, I have found elements which have in many ways remained unchallenged. In the following I will try to describe the nature of the dynamics of his work, also in what historical context we may evaluate his contribution today, and in which way it illuminates the strength of dominant paradigms against the concepts of the individual.

Gudmund Hatt was born in 1884 in the small village of Vildbjerg on the moors of Central Jutland. He was intellectually much influenced by his father from a very early age, and many different disciplines interested him, including natural sciences, psychology and philosophy. He started to read medicine but soon gave it up, travelling instead to America. He became deeply interested in ethnography while spending a year among the Cherokees in the territory of Oklahoma. Afterwards, in 1906–1907, he began studying ethnography under Professor R.B. Dixon (1875–1934), and it is probably then he realized that ethnography and archaeology were two closely connected disciplines.

In the years which followed he and his wife, Emilie Demant Hatt (1873–1958), carried out extensive field research among the Lapps in Northern Scandinavia, and these journeys resulted in a good many publications. In 1914 he gained his doctorate on a thesis about the skin garments worn by Arctic peoples; a work which his professor, H.P. Steensby (1875–1920) later described as follows: "He has, however, not only made the descriptions. He has also penetrated his somewhat multifarious material, and proved capable of presenting it with scientific insight, so that interrelated phenomena and development emerge which were not before realized." (Steensby 1915, p. 274). Other works in these years dealt with subjects such as reindeer-nomadism.

The underlying belief reflected by these studies is the great significance of ecology in the improvement of society. One may call it an environmental-deterministic perception of history, in the sense that social evolution takes place inside the given ecological framework.

Hatt's ethnographical studies and field-work continued until around 1919, when he became Keeper of Antiquities at the National Museum in Copenhagen. During the Twenties he and other members of the museum staff were sent round the Danish countryside to inspect and restore prehistoric monuments, and if necessary to carry out excavations.

These journeys of inspection were gradually to bring his ethnographical background to the forefront in his archaeological work. In these years he witnessed the great changes taking place in the Danish cultural landscape – a process of transformation that threatened to destroy thousands of prehistoric monuments because no legislation protected them. The penetration of capitalism and the mechanization of agriculture in Denmark broke up forever the material and spiritual patterns of a peasant culture which had evolved through thousands of years. Still more intensive farming methods, expanding traffic networks, not to mention the large-scale reclamation of moorland, were followed by a comparatively heavy migration from the countryside to the growing urban industrial centres. It was especially the mechanized reclamation of moorland which caused the destruction and elimination of an enormous number of prehistoric monuments.

While other archaeologists at the National Museum seemed unaware of this disastrous situation, Hatt realized that the transformation threatening the landscape demanded special initiatives. The answer lay in a large-scale series of campaigns to safeguard and investigate the most endangered prehistoric elements in the landscape. He could easily see that archaeological institutions, and the whole archaeological environment at that time, were not prepared for a rescue attempt on this scale. He himself had to act.

It was not easy. A systematic campaign to excavate barrows had been carried out in the 1890's by S. Müller, but there was little understanding of the importance of Early Iron Age settlements and field-systems. In the first place he had to demonstrate their culture-historical significance, and secondly, he had to develop certain principles of excavation, in that existing methods were not fitted for that sort of field-work. Hatt's excavation of Early Iron Age farms and villages were characterized by quite a new method. In order to establish a survey of the structure of settlements, he stressed the necessity of uncovering sizeable areas at one time. This reform of field-research methodology was revolutionary, not only in Danish archaeology, but probably also in European archaeology (fig. 1).

Upon realizing this Hatt became occupied for the next thirty years with two great campaigns, both of which took place in Jutland.

In 1926, he realized that the traces of low banks on the moors of Jutland were in fact ancient field boundaries, and he felt it a personal obligation to examine these remains. The National Museum could not finance an investigation on this scale, instead he asked the Carlsberg Foundation (4) for money. The Foundation granted him financial support, and the campaign was conducted in the years 1928–1937 (5).

His aim was firstly to establish a survey of the surviving field-systems, and secondly to investigate and excavate as many of these as possible. The work was systematically carried out by himself – but later he hired a student as assistant, as he literally had to race against the tractor (6). The result was the recording of more than a hundred complexes, which Hatt followed up with numerous scientific and popular works (7) (fig. 2).

The "Celtic field" campaign posed Hatt a lot of questions. What did these field-systems express? Was the cultivated land to be regarded as private property? Was there a community in the Early Iron Age village to be compared with the well-known village fellowship of the Middle Ages? He realized, however, that these questions could not be answered exclusively by the field-systems; work on Iron Age settlements which had slowly got under way in the Twenties would have to continue.

This second campaign commenced in 1934, and it was to last until the 1950's. Once again the Carlsberg Foundation provided the financial basis for the project.

Fig. 1. Excavation at Nørre Fjand, Western Jutland. Hatt's campaign was first and foremost characterized by large-scale surface clearances. During the 1930's and 1940's, several settlements were excavated by this method (photo in the National Museum, Copenhagen).

Hatt had at the time left the National Museum for a professorship in Human Geography at the University of Copenhagen. Characteristically, in his first application to the Carlsberg Foundation, he stressed the interrelations between landscape, field-systems, settlement-structures, ecology and mode of production (8). It was a unique viewpoint in Danish archaeological circles at that time.

A sequence of splendid excavations deserve a more comprehensive mention and among these, to mention but a few are sites such as Nørre Fjand, Østerbølle, Skørbæk Hede, Mariesminde, and Bork Mærsk. This is not the place to give a detailed description of the entire campaign. Suffice it to say that it had the same visionary and theoretical perspectives as the "Celtic field" campaign.

To demonstrate this, I shall quote a short extract from an application from Hatt to the Carlsberg Foundation in 1937 as follows: "If the intention is to complete an excavation, any interruption will be detrimental to it. The National Museum's excavations of settlements have perpetually suffered from being on such a small scale. To continue small excavations year in, and year out, will in the long run be expensive, and give incomplete, confused results. If one wants to pursue settlement studies, the loss of time and money which inevitably accompanies interruption and resumption must be avoided." (9).

These points are still of relevance today in the context of rescue archaeology in Denmark, especially in connection with the so-called "Natural Gas Project".

Hatt followed up his field-work with an impressive amount of scientific and popular writings. These publications were characterized by a still more developed materialistic point of view, although his conclusions were still marked by environmental determinism. They are a striking combination of ethnographical, geographical and archaeological ideas merging in what could be termed "human geography". He described the Early Iron Age in Denmark as a non-communistic society, and one in which arable land was under private ownership. The pesants of that period he saw as "conservative democrats". He considered the freedom loving, hard-working peasantry to be the dynamic force in the progress of history.

I would like here to mention a few of his publications, because they may well be compared with outstanding contemporary research in European archaeology. In 1937 he published the book "Landbrug i Danmarks Oldtid" (Prehistoric Agriculture in Denmark) – popu-

Fig. 2. Three representatives of Danish archaeology in the 1930's: Johs. Brøndsted (1890–1965) to the left, Gudmund Hatt (1884–1960) in the center, and the keeper of *Vesthimmerlands Museum* in Års, S. Vestergaard-Nielsen (1879–1962) – photographed at Borremose in 1937 by C.J. Becker. – Owing to his investigations, Hatt in more than one way became the connecting link between the centralized academic environment around Brøndsted and the rural environment.

lar writing in the best sense of the word, and a splendid example of the interdisciplinary approach. It may be compared with J.G.D. Clark's "Prehistoric Europe: The Economic Basis" (1952).

Hatt followed up his book with a short theoretical article entitled "The Ownership of Cultivated Land" (1939). In this article he tried to explain the progress of history through his own personal combination of archaeological, ethnographical and geographical knowledge. The explanation and discussion was given in terms like "the right of property", "field-structures", "village community" and "collectivism and individualism". To quote the concluding sentences: "It seems to me that an unbiassed mind, examining the mass of ethnological evidence, must come to the result that community ownership and personal ownership of land are both ancient, perhaps equally ancient. In a well balanced culture, these two forms of ownership live side by side, supplementing each other in a sort of harmony." (p. 22)

Hatt had another and even less known interest, namely conservation policy. In the late 1920's he was the first person connected with the National Museum to step forward officially and call for conservation legislation which would claim all ancient monuments to be state property. He regarded the popular interest in and commitment to this question to be of fundamental importance, but he was also aware that mechanization – especially of agriculture – made legislation imperative (10). Yet the scope of the Conservation of Nature Act, finally passed in 1937, was probably not far-reaching enough for him, as it did not provide any protection to field-systems and settlements, but mainly to megalithic monuments and barrows. Perhaps as a consequence of this he left the Board of the Nature Conservancy on which he had sat since 1931.

Hatt's opinion on conservation policy was in fact in contradiction to the work already carried out by the archaeologists of the National Museum. The interests of this group were primarily characterized by a strictly archaeological concern for archaeological objects, whereas Hatt saw the cultural landscape as a whole – with the archaeological monuments comprising part of it.

The reader may well ask why the present article is preoccupied by a single individual in the history of Danish archaeology. The main reason is that the thoughts and aims of Hatt signify something of more general interest. He was a man of his age: a fellow player as it were, yet nevertheless an opponent of it. It is especially characteristic of Hatt that he developed in strong opposition to contemporary opinion in the Danish academic world. He was a representative of the natural sciences – a fact which nearly prevented him from finding employment at the National Museum. He also had deep roots in the humanist tradition of the late nineteenth century in Denmark (11), and his educational background was quite different from other prominent archaeologists of that period. It was characteristic that most of them were classical scholars or historians. Hatt broke this pattern, and it is in this light that the individuality of his work has to be regarded.

He established the basis for what might have become a tradition in Danish archaeology, combining as he did, ethnography and human geography with archaeology (12). However, the generation of archaeologists which grew from J. Brøndsted's reorganization of the National Museum in the early 1930's adopted neither Hatt's methods nor his point of view. They were trained according to strictly archaeological concepts, and Hatt probably soon realized this. He knew what had to be done, but was aware that it could not be brought about through the archaeological establishment. In order to achieve his goals he had to follow his own convictions.

The tradition established around Brøndsted was to be continued until today. A tradition which has in many ways been strictly confined to what can be termed "archaeology" in the narrow sense of the word. The tradition which could have been inspired by Gudmund Hatt is today sadly missing in Denmark. A few of his pupils tried to follow up his work, but very little was done in regard to the prehistoric material (6).

On this count, the history of Danish archaeology stands in contrast to Swedish archaeology, where especially the most recent decades have seen some splendid interdisciplinary investigations combining, for example, archaeology and human geography. And some outstanding large-scale analyses of several Swedish landscapes have resulted from them (i.a. Carlsson 1979).

If we look beyond Scandinavia, we may compare (of course with reservations) Gudmund Hatt with Gordon Childe. The evolutionary materialistic point of view held by Childe is very close to that of Hatt. Both consider that specific natural conditions give rise to specific forms of material development, and that technological skills led to greater prosperity combined with a growing democracy. Both Childe and Hatt remained strangers to conventional archaeological wisdom (13).

One of the big Danish newspapers wrote in Hatt's obituary in 1960: "A dynamic scientist and personality has passed away; in his last years he was a very lonely man. As a geographer his name will be remembered by coming generations, but to the present generation he remained a stranger without a name." (14).

Today, just as fifty years ago, Gudmund Hatt and his work – in this centenary year of his birth – represent a challenge to the archaeological world: the existential coherence of his past, present and future; the stringent coherence of theory and practice; the visionary antiquarian insight, the strategic perspectives of his research, not to mention his materially humanistic approach to history. Indeed, "new" archaeology has responded no better to this challenge than the bitterly attacked "traditional" archaeology.

Steffen Stummann Hansen, Ahornsgade 8B, DK-2200 Copenhagen.

NOTES

1. 1st edition, Copenhagen 1938–1940. 2nd revised edition, Copenhagen 1957–1960.
2. Cf. Kristiansen 1978, Becker 1979a and Jensen 1980.
3. My researches to date in an unpublished M.A. thesis entitled: *Gudmund Hatt. Til belysning af forholdet mellem "arkæologer og fornuftige mennesker"*. An analysis of Hatt's view of man and history, with special attention to his work within the sphere of Danish archaeology. Copenhagen 1981, at the Institute of Prehistoric Archaeology, Copenhagen University. Cf. also Stummann Hansen 1980, 1983a and 1983b. The present article is more or less identical with a paper of the same title read at the "Fourth Annual Conference of the Theoretical Archaeology Group", held from 13th to 15th December 1982 in Durham, England.
4. The Carlsberg Foundation was established in 1876 by the brewer, J.P. Jacobsen (1811–1887) to support scientific research activities.
5. Cf. Hatt 1949, Stummann Hansen 1980 and 1983b.
6. Especially important was the appointment of Axel Steensberg. In 1938 Axel Steensberg embarked on an extensive investigation of medieval Danish settlement and agriculture for the Third Department of the Nationalmuseum.
7. Cf. bibliography (incomplete) in *KUML* 1959. In the present case we refer to Hatt 1936.
8. The application to the Carlsberg Foundation is dated 29th September 1934. In the archives of the Carlsberg Foundation.
9. Report to the Carlsberg Foundation, dated 8th April 1938. In the archives of the Carlsberg Foundation.
10. For Hatt's work connected with nature conservation cf. Stummann Hansen 1983b.

11. Hatt's philosophical roots were particularly close to the humanistic philosophy of Harald Høffding (1843–1931), which grew up after the collapse of national liberalism in the years following 1864.
12. The close relation between ethnography, archaeology and geography, evident in all Hatt's work should in essentials be considered to lie at the centre of the somewhat diffuse currents which swept through Danish archaeology during the 1970's under the rather self-conscious – and misleading – name of "New Archaeology".
13. It should be mentioned that Gordon Childe was also inspired by R.B. Dixon (Trigger 1979, p. 126ff). V. Gordon Childe's methodological and theoretical contribution to archaeology has also – charcteristically – been taken up for review in the 1970's by British archaeologists in the light of recent trends in archaeology. For example, in biographies by Trigger 1979, McNairn 1980, and Green 1981.
14. *Kristeligt Dagblad*, 28th January 1960.

REFERENCES

BECKER, C.J. 1979a: Arkæologi i Danmark – i går, i dag og i morgen. *Fortid og Nutid*, vol. XXVIII. København.

– 1979b: Nordisk arkæologi og europæisk forhistorie. *Københavns Universitet 1479–1979*, vol. XI. København.

CARLSSON, D. 1979: *Kulturlandskapets utveckling på Gotland (The Development of the Cultural Landscape on Gotland. A Study of Changes in Agriculture and Settlement during the Iron Age)*. Visby.

GREEN, S. 1981: *Prehistorian. A biography of V. Gordon Childe*. Wiltshire.

HATT, G. 1914: *Arktiske Skinddragter i Eurasien og Amerika. En etnografisk Studie* (dissertation). København.

– 1919: Notes on reindeer nomadism. *Memoirs of the Am. Anthropolog. Ass.*, Vol. 6.

– 1922–1927: *Jorden og Menneskelivet*, bd. I–IV (ed. G. HATT & M. VAHL). København.

– 1928: To Bopladsfund fra ældre Jernalder, fra Mors og Himmerland. *Aarbøger for nordisk Oldkyndighed og Historie*. København.

– 1931a: Prehistoric fields in Jylland. *Acta Archaeologica*, Vol. 2. København.

– 1931b: Gravhøjene. *Danmarks Naturfredningsforenings Aarsskrift*. København.

– 1936: Oldtidens Landsby i Danmark. *Fortid og Nutid*, bd. 11. København.

– 1937: *Landbrug i Danmarks Oldtid*. København.

– 1939: *The Ownership of Cultivated Land*. Det Kongelige Danske Videnskabernes Selskabs Historisk-filologiske Meddelelser, bd. 26:6. København.

– 1949: *Oldtidsagre*. Videnskabernes Selskab, Arkæologisk-kunsthistoriske Skrifter II, 1. København.

– 1957: *Nørre Fjand. An Early Iron-Age Village Site in West Jutland*. With a contribution by Holger Rasmussen. København.

JENSEN, J. 1980: En kommentar til debatten om dansk arkæologi – fortid og fremtid. *Fortid og Nutid*, bd. XXVIII. København.

KRISTIANSEN, K. 1978: Dansk arkæologi – fortid og fremtid. *Fortid og Nutid*, bd. XXVII. København.

MCNAIRN, B. 1980: *The Method and Theory of V. Gordon Childe*. Edinburgh.

STEENSBERG, A. 1961: Gudmund Hatt (obituary). *Naturhistorisk Tidende* 1961.

STEENSBY, H.P. 1915: Review of G. Hatt: Arktiske Skinddragter i Eurasien og Amerika. *Nordisk Tidsskrift*.

STUMMANN HANSEN, S. 1980: Oldtidsagrene på Gørding hede. *Hardsyssels Årbog*. Lemvig.

– 1983a: Gudmund Hatt – en kort biografi. In: *Emilie Demant Hatt 1873–1958 – blade til en biografi*. Skive Museum.

– 1983b: "En uoprettelig Forringelse af Landet. En Uret mod Nationen." Gudmund Hatt og fredningen af det danske kulturlandskab (English summary). *Antikvariske Studier*, bd. 6. København.

TRIGGER, B.G. 1979: *Gordon Childe: Revolutions in Archaeology*. London.

Journal of Danish Archaeology vol. 3, 1984, pp. 170–176

Mølleparken

A Settlement of the Fourth/Fifth Centuries AD at Løgumkloster, South Jutland

by STEEN WULFF ANDERSEN and FLEMMING RIECK

In September 1978 Haderslev Museum was informed that a series of smelting-pits had been discovered during the laying of heating-pipes for the residential development 'Mølleparken' at Løgumkloster's northern edge. A trial excavation that autumn showed that remains of a settlement of the latest Roman/early Germanic periods were here, besides a number of slag-pits. A proper investigation took place the following summer, immediately before the area was built upon (1). About 10,500 sq.m. of the development area's western part were excavated, revealing 28 smelting-pits, 7 buildings, and a small number of less immediately determinable features. In general the settlement remains were substantially ploughed out. No culture layer remained, and in several places only a few centimetres of the post-holes were left. The area excavated is believed to cover the bulk of the original settlement. As the site-plan shows (fig. 2), large areas without features were uncovered both east and west of the buildings, and trial trenches both north and south indicate that the limits of settlement in these directions have been found. The construction of nearby roads, sewers, and heating-pipes was watched in progress without further settlement traces being observed. Bearing recent years' investigations at Vorbasse in mind, however, it remains possible that this settlement site was a part of a larger village complex (cf. Hvass 1980 (figs. 6–7)).

THE BUILDINGS

The southernmost building – *Building I* – is a very unclearly marked long-house of ca. 9–10×4–5m. It is aligned E-W, parallel to Building II, with which it forms

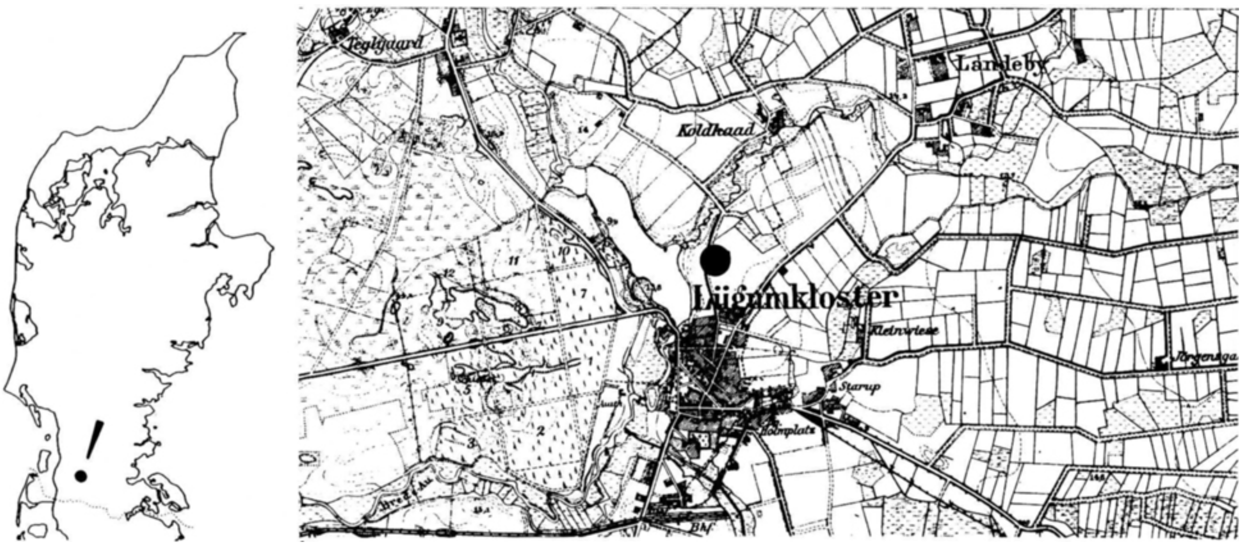


Fig. 1. The settlement is situated in the western part of the expanse of Tinglev Heath, an area with many low boggy tracts. From the 1877–80 map. The site is marked with a dot. Here scale 1:40.000.

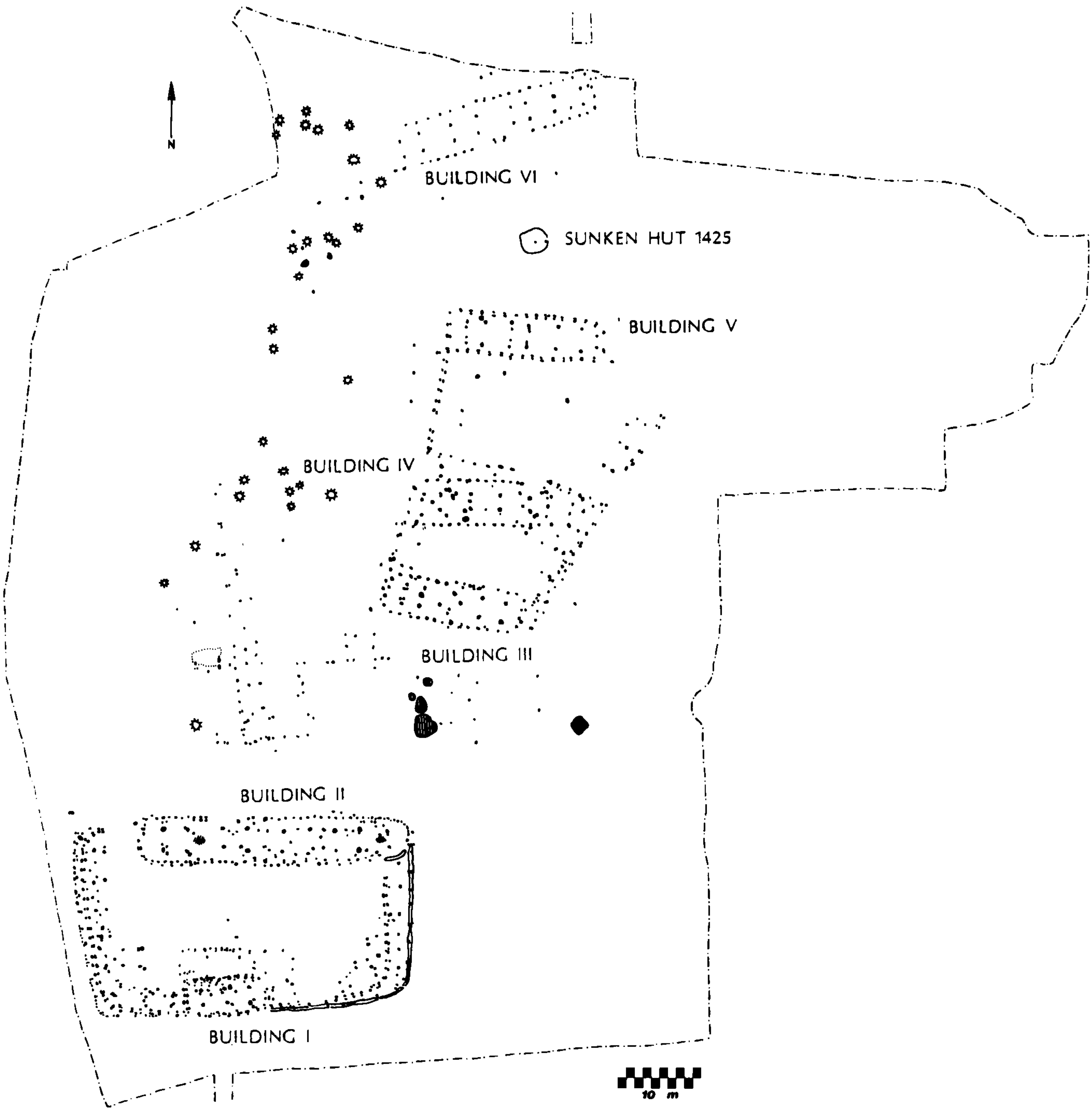


Fig. 2. General plan of the excavation. The slag-pits are shown with 'star' signatures (left).

a single building-complex (fig. 3). The building may be recognized principally from three sets of roof-bearing posts. The walls appear to have consisted of doubled pairs of posts, and the southern wall seems to have continued into the fence that enclosed the courtyard. No signs of fire-places or a separate stall were found, and it is therefore difficult to say what the building's function was. But viewed together with Building II, it is most reasonable to regard it as some sort of outhouse.

Building II measures about 35·5×5·5m. and is aligned

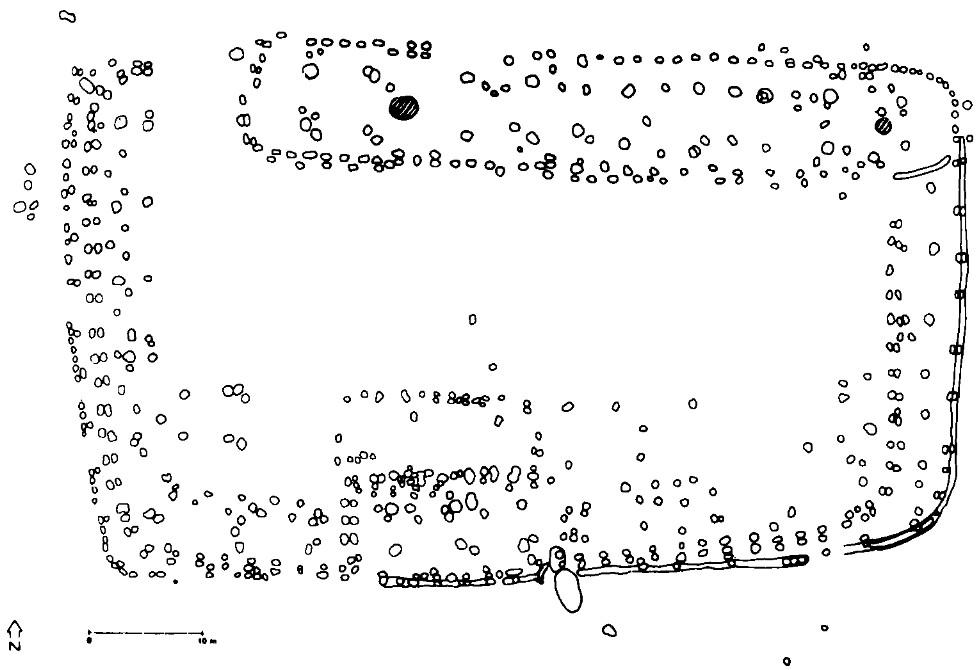


Fig. 3. The complex with Buildings I and II.

E-W. It forms the northern boundary of the above-mentioned building-complex. It had straight sides and rounded gables, and the roof was carried by 9 pairs of posts. The walls appeared partly as a single row of post-holes, and partly as a double row. This variation need not reflect various forms of wall-construction, but could result from uneven preservation of the post-holes. There is a wide gap in the northern side which can probably be attributed to the same causes. The entrance to the building seems to have been in the middle of the southern side. The building had two fire-places, one at either end. The westernmost consisted of a compact layer of burnt clay above a pit which was filled with sand burnt red and a number of potsherds. The easternmost hearth was a rather more complex construction: at the base, an oval pit with dark burned sand, below a compact layer of sherds from one or two vessels, and at the top a layer of clay about 1cm. thick, which unfortunately was incompletely preserved. Traces of straw could clearly be seen on the underside of the clay layer.

The two hearths indicate that both ends were lived in, which is not the usual notion of the internal arrangement of Iron Age buildings. But it is not suggested that the whole building was residential. Contemporary long-houses include examples with the middle section used as a stall, and this cannot be ruled out for building II if one bears in mind the state of preservation of the building remains (cf. Hvass 1978).

As was stated, buildings I and II belong to a single building-complex, enclosed by a substantial fence. The enclosed area is about 900 sq.m. The fence appears to have been renewed at some stage. The phase which appears to be the earlier consisted partly of single and partly of paired posts. In the second phase the whole fence was shifted slightly eastwards, perhaps in connection with a putative extension of Building II with one pair of roof-bearing posts. This fence is clearly more substantial than its predecessor. It consists of a row of double-posts which were supplemented on the inner side by large upright posts of the same size as the buildings' roof-bearing posts. It is uncertain, however, whether these large posts were really part of the fence, or if it was a case of a sort of lean-to construction connected to the fence (2). Both phases of the building complex had their entrance in the north-west corner, by the western end of Building II.

North East of the Buildings I and II site are three buildings, *Buildings III, IV, and V*, which are very similar to one another both in size and form. All are aligned E-W, though Buildings III and V are slightly angled SE-

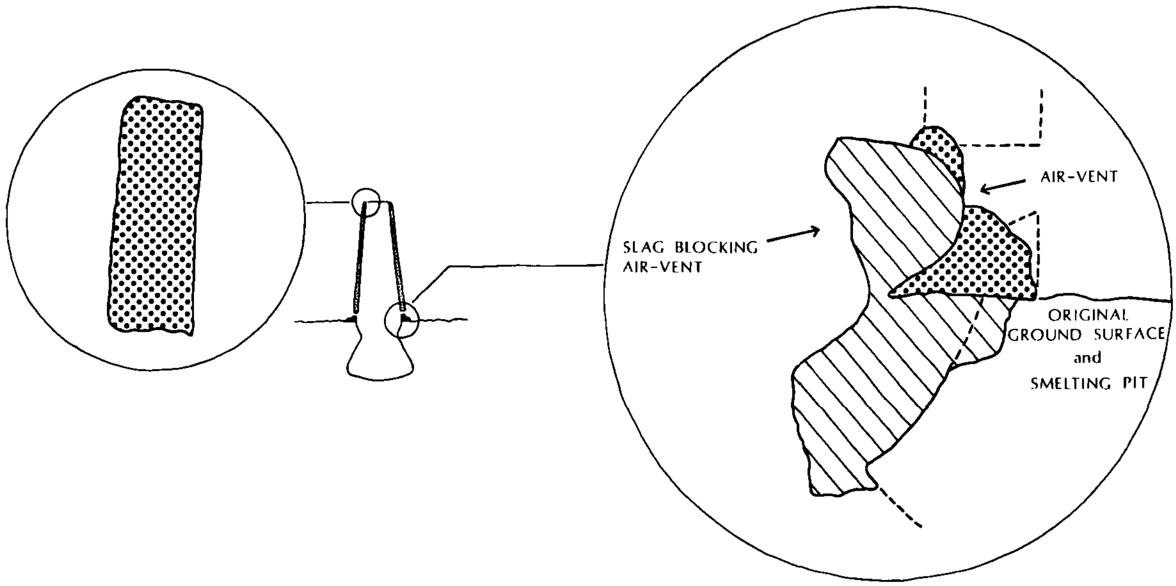


Fig. 4. Sections through slag-lump 538 and shaft fragment 1374. The position of the pieces are indicated on the schematized reconstructions. Clay stippled, slag hatched. Scale 1:2. Drawn by Jørgen Holm.

NW. They are between ca. 16 and 18m. long, and 5 and 5·5m. broad. Buildings III and IV have walls formed of single posts while those of Building V had doubled posts. Two or three tranverse partition walls can be seen in Building V. All three buildings have straight sides and rounded gables.

The number of sets of roof-bearing posts are 5,4, and 5 respectively. The three buildings are connected to one another by fences but do not form a single building-complex. It was unfortunately impossible to determine which buildings were contemporary by stratigraphic observations, so the interpretation of the relationship between the three buildings can only be based upon the ground-plan. Probably there are two building-complexes, each with a trapezoid courtyard. Fences consisting of double posts can be followed for some 13m. north of either gable end of Building III, the ends of which are connected by another fence. Immediately north of this complex is a fenced-in area of about the same size, bounded to the north by Building V, and to the east and west by rows of double posts which are direct continuations of the fences pertaining to Building III. This building-complex has a large opening in the north-east corner, but this can be attributed to poor preservation in this area. On the basis of the continuous line of the fences, the two building-complexes are considered to be contemporary. But it is uncertain where to place building IV in this context.

Building IV is wholly inside the courtyard belonging to Building III, and in the west ends right at the enclosing fence. This implies that the building has been added to this complex, but its slanting position relative to Building III leaves it possible that this is a coincidence, and that Building IV could be earlier or later than the building-complex.

None of these three buildings have hearths or traces of stalls, so it is impossible to say anything about what functions the different parts of the buildings had.

About 20m. north of Building V is the last of the excavated long-houses, *Building VI.* Unlike the others this is not associated with any courtyard. It is aligned ESE-WNW, and measures 25×5m. The sides were straight and the gables rounded. The roof rested on 7 sets of posts, and it can also be seen that there was an entrance to the building in the middle of the southern side.

Besides the long-houses, there was also found a *sunken-hut,* (excavation no. 1425) positioned between Buildings V and VI. It appeared as a large oval feature measuring 3·35×2·95m., and 50cm. deep. The sides of the pit were slightly curved inwards, and the bottom was just about flat. A particularly pronounced and clear post-hole was found at the east end, which went 46cm. deeper down than the bottom of the sunken-hut, while at the west end was a much disturbed feature which possibly marks a post-hole. There was also an oval post-hole about 18cm. deep in the middle of the hut. Loom-weights of unburnt clay and a number of potsherds were found in the fill of the hut.

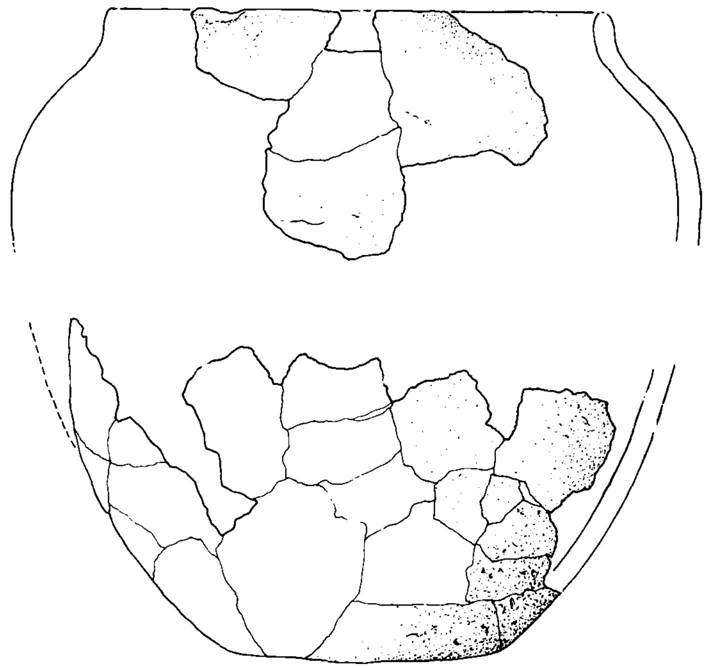
FEATURES ASSOCIATED WITH IRON-EXTRACTION

As was described, the initial occasion for the excavation was the discovery of some slag-pits. These features are situated on the edge of the site in a row west of Buildings III-VI. There can therefore be no doubt that they are contemporary with the buildings. 28 pits were investigated in all, with diameters varying from 50cm. to 1·05m., and depths between 10 and 50cm. The slag content varied from 3·5 to 156·5kg. In general the features were in a very poor state of preservation. Either they were largely ploughed out, or more or less disturbed. Only in a few cases were larger lumps of slag found in their original places. As far as one can judge, all the constructions are of the usual type, with a subterranean collection-pit for the slag (see Voss 1962).

A lot of charcoal was mixed up with the slag in several of the pits, together with bog-iron remains, rather small amounts of charred straw, and more or less scorched fragments of the furnace's clay cover, including a piece of the top of the funnel.

Remains of the funnel's base could also be seen on one substantial piece of slag, with the trace of one of the air-vents. The associated slag-pit was totally disturbed and tells very little about the construction of the furnace, but a cross-section of the interface between the funnel and the pit can be reconstructed from the piece of slag (fig. 4). From the curvature of the piece of slag the diameter of the furnace can be reckoned as about 55cm., and in its narrowest place the slag-pit was about 45cm. in diameter. Unlike other furnaces, there appears to have been no cylindrical section between the upper and lower parts of the pit.

The site of this iron-extraction complex was well chosen. The many meadow-lands of the area were undoubtedly rich in bog-iron. During the excavation, for



a

example, bog-iron was observed in the dredging of Kisbæk, some few hundred metres north of the settlement site.

PITS, etc.

Besides the slag-pits and the post-holes a small number of further features of varying sizes and depths were found. All contained some potsherds and may therefore be regarded as rubbish pits, although they could of course have originally had another purpose. The pits were particularly concentrated in the area south of Building III.

ARTEFACTS AND THE DATING OF THE SETTLEMENT

Apart from the remains of iron-extraction activity, only a very scanty find-material was produced by the excavation. In the main it consisted of potsherds, but a few iron fragments were also found, and a few burnt bones, a glass bead, a loom-weight, bits of burnt daub, and various grinding-, quern-, and whetstones. None of these artefacts can be closely dated, however, and the

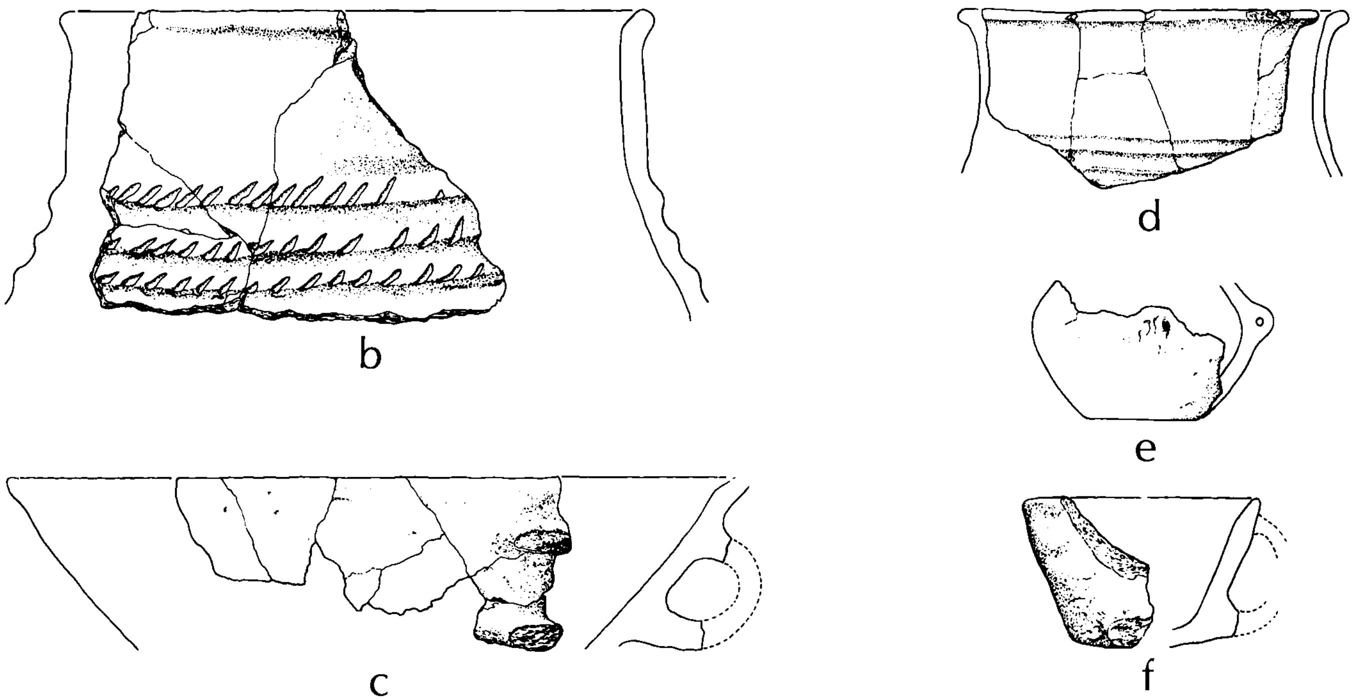


Fig. 5. Pottery from the settlement. d was found in the sunken-hut 1425, while b and e are from Building II. The others are not associated with any features. Scale 2:5. Drawn by Jørgen Holm.

dating of the settlement is therefore based exclusively on an assessment of the pottery (fig. 5).

As is usual on settlement-sites, the potsherds are greatly broken up, and only a few pieces of pots have been reconstructable. This has produced two small pottery cups, vessels with a high neck and out-turned rim, and large, globular vessels with a slightly flaring rim. Particularly characteristic of the ornament are broad grooves, and applied ridges with diagonal hatching can be seen on one neck-sherd. But a very large part of the material is undecorated. Looked at as a whole the material has to be assigned to that broad group which is generally reckoned as the pottery of the 4th. and 5th. centuries. If the absence of characteristic 5th.-century elements such as narrow beakers with tripartite profile, vessels with pierced horizontal lugs, and vessels with high shoulder is taken into account, the find belongs to the first half of this period, although the scanty artefact-material does not encourage one to make a particularly close dating.

In contrast to the pottery, C-14 dates of charcoal from four of the slag-pits however indicate a slightly later date for the settlement:

K-3846 (Slag-pit 533) : 1510 ± 70 BP.
K-3847 (Slag-pit 532) : 1560 ± 70 BP.
K-3848 (Slag-pit 1363): 1500 ± 70 BP.
K-3849 (Slag-pit 1370): 1550 ± 70 BP.

Following Clark's calibration (*Antiquity* 1975) the dates fall into the calender years between 420 and 470 A.D., while the same datings following Stuiver's calibration (*Radiocarbon* 1982) become a little later: 435–555 A.D. (3). The samples' own age must be added to this, which it has not been possible to say anything about.

If one takes the margins of uncertainty of both pottery dating and C-14 dating into account the divergence between the two forms of dating is not alarmingly large.

CONCLUDING REMARKS

The buildings at Mølleparken fit nicely with the increasingly large number of buildings from the 4th. and 5th. centuries which have been excavated in southern Jutland in the last 25 years. Mølleparken has in particular many features in common with the extensive 4th.-

and 5th.-century settlement at Vorbasse. This is not just a matter of the size and form of the buildings, but also the whole character of the site. Thus Mølleparken's regular building-complexes (Buildings I/II) with a long-house and (?) a smaller out-house are paralleled in several places in the Vorbasse settlement, and the peculiar fence construction, with heavy posts on the inside, also has close parallels at Vorbasse (4).

The most important economic foundation for the Mølleparken settlement was undoubtedly animal husbandry. Although no signs of stalls were found in any of the buildings, the situation alone, close by good pasture lands, shows that animal husbandry must have had great significance. A secondary activity was iron-extraction in furnaces. For this too the area has the natural prerequisites. The surrounding meadows produced bog-iron, and the meadows of the area were probably rich with trees for charcoal-production. The combination of animal husbandry and iron-extraction is again paralleled at Vorbasse, and also on other newly-found settlement-sites of the 4th. and 5th. centuries.

Translated by John Hines

Steen Wulff Andersen, Flemming Rieck, Haderslev Museum, Dalgade 7, DK-6100 Haderslev

NOTES

1. Haderslev Museum parish register no. 71, Løgumkloster parish (Lø herred, Tønder a.). The find was discovered by Niels Sterum. The excavation was financed by Løgumkloster Kommune. Gunhild Busch, Jørgen Christoffersen, Ole Grøn, Jørgen Holm, Flemming Rieck, and Niels Sterum took part for varying lengths of time.
2. A corresponding structure is known from Vorbasse, cf. Hvass 1978 p. 64f.
3. According to a letter from the Copenhagen C-14 Dating Laboratory of 3-1-83. Thanks are given to Dr. Henrik Tauber for permission to publish the results.
4. cf. note 2.

REFERENCES

Hvass, S. 1978: Die völkerwanderungszeitliche Siedlung Vorbasse, Mitteljütland. *Acta Archaeologica* vol. 49. Copenhagen.
– 1979: 5 års udgravning i Vorbasse. *Mark og Montre* 1979. Esbjerg.
– 1980: Die Struktur einer Siedlung der Zeit von Christi Geburt bis ins 5. Jahrhundert nach Chr. *Studien zur Sachsenforschung* 2. Hildesheim.
– 1983: Vorbasse. The Development of a Settlement through the First Millenium A.D. *J.D.A.* vol. 2.
Jensen, S. 1978: Overgangen fra romersk til germansk jernalder. *Hikuin* 4. Århus.
Voss O. 1962: Jernudvinding i Danmark i forhistorisk Tid (*Prehistoric Iron Smelting in Denmark*). *Kuml* 1962. Århus (1963).

Journal of Danish Archaeology vol. 3, 1984, pp. 177–186

Tiles and Coastal Trade

A Contribution to the Economic Life of South-East Funen and Langeland during the Renaissance

by JØRGEN SKAARUP

The knowledge of the noble art of tile making seems to have reached Denmark around the middle of the 12th century when master builders and tile makers recruited from Northern Italy have in all probability been our teachers (E. Møller 1964: 11). The new building material was surprisingly quick to catch on among the big builders of the period: King, church, and nobility. This has undoubtedly been due to the huge and easily available deposits of clay. The tractability of the clay in comparison to the traditionally rigid building material hitherto used, granite and chalk, has probably also played its part.

Churches, monestaries and castles sprang up by the hundred, and towards the end of the Middle Ages commoners also began to build brick houses in several of the major Danish towns. The consumption of tile and brick must have been huge and must have formed the basis for the subsistence of numerous tile makers. Many of them seem to have been itinerant and have travelled from building site to building site, erecting their kilns where they were needed (cf. A. Steensberg 1962: column 115).

However, prior to the end of the Middle Ages permanent tileworks had also been erected in connection with feudal castles, towns, and a few large manor houses (V. Lütken 1909: 75 and 163, H. Johannsen and E. Møller 1974: column 152, J. Jensen 1977: 27). These tileworks or brickyards, some of which were in use well into the 17th cent., were always placed in areas rich in clay and with fuel available from the neighbouring forests. Furthermore, tileworks connected with feudal castles and manor houses seem generally to have been located so as to facilitate embarkation from a landing stage in the immediate vicinity (B.A. Hansen and M. Sørensen 1980: 221 f.).

This is worth notice, for whereas a substantial part of the medieval tile production seems to have taken place at the individual building sites when a demand arose as

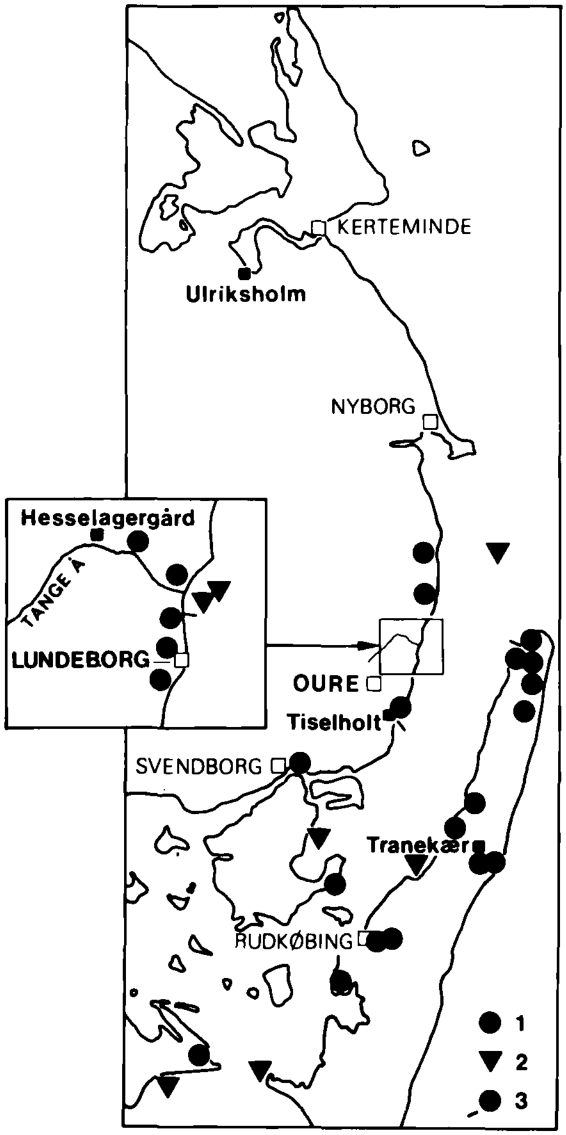


Fig. 1. Map of east Funen and Langeland showing finds connected with the brick making industry in the 16th and 17th centuries in the area around the southern part of the Great Belt. 1: Tileworks. 2: Brick-loaded wreck. 3: Site of embarkation with landing stage. At the top, at the bottom of Kerteminde inlet is Ulriksholm, one of the customers.

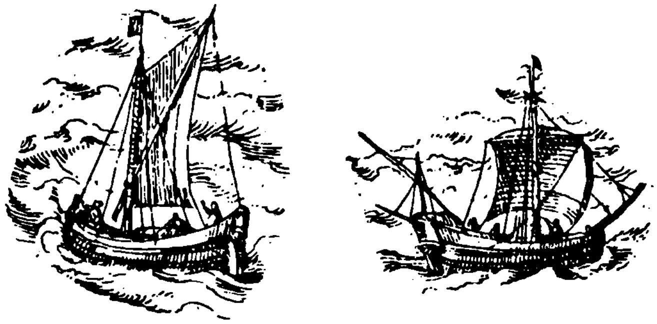


Fig. 2. Craft and Boier. The craft is a single-masted sprit-rigger, whereas the somewhat larger boier is twin-masted with a square-rigged mainmast and a lateen rigged mizzenmast. From old print.

already mentioned, this pattern seems in many cases to have been discontinued during the 16th and 17th centuries. The success of the Reformation during the first half of the 16th century did indeed put a stop to the ambitious church and monestary projects, but it also involved the transfer of huge resources to the King and the nobility. This transfer of resources and the general prosperity of the Danish Crown and nobility during the 16th and the first half of the 17th centuries seem to have created the basis for a commercial tile production. The growing wealth among the upper echelons of the commonalty may also have played a part. At any rate the Crown and the nobility as well as the commonalty invested their profits in prestige building projects.

Langeland and South-east Funen were among the areas that profited by the demand of tilework products during the Renaissance. Both areas are reasonably wooded, have excellent clay deposits, and have easy access to the Great Belt and the sound between Funen and Langeland whence the products could be embarked. Thus all basic conditions for Renaissance tile production have been present, and the presence of numerous kilns and old clay pits indicates that they have been exploited (fig. 1).

The central location of this area has probably also been of some significance. The tilework products must almost exclusively have been sent by sea route, and as will appear from the following, already at that time there were enterprising, local shipmasters whose vessels have been able to carry the heavy loads to destinations all over the realm. Overland transport must have been out of the question. The carts and wains of the period could only contain around fifty bricks (J. Koch 1973: 6), and the primitive roads were not suitable for heavy haulage.

The extensive tilework production in South-east Funen and Langeland is mentioned several times in the written sources handed down to us (V. Lütken 1909: 163, J.P. Trap 1957: 857, J. Jensen 1977: 27 f.). On Langeland the Crown with its feudal holdings seems to have played an important part in the brick making industry. The large tileworks Botofte at Tranekær Castle is first mentioned towards the end of the 15th century and seems already at that time to have made bricks for building activities elsewhere in the country. In South-east Funen tilework production seems to have started during the 16th century on the initiative of two local noblemen. Here, as well as on Langeland, there have been tileworks owned by commoners in the 17th century and probably earlier.

The 16th and 17th centuries were the heydays of the brick making industry in South-east Funen and Langeland. Subsequent disasters of war and deforestation seem then to have put a stop to the industry, and from about 1700 and well into the 19th century imported bricks from Lübeck and the numerous tileworks in Schleswig seem to have ousted the local industry from the market (Cf. E. Møller 1964: 14).

Whereas the brick making industry in the country as a whole as well as in this particular area has been reasonably well elucidated by the discovery of numerous kilns and by the written references, we have hitherto known next to nothing about the vessels in which the bricks were shipped. Stray comments in the written sources and a few illustrations of cargo vessels of the period have been just about all. However, as regards South-east Funen we are in the fortunate position of having a preserved building account supplying us with detailed information about the extensive shipping of bricks and about the numerous people engaged in this trade (J. Jensen 1977: 9 f.).

The building accounts concern the manor house Ulriksholm near Kerteminde, the construction of which was begun by Christian IV in the 1630s and continued during 1644–47 after he had presented the estate to his favourite son, the adolescent Ulrik Gyldenløve (V. Lorenzen 1963: 127–40). A total of 1,200,000 bricks were used, all purchased on South-east Funen. The sellers were partly noblemen who had their own kilns such as Tønne Friis of Hesselagergaard and Henning Valkendorff of Tiselholt, and partly commoners such as the

Fig. 3. Air-photo of the Lundeborg area. At the bottom the Lundeborg fishing hamlet and its harbour are shown. Top left the manor house of Hesselagergård and the river Tange on its way to the Great Belt. Slightly south of the mouth of the river, roughly in the middle of the sea section of the picture, the old landing stage is shown as a dark shadow across the sand bars. The dark shadows further out indicate the two wrecks, the heaps of ballast stones etc. Airphoto by U.S. Air Force 1954.

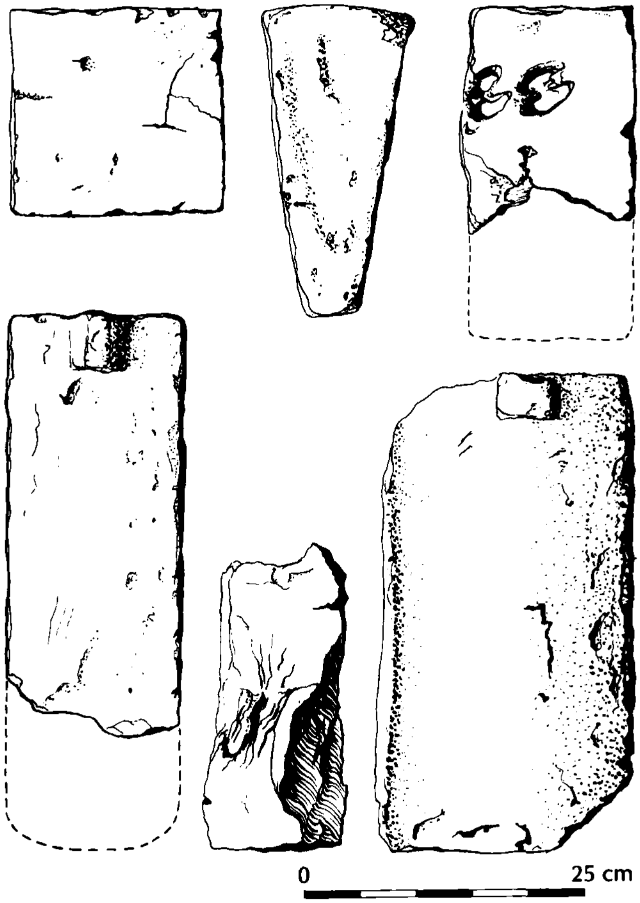


Fig. 4. Samples from the Lundeborg brick makers' line of production.

brick makers of Oure and Hesselager parishes. Among the latter, three are said to have lived in Lundeborg, among them brick maker Jens Rasmussen, one of the big producers. The transport, usually by ship from nearby sites of embarkation, was on occasion undertaken by the brick makers themselves or otherwise by local shipmasters with good Danish "sen"-names. We know little about the vessels. The classifications "boier" and "craft" are mentioned, and one single ship's name has also survived: the Fortuna. Of the two types of cargo vessels undertaking the Scandinavian coastal trade well into the 18th century the "craft" was the more common. Both were small, usually clinker built vessels with a rather simple rigging (fig. 2).

In 1973 in the Great Belt off Lundeborg a brick loden wreckage was found which was relatively soon recognized as a craft (J. Skaarup 1980: 63 f.). The wreck was examined by archaeologists from Langelands Museum, who became interested and decided to investigate further. The results were beyond all expectations. In the course of the ensuing years they learned of another 6 wrecks with brick loads in the water off Langeland. It has been possible to locate and examine five of them. They have all turned out to be of the Late Medieval/ Renaissance period, and most of them belong to the 'craft' type.

Along with the examination of the wrecks investigations have been carried out to locate kilns, old clay pits, and sites of embarkation. On Langeland alone at least 12 sites of brick making that seem to have been in use during the Renaissance, have been established so far (fig. 1). Three sites of embarkation dating from the same period with remains of stone landing stages surrounded by dropped or discarded bricks have also been located and examined. One is located at Brunegaarden near the Northern tip of Langeland, and the other two are located off the manor houses of Tiselholt and Hesselagergaard, the very estates mentioned as major contractors in the Ulriksholm accounts (J. Jensen 1977: 27). At all three localities kilns and clay pits have also been found.

The site of embarkation at the mouth of the river Tange slightly north of Lundeborg, approx 1.5 km SE of Hesselagergaard (fig. 3.) is the most thoroughly investigated of them. Amateur divers from Funen located a large landing stage at a right angle to the coast line, and streching out to a depth of one metre. Spread over a considerable area of sea-bottom around the landing stage were found large quantities of bricks and sherds of unglazed black pottery. The tilework represents many different types (fig. 4) and suggests, as does the pottery, a varied line of production, which can be assigned to the 16th and 17th centuries.

Due to shallow water only barges and lighters can have been loaded from the landing stage. Barges and lighters must have taken the loads out to the boiers and craft waiting at anchor at some distance from the shore – exactly where is indicated by the heaps of discarded ballast stones on the sea-bottom, often surrounded by fragments of brick dropped during the loading. These heaps also bear witness to the unilateral character of the local trade. It has apparently seldom been possible for shipmasters to secure cargoes for the landing stage at the River Tange.

It seems at least four of the brick-loaded wrecks in the waters between Langeland and Funen-Taasinge-Aerø

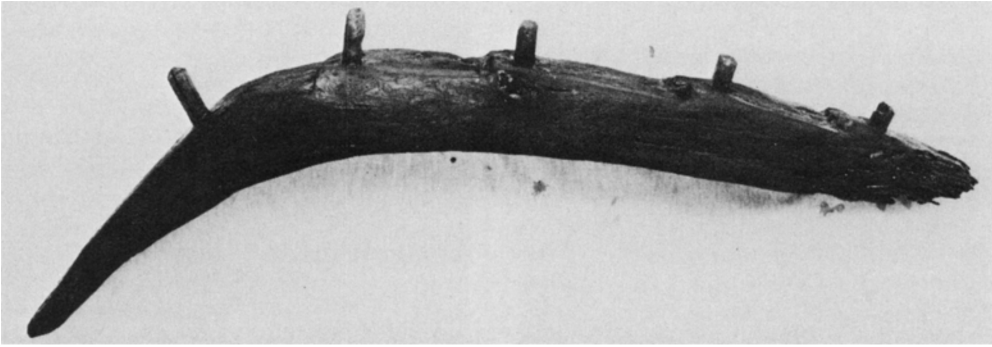


Fig. 5. Fragment of an oak rib from a brick-loaded Renaissance wreck located in the Ristinge causeway between Langeland and Ærø. The fragment is 120 cm long.

belong to the craft type. They are as follows: 1) a completely fragmented clinker built wreck loaded with large medieval bricks and pantiles which foundered in the Ristinge channel (fig. 5) – the old, now sand blocked channel between Langeland and Aerø (fig. 6), 2) a small clinker built oak vessel with a load of large medieval bricks, which foundered in the Praestegaard Bay, and 3 and 4) two partly preserved, clinker built wrecks loaded with large medieval bricks and pantiles respectively, which foundered off the site of embarkation at Lundeborg. In the Lunke Bay at Taasinge there is furthermore a brick-loaded wreck we know very little about (V. Jensen 1982; 80), and on the dangerous stone reef off the island of Vresen is a second one. These are probably also foundered craft.

A large fragment of the forebody of a carvel built vessel loaded with large medieval bricks and with upto 40 cm wide oak planking has also been discovered at Drejet off Ærø. It is possibly the wreck of a boier. At any rate it shows that vessels with a larger cargo capacity than craft also took part in the brick traffic of the 16th and 17th centuries.[1]

The two wrecks at Lundeborg, lying at a depth of 2.5 to 5 m. and approximately 100m from each other, are of special importance to the elucidation of the craft type. Both vessels seem to have foundered fully loaded, probably due to sudden shifts of wind that may easily have fatal consequences at an exposed anchorage. The craft must have arrived at the site of embarkation in ballast. Their discharged ballast stones still lie in piles on the sea-bottom close to the wrecks.

The wreck closest to the coast was heavily damaged by the passage of time. Currents, ice drift, and shipworm had long since removed all exposed parts, and only the sand-covered remains of the starboard side of the stern was left (fig. 7). At the sea-bottom, half buried by sand lay the remains of the ship's load: large quantities of large, red, medieval bricks, and a few pantile fragments.

By means of an injector-pump the sand was removed and the preserved portions of the wreck laid bare. It was

Fig. 6. Section of President of Charts Jens Sørensen's chart of the Western Baltic from 1692. The chart shows a.o. the depths of the navigable causeway beween Langeland and Ærø. Furthest to the NE the island of Vresen is seen with the long stone reef to the south.

Fig. 7. Section of interior hull of brick-loaded wrecked craft at Lundeborg (Photo by P. Glud).

Fig. 8. The stern of the best preserved Lundeborg wreck. The ruler shows where the sternpost has been fixed to the preserved keel. To starboard and port the collapsed side-planking is shown partly covered by pantiles (Photo by P. Glud).

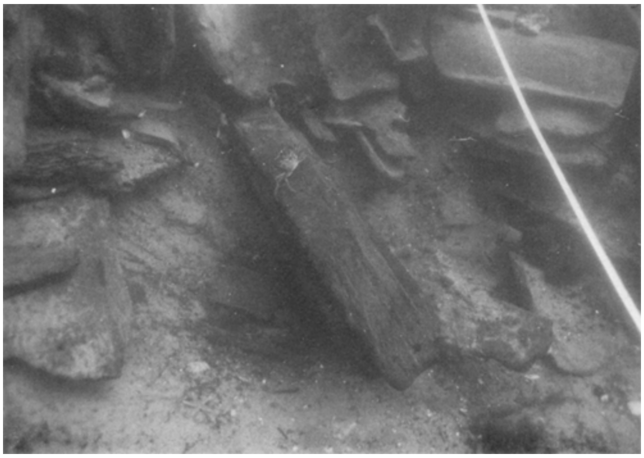


Fig. 9. The forebody of the craft with the repaired oak keel surrounded by pantiles from the load. On either side of the rabbets on the same level remains of the side-planking are just visible (Photo by P. Glud).

Fig. 10. U-shaped beech truss bow found along with tholepins from the boat.

thus established that these were the remains of a clinker built oak vessel whose strakes were fastened to the ribs by means of heavy wooden nails. It must have been a rather spacious and beamy vessel. According to the strake and rib measurements the vessel must have had a length of 15–20 m and a beam of 4–6 m.

In spite of the poor condition of the wreck the exposure of the inside of the hull revealed cordage and movables, preserved because the wreck was covered by sand soon after the vessel foundered. Of importance to the dating were the sherds of several pipkins, a pitcher (?) a couple of bowls with handles, earthenware dishes with beautiful brown, green, and yellow lead glaze – all of them Renaissance types, probably deriving from the 17th century. Signs of wear suggest that these are the crew's cooking utensils. The victuals to be prepared in these earthenware vessels are probably represented by a hog bone. A rather large collection of delicately woven scraps of textile, probably the remains of a piece of garment, two unfortunately quite brittle leather shoes, and scraps of knitted material (stockings?) suggest the haste with which the crew has had to leave the sinking vessel. Likewise the crew has probably been compelled to leave behind a delicately worked wooden marline spike.

The other Lundeborg craft had foundered in deeper sea and is considerably better preserved a.o. because

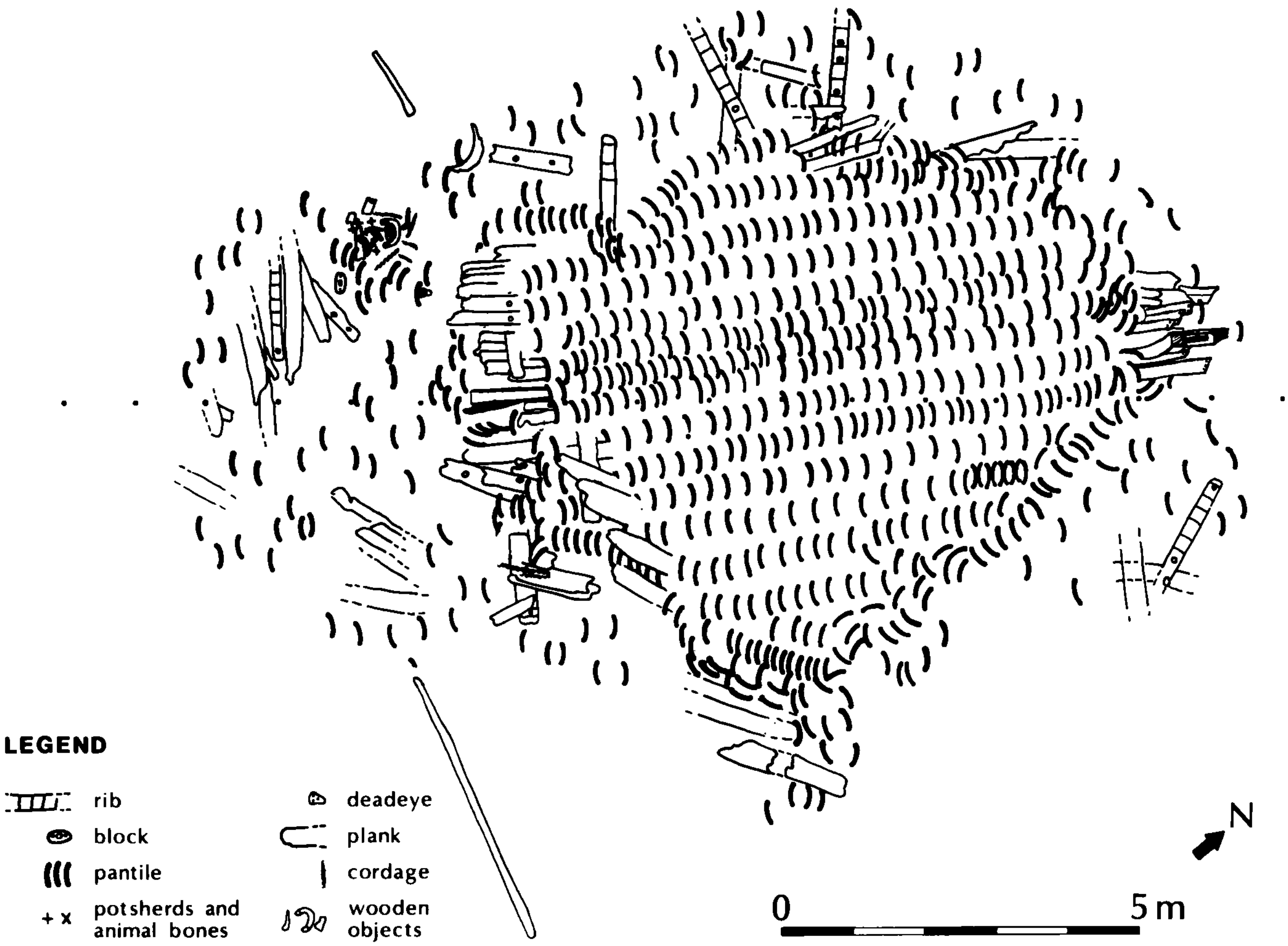


Fig. 11. Survey map of the pantile-loaded Lundeborg craft. Jørgen Skaarup del. 1:100.

the load consisting of pantiles and small amounts of flat tiles and bricks still covers large sections of the hull. On the other hand this has also considerably restricted the possibilities of investigation. For the removal of the load would invariably expose the wreck which would soon disintegrate unless it were raised and preserved, and this costly solution is unfortunately not realistic at the present.

The bow of the craft, which was turned towards SW when she foundered, is not covered by the heavy and compact load of tiles and bricks, and was thus somewhat damaged as were the upper parts of the hull that were free of the load and thus exposed to currents and seas. The stern has probably been pressed out already at the loss of the craft when the heavy load of tiles roused into the stern of the craft. Apart from these defects the major part of the hull seems to be intact though almost completely leveled due to the weight of the load (fig. 11).

As was the case with the first mentioned Lundeborg craft the hull is made of rather thin oak planks held together by iron nails and fastened to the oak ribs with heavy wooden nails. In accordance with Scandinavian tradition it is clinker built, i.e. the planking overlaps like roof tiles. The Mediterranean fashion of laying on the planking with the edges together instead of overlapping thus forming a smooth side, the so-called caravel building named after the Portugese caravels, was however beginning to gain popularity in Scandinavia towards the end of the 15th century. But it seems not to

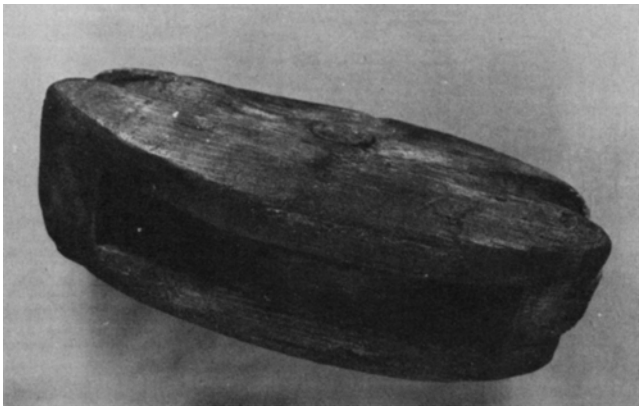


Fig. 12. Wooden block found in the forebody of the vessel.

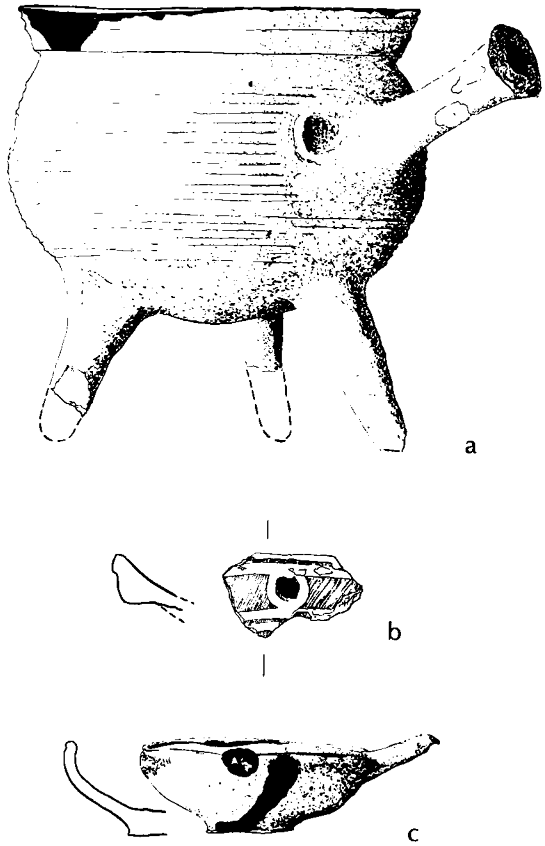


Fig. 14. Pipkin (a), fragment of dish (b), and bowl with handle (c), all glazed on the inside. Found in the pantile-loaded wreck at Lundeborg. 1:3.

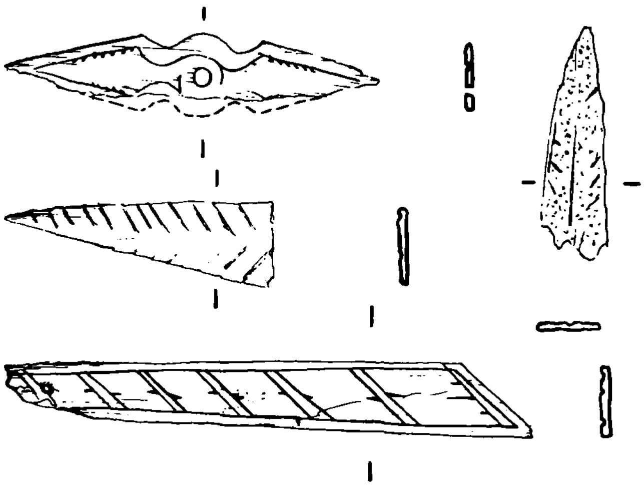


Fig. 13. Ornamental bone fittings found in the forebody of the best-preserved of the Lundeborg wrecks. The biggest one is 8.9 cm long.

have been used in small Scandinavian cargo vessels and fishing boats until fairly late. In both building methods the seams of the planking were caulked with tar-soaked hemp or wool. This was also the case with the Lundeborg wrecks.

After the partial exposure of the keel and floor timbers it was noted that the bows and stern of the craft were flared and had a slender underwater section, so they have probably been very seaworthy. The stern seems to have been straight, but with the sternpost missing, it is impossible to say whether the vessel has been sharp-sterned or has had a transom stern (Fig. 8). The heavily disrupted forebody yields no trace of the bow, but judging by contemporary illustrations the stem has probably been slightly raked. In the forebody the keel showed signs of heavy repairs that must have weakened the ship's hull considerably. The vessel seems to have run aground at an earlier date, which has necessitated major repairs including the replacement of the foremost 4 to 5 m of the keel. Today this section of the keel is missing (fig. 9).

There is nothing to suggest that the vessel has had a superstructure. The hull has probably been open like a boat, perhaps with the exception of a decked forecastle to give shelter to the crew and their personal belongings. Supplies and cooking utensils have probably also been kept here.

The heavy load has not rested directly on the planking of the vessel. Like most other cargo vessels the small craft has been equipped with a solid inner lining, in this

Fig. 15. Fragments of black earthenware pot found off the stern of the pantile-loaded wreck. Diameter 26 cm.

case made of one inch fir planking, to prevent the load from contacting and damaging the hull planking.

The preserved sections of the hull make it possible for us to safely determine the length of the craft to 16 m. The beam seems to have been between 4 and 5 m. Fully loaded the craft has had a draught of less than 1.5 m, which explains why this type of vessel was so widely used in the shallow waters of Northern Europe.

Little was left of the vessel's rigging, as could be expected. Traces of wear and preserved pieces of cordage seem to indicate that a U-shaped piece of delicately worked beech and with perforations at both ends must be a truss bow fastening the spar or yard or the upper edge of the sail to the mast (fig. 10). Among the finds deriving from the vessel's standing and running rigging should be mentioned a couple of beautifully preserved wooden blocks, cleats used for fastening the sheets, a wooden deadeye with traces of a surrounding iron ring, and large quantities of cordage including remnants of a three-stranded, short-spliced hemp rope. An approx. 4 m long but only 9 cm wide pole found outside the wreck seems too slender to have been a spar. It may possibly have been a sprit. Unfortunately none of the finds enable us to determine whether the craft was square-rigged or sprit-rigged. Next to the craft the remains of a small boat were found, probably used when loading and unloading.

The well-preserved load, mainly consisting of pantiles, has made it possible to estimate the cargo capacity of the craft. The tiles are still stacked in long, tightly packed rows along the vessel. The load sems originally to have consisted of 15 parallel rows composed of three or four layers on top of each other, covering a volume of approx. 4 × 8–9 × 1 m. With an average of 32 bricks per running metre the number of pantiles can be estimated at a minimum of 12,000. The weight of a pantile is on an average approx. 3 kg., so the entire load including bricks and flat tiles has been around 36 tons. So this vessel is among the larger ones, for the reference material mentions vessels carrying only one third of this weight. The 12,000 pantiles may very well derive from one single firing in one single kiln. Pantiles are brittle and cannot be stacked as tightly as bricks; and most of the large kilns of the period were able to bake 30,000 bricks at a time (H. Johansen and E. Møller 1974: sp 152).

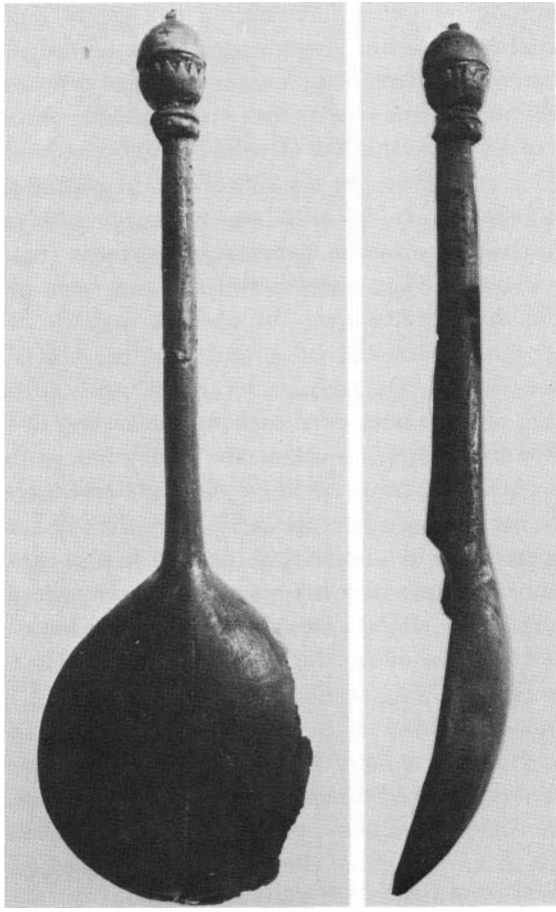


Fig. 16. Spoon made of spindletree wood, measuring 16.5 cm. The end of the handle is shaped like a stylized achorn. From the forebody of the pantile-loaded Lundeborg wreck.

Judging by the dimensions of the vessel and the limited information about cargo ships of the period found in the written sources, the crew has consisted of hardly more than two or three men besides the shipmaster. It seems that the crew has lived in the forebody of the vessel where the remains of clay pipes and shoes have been found along with bone fittings probably used as ornaments on knife handles and sheaths (fig. 13). The vessel's oaken water-barrel has also been placed before the mast as were the cooking utensils, which once again consisted of glazed pipkins, bowls and dishes (fig. 14). The supplies for this abruptly curtailed voyage seem to have been copious. According to Ulrik Møhl's bone determinations the galley has probably contained beef, lamb, suckling pig, and horse meat.

On the basis of the seperate findings the two Lundeborg craft can be assigned to the first half of the 17th century. As such they belong to the latter part of the history of the site of embarkation and may have been owned by some of the shipmasters mentioned in Christian IV's building accounts. The deliveries to Ulriksholm during 1644–47 have probably been one of the Lundeborg tile makers' last contracts. A few years later the Swedes sacked the country and destroyed a.o. the active tilework industry at Lundeborg. The devastation seems to have been so thorough that production was never started again (J.P. Trap 1957; 857).

The coastal trade clearly felt the slump. The partial disappearance of the tile loads hit only one aspect of the activities of the cargo vessels, though. The farmers and fishermen of Southern Funen and surrounding islands traditionaly carried out an extensive coastal trade, sailing food stuff to the towns in Northern Germany and Schleswig-Holstein and bringing back steel, salt, and hops, etc. The idea was that the owner of the craft might sell his own products and bring back goods for his own usage. These privileges were (naturally) often misused and as such an insult and injury to the area's chartered towns, who with franchaise in hand sought by all means to halt the trade – never to succeed (H. Berg, L. Bender Jørgensen & O. Mortensøn 1981: 173f.). In spite of war and crisis the coastal trade seems to have survived and has formed the background for the expansion of the sea trade in the South Funen area during the next centuries.

Translated by Ul S. Jørgensen

Jørgen Skaarup, Langelands Museum, DK-5900 Rudkøbing.

NOTE

1. The wrecks have been entered in the records of Langelands Museum under the following numbers: LMR 11316, LMR 9712, LMR 10125, LMR 11199, LMR 11241, and LMR 8334.

REFERENCES

BERG, H, BENDER JØRGENSEN, L. & MORTENSØN O. 1981: *Sandhagen. Et langelandsk fiskerleje fra renaissancen.* Medd. fra Langelands Museum, Rudkøbing.

HANSEN, B.A. & SØRENSEN, M. AA. 1980: Bistrup Teglværk. *Hikuin* 6. Aarhus.

JENSEN, J. 1977: Organisering og financiering af byggeriet på Ulriksholm i 1630'erne og 1640'erne. *Odense University Studies in History and Social Sciences.* Vol. 50. Odense.

JENSEN, V. 1982: *Tåsinge rundt – en lokalhistorisk sejltur.* Svendborg.

JOHANSEN, H & MØLLER, E. 1974: Tegl. In: *Kulturhistorisk leksikon for nordisk middelalder.* Bd. XVIII. Copenhagen.

KOCH, J. 1973: Bagte sten. *SKALK* no. 1, 1973. Højbjerg.

LORENZEN, VILH. 1965: Ulriksholm. In: *Danske slotte og herregårde* (AA. ROUSSEL, ed.) 2. ed. Bd. 7. Copenhagen.

LÜTKEN, VILH. 1909: *Bidrag til Langelands Historie.* Rudkøbing.

MØLLER, E. 1964: *Tegl* 8. Teglindustriens tekniske tjeneste. Copenhagen.

SKAARUP, J. 1980: Et 1600-tals skibsvrag ved Lundeborg. *Fynske Minder* 1979–80. Odense.

STEENSBERG, A. 1962: Husbygge. In: *Kulturhistorisk leksikon for nordisk middelalder.* Bd. VII. Copenhagen.

TRAP, J.P. 1957: *Danmark.* 5. ed. Bd. 5,2. *Svendborg amt.* Copenhagen.

Journal of Danish Archaeology vol. 3, 1984, pp. 187–198

A Contribution to the Evaluation of Archaeological Field-Surveying

by JØRGEN A. JACOBSEN

INTRODUCTION

In recent years field-survey (reconnaissance) has been of increasing importance to the archaeological collecting of data, partly in connection with purely scientific prospecting projects, partly to an increasing extent, as part of the archaeological rescue work made possible by the Conservation of Nature Act of 1969. A number of archaeological investigations carried out in connection with big-scale road constructions have now been terminated and made accessible for further treatment. The material from this store of data now available gives possibilities for a critical evaluation of reconnaissance as an archaeological work method. The following pages are to be seen as a contribution to an evaluation of this kind, and – at the same time – as an invitation to a methodical debate, making use of future experience in the practice of reconnaissance.

The material on which the present article is based, originates from the investigations of the East Jutland motorway, the motorway of East Funen, and from a smaller road project on Southwest Funen (Andersen, N.H. 1977, Jeppesen and Thrane 1979) (1) The investigated test area totals 2.45 sq.km, inside which 116 prehistoric phenomena of widely varying type and extent were observed (2). A total of 41 localities were later made the subject of excavations. These localities were selected according to rather varied criteria, however, mainly due to expectations originating from research problems of current interest. From a methodical point of view consistent trial excavation at all localities would have been the most informative, but for obvious reasons hardly practicable. As a supplement to and in support of the observations from these areas, data from the prospecting project on Southwest Funen have been frequently used (see Thrane 1976 p. 5–17, Thrane 1978 p. 108–119).

To illustrate the applicability of reconnaissance to the archaeological collecting of data, the above mentioned material has been confronted with the following questions:

1. What is found by surface survey and what is missed? The question concerns types of material as well as types of subsurface deposits.
2. Which factors inherent in the landscape might bias the observations either negatively or positively?
3. How precise are the datings of surface material – are they operational?
4. To what extent are the datings of surface material in accordance with the datings of the excavated material?
5. Are there any alternatives to reconnaissance?

1. WHAT IS FOUND? – TYPES OF MATERIAL AND ARCHAEOLOGICAL REMAINS

In order to sort out the indications of prehistoric activity which dominate surface collections, a comparison is made between observations from the 3 test areas, supplemented with registered material from the Southwest Funen investigation.

In spite of considerable mutual variations, it is observed that flint and combinations of indicators including flint are predominant – this is hardly surprising.

The reason is obviously that the material resists disintegration as well as damage caused by agricultural activity. The significant dominance of flint in the surface material clearly has predictable consequences on the representation of finds, it tends to lead to a skewness in datings: finds from the later prehistoric periods, which mainly manifest themselves by surface finds of sherds, might be expected to be underrepresented in the material, as indicated by table 2. Concurrent observations have been made in connection with the Scanian Hagestad-prospecting project (Strömberg 1978 p. 7). In the regional surveys from West Jutland and Northwest Zealand conducted by Th. Mathiassen, Stone Age ma-

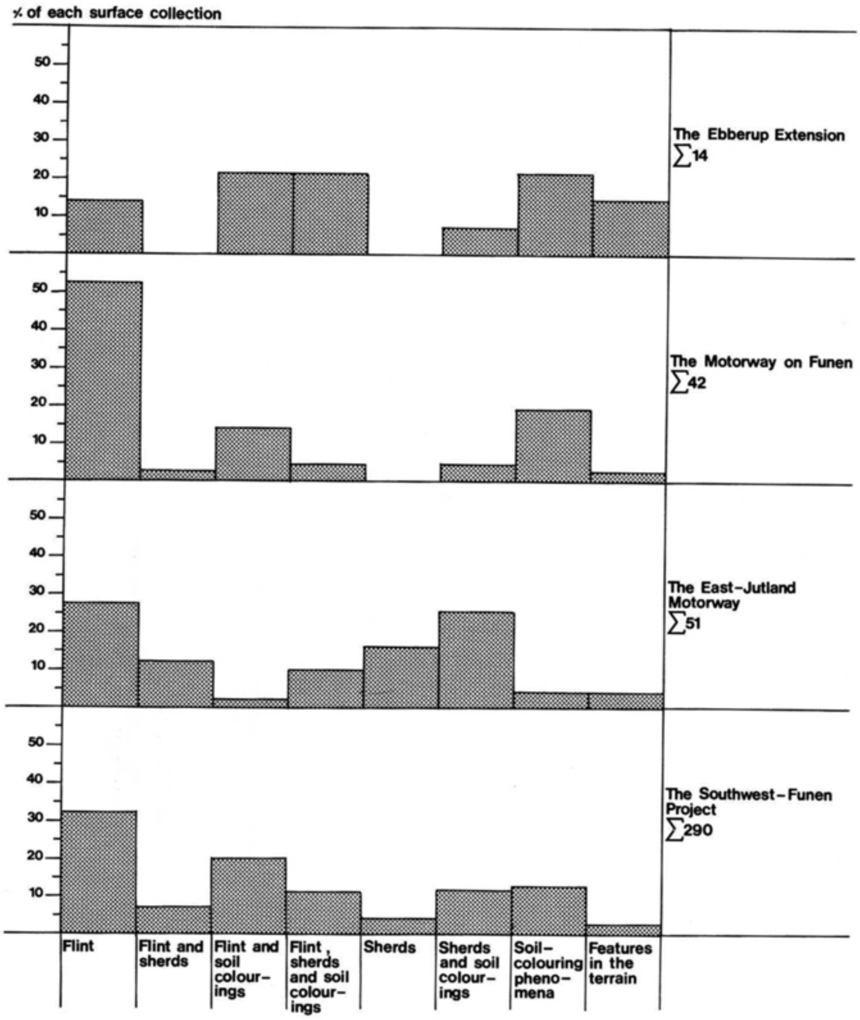


Fig. 1. Dominating categories of finds in surface collections. Pia Vallø *del.*

terial dominates to the extent of 91.46% and 94.49% respectively, calculated from the total collection of finds. However, Mathiassen's material is not quite comparable with the material treated here, as he included registrations of private collections – inspite of that, though, the trend is evident (Mathiassen 1948 and 1959).

As sherd-producing finds predictably might be underrepresented by reconnaissance, it seems essential to explain how far the phenomenon is due to the rate of decomposition of prehistoric pottery: Whether reconnaissance early in the season contributes to a higher frequency of sherds than in the months of spring, when field surfaces have been exposed for a longer period to precipitation and heavy variations of temperature.

To examine the question a test has been made on the basis of surface finds from the Southwest Funen project. All surface finds which can be ascribed to specific months of reconnaissance have been included, a total of 637 surveys, of which 248 were sherd producing (see fig. 2).

Taking into account a possible bias caused by extreme conditions of climate or precipitation in a single year or more, the test material includes the years from the initiation of the project until now, i.e. 1973–1980. If distributed over the 3 periods of reconnaissance, autumn (October–December), winter (January–February), and spring (March–April), the sherd producing finds show the following distribution: autumn 55, winter 52, and spring 141. If these observed values are con-

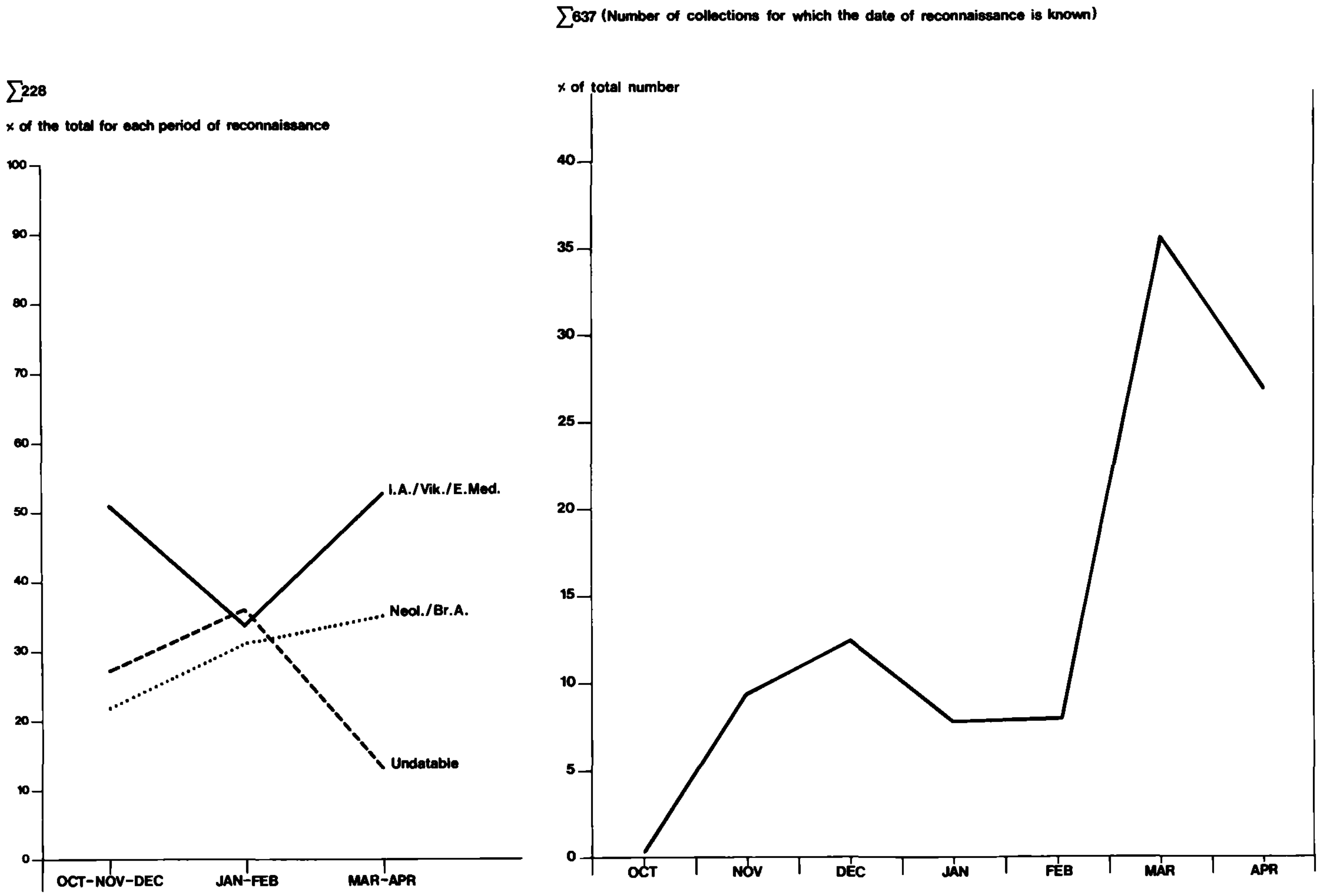


Fig. 2. Left: Reconnaissance activity in the SW-funen area 1973–1980. Pia Vallø *del.* – Right: SW-Funen. Graphical representation of the distribution of sherd-finds during the season of reconnaissance in the years 1973–1980. Pia Vallø *del.*

fronted with an expected distribution, based on a null hypothesis postulating an even distribution throughout the season, no significant difference between the expected and the observed variation in sherd frequencies is found (3.).

According to test 1., the chance of finding prehistoric sherds on the surface does not seem dependent on the period of reconnaissance. The question arises, however, as to how far this is equally valid for finds of pottery from all 3 pottery producing main periods in prehistory. It would thus be reasonable to assume that precipitation, frost and large changes of temperature would rather quickly cause the decomposition of the generally fragile Neolithic, partly Bronze Age ware, whereas the more resistant ware from the Iron Age might be expected far better to be able to withstand the actions mentioned. Furthermore, it might even be expected that the Iron Age ware would be seen better by reconnaissance in spring as a result of prolonged washing. On the basis of the previously mentioned material from Southwest Funen, the distribution of sherds over the different prehistoric periods throughout the survey season has been visualized graphically in fig. 2 (values per month are shown to the right). According to the graph, the proportion of Neolithic/Bronze Age sherds is seen to decline considerably in the winter towards the end of the survey season, whereas the tendency for the Iron- and Viking Age ware (Baltic ware) deviates markedly: the same frequency both in autumn and spring, broken by a rather inexplicable decline in the

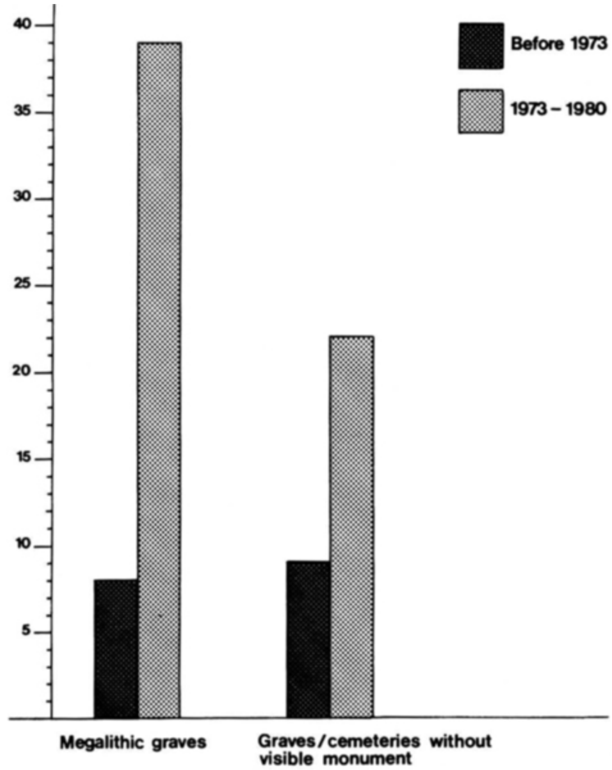


Fig. 3. The increase in megalithic graves and graves/cemeteries of the Bronze- or Iron Ages without visible monument. The parishes of Dreslette, Hårby and Flemløse on SW-Funen after the initiation of systematic reconnaissance in 1973 (cemeteries containing several urns counted as one unit). Pia Vallø *del.*

middle of the season. The increasing part of undatable sherds might be interpreted, with caution, as a rising amount of Iron Age ware in disintegration. To estimate how far these observations can be statistically supported, the material has been subjected to a X^2-test. The starting point for this is a null hypothesis postulating that the ratio between the different periods' share of sherd finds does not show any significant mutual variation, but a stable mutual ratio throughout the season.

An X^2-value of 15,232, with 4 degrees of freedom gives a probability between 0.01 and 0.001, that is – admitting less than 1% of occurrences, where the situation analyzed would come out by chance (Dalton a.o. 1972, Appendix 4). The test clearly rejects the null hypothesis, thereby supporting the observed tendency on the graphs. As seen, the finds of sherds of Neolithic/Bronze Age ware mostly suggest the rejection of the null hypothesis, in favour of the above mentioned assumption that there is a decreasing proportion of this ware towards the end of the survey season. The reason why the ratio between observed and expected distribution of Neolithic/Bronze Age ware is more positive in the winter months, may be because sherds have by that time gained optimal visibility from washing. Admittedly, the test method and numerically rather limited material prevent sweeping conclusions from being drawn. Yet these observations will perhaps be of future interest for reasons which will be mentioned.

In consequence of the stated predominance of flint in surface material, settlement indicators are the prevailing types of finds. In the road project material the few instances of surface finds interpreted as burials have all been discovered by virtue of features in the terrain such as mounds (1780, 1793, 1794, 1831). The degree of certainty for the identification is suggested by the two finds of lowest rank shown in table 1! The clearest category of burial finds is presumably megalithic barrows, the discovery of which is promoted by indications like large, ploughed up stones and calcinated flint. In fig. 3 is shown the increment of megalithic graves since the start of the survey in 1973 in the intensively surveyed parishes of Dreslette, Flemløse, and Hårby on Southwest Funen. In addition fig. 3 shows the increase of finds of moundless grave sites during the same period. Although subject to a considerably higher degree of chance discovery, the increase in this category of finds is evidently furthered by reconnaissance as well. In the motorway material, the degree of chance is illustrated by the site FSM 4100 (see table 2).

2. THE INFLUENCE OF LANDSCAPE FACTORS

Field conditions. Field surfaces covered by crops, no matter of what kind, are clearly an obstacle to a favourable survey result. In Mathiassen's surveys, large parts of the areas were covered by crops (Mathiassen 1948, p. 7). Concerning the motorway on Funen, about 3.5 out of 12.55 km of road line were grass-covered; this was an obstacle to the efficiency of the field survey. Similar conditions were found in the East Jutland area. On Funen experimental sampling by ploughing in some of the grass-covered areas proved unsuccessful, presumably because a great deal of surface washing is a prerequisite for optimal conditions of visibility (e.g. Thrane 1978, p. 111). Due to the duration of the project in Southwest

Funen, it was possible to wait for the best field conditions: field surfaces ploughed in the autumn and exposed to precipitation for some time.

Soil types. The investigated stretches of road are all situated in regions covered by the last glaciation, and the results of investigations here can hardly be held valid for areas with a different geomorphological character. Here heavy clay soils are the dominant soil types. It is the experience of the author that no existing map material gives sufficient information about soil-type differences as even minor areas contain quaternary – geological variations – to a considerable extent. This applies to the formerly published geological soil maps (Bornebusch and Milthers 1935), as well as to the newly elaborated soil classification maps of Denmark, which are the most relevant for archaeologists (Ministry of Agriculture 1979). The latter, however, must be characterized as being sufficiently detailed for settlement studies at a regional level (as e.g. Jensen 1979). For the purpose of survey projects, the soil classification done by the field worker on location is the only adequate procedure. The higher degree of subjectivity is presumably compensated for by far more detailed data. In the material treated here, descriptions of soil-type conditions made by the field surveyor or excavator have been exclusively used. Concerning the South-west Funen project, soil-type differences are recorded within every single survey area – usually every field. In spite of the fact that prehistoric pottery found in heavy clay soil is generally in a rather bad state of preservation, there does not seem (according to table 1) to exist any correlation between soil type and the discovery of the different categories of surface finds.

Slopes and erosion: Veiling and revealing factors in surveys. As a factor obviously distorting survey results, the humanly created influence on the relief of the terrain must be mentioned – more precisely the effects of erosion. A comparatively flat surface is unlikely to be exposed to any erosion caused by agriculture in later times. In areas of this kind, the only critical factor concerning the discovery of artefacts and constructions is presumably the depth of topsoil. Quite the opposite is the case in undulating terrain, where the depth of topsoil and relief seem far less stable. During surveys on Southwest Funen, characterized by a rather hilly landscape, it has frequently been proved that agricultural activity is constantly the cause of soil movement from the higher ground to the lower.

The term "constructions" is used here to describe archaeological remains such as ancient monuments, traces of settlement, graves, pits, etc.

When examining field maps in the scale of 1:2,000 on which such observations are routinely noted, it appeared that 44 of 224 completed maps (scarcely 20%) had notes of uncovered, ploughed up subsoil material. Presumably the phenomenon has been accelerated by the mechanization of agriculture and the introduction of deep-ploughing during the 1950's (See Strömberg 1978, p. 11 and Thrane 1974).

The consequences of this artificial erosion are not hard to predict: the removal of high-lying constructions (e.g. the well-known over-ploughed mounds), and the veiling of artefacts/constructions in low-lying situations. An increasing depth of topsoil downwards in sloping terrain was detected at 11 of the test-excavated localities. One of these sites had an apparently secondary deposit of burnt, brittle stones, whereas 3 other sites turned out to be far more extensive than estimated from the surface. One of these even contained finds dating from a period not indicated by surface observations.

An observation made during a systematic test pit sampling on Northeast Funen indicates the existence of quite a different kind of veiling phenomenon. There appeared to be a man-made increase in the layer of topsoil, apparently a result of intensive manuring within a short radius of agrarian settlements. In the case mentioned, an extensive topsoil layer at a depth of 40–60 cm covered a Roman Iron Age site and a Bronze Age settlement, which had not been discovered during the preceding intensive surface survey. Unlike localities exposed to erosion, the topsoil depth here decreased towards the lower parts of the area (Jeppesen T.G. 1978, p. 104). In the test material treated, similar observations have not been made, which may be due to the localization of motorways. Whereas the gradual disappearance structures due to erosion can be expected – and has been observed – the phenomenon does not seem to be accompanied by any appreciable horizontal dislocation of the artefacts. As regards flint artefacts, it is obvious that while pits and structures are being destroyed by the plough, the flint itself is not moved to any perceptible extent. The locational stability of flint seems to be certified by various excavations of Stone

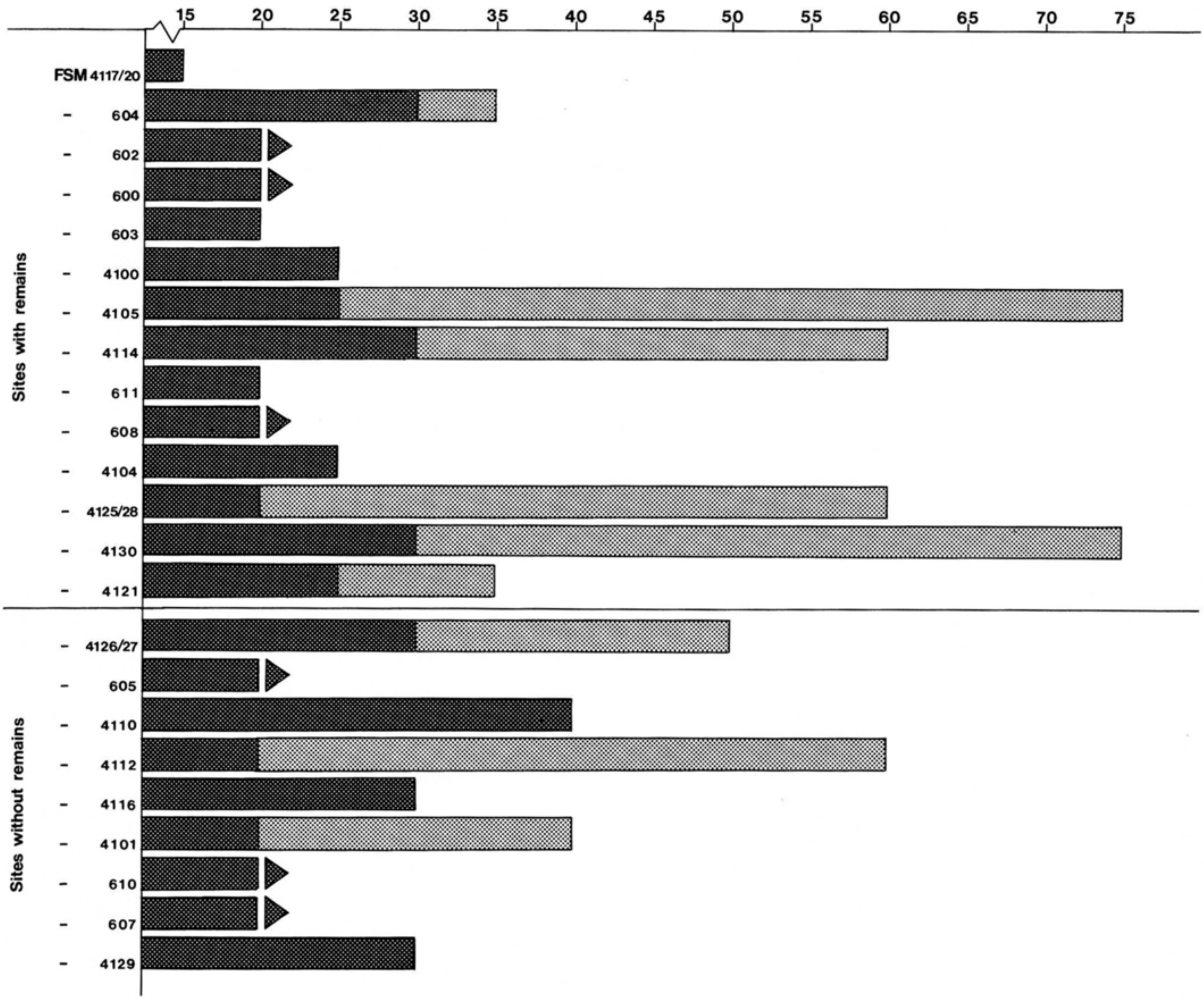


Fig. 4. Topsoil depth at 23 trial-excavated sites. The sites are ranked in decreasing degrees of positive S/E-ratio. Pia Vallø *del.*

Age sites (Andersen S.H. 1973, p. 15, 1975, p. 13, 1979, p. 8–16).

Prehistoric sherds possess a locational stability because of their rapid decomposition; through their very presence they must be indications of archaeological remains in the process of destruction. For that reason sites discovered by field-surveys must be accurately localized and positively estimated. The depth of ploughing is closely connected with the erosive phenomena mentioned, and it is an essential factor if representative survey results are to be correlated. An increase in normal depth, for instance in connection with a change of crops, might totally alter the possibilities of observation (See Andersen S.H. 1979, p. 8). In several instances this has been demonstrated in the Southwest Funen area, where re-surveying forms a methodical part of the archaeological mapping of the region.

3. THE DATING OF SURFACE MATERIAL

In table 3 a number of dated surface localities are shown (datings according to the survey reports). The unequal representation is evident. It is obvious that in the flint dominated periods the majority of datings possess a tolerance making them unfit for settlement studies (a few sites from the Ebberup road being the exception). A total of 7 sites are dated within the Late Neolithic. For this period however, as shown in the table, datings on the basis of surface material are deceptive, as only one dating out of four tested has been (partly) verified (FSM 4100).

In the case of the Neolithic, pottery clearly exceeds flint. Yet for this period surface finds of pottery seem the most problematic, owing to their apparently rapid destruction (e.g. see Thrane 1974, p. 317). It could well be worth testing to see if autumn surveys would yield more acceptable dating material. The tolerance in the dating of the Iron Age material is considered to be within acceptable limits, and fully applicable to settlement studies. Obviously, the basis for these datings is the physically resistant pottery with its few and often quite distinct chronological characteristics.

The well known problem: an absence of settlement material from the Late Iron Age also makes itself felt in the survey material treated here. In the two cases in which settlement remains were revealed during excavations they had not been detected previously from the surface finds (FHM 1832, FHM 1833). On Funen the Early Iron Age pottery is succeeded by the medium hard-fired, socalled Baltic ware, which was produced from the early 11th century (Jeppesen T.G. 1979, p. 104). An extremely thin scattering of this ware occurs on Late Viking/Early Medieval sites. This could be explained from the fact that sherds – like other settlement refuse – were spread over the fields during manuring (Liversage 1977, p. 24). If a similar practice is presumed for the Late Roman and Germanic Iron Age, when pottery in all probability was far less resistant, the solution of the Late Iron Age problem might be, as proposed by Jeppesen, to pay particular attention to soil colouring phenomena (Jeppesen 1977, p. 85).

Trial excavations as a verification of surface observations. An analysis of trial excavations as a mean of isolating factors influencing survey results is impeded by a test material which is numerically well below the minimum limits for statistical treatment – at least if a meaningful distinction between the variables involved is to be maintained. For that reason, the data are shown in a table – table 1 – ranked in a descending degree of positive relations between surface observations and excavation results, henceforth called the S/E ratio.

Terrain and topsoil depth. As previously mentioned, recent cultivation has a permanent erosive effect on more hilly landscapes, like those treated here. Thus it could be expected that localities in sloping terrain would tend to a greater extent towards negative S/E ratios, than would sites in flat areas. To test this, the slope of excavated sites has been calculated and divided into four classes, on the basis of map material (4). The limit of 4° between slight and heavy slope is fixed in consideration of the relief of the test areas. On the soil classification maps, 6° is used as the critical value for cultivated areas. All 6 sites on level ground yielded constructions. The ratios between the number of sites with constructions and the number of surface indications on terrain of slight and heavy slope were 11:19 and 6:8 respectively. Thus these few observations do not show any distinct trend. However, as four of the sites (detected by flint) were on level ground with a comparatively shallow topsoil (FSM 4117/20. 4100, 4130, 602), this might be seen as an indication – as already suggested – that later cultivation has only a slightly destructive effect on remains/constructions in level areas not perceptibly exposed to erosion.

Could this possibly partly explain the preponderance of extensive and well preserved settlement finds from the Bronze- and Iron Age west of the borderline of the last glaciation, where the terrain is generally less hilly? How is the terrain and what are topsoil depths at those few places where habitations have been detected in East Denmark, – otherwise characterized by settlement finds with pits as the only constructions? Regrettably specifications of the present cultivation layer have been given for only 23 sites, though it is a factor presumably influencing the chances of making surface observations, as well as of finding preserved constructions below (see Thrane 1978, p. 115). In fig. 4, depths of topsoil are arranged according to table 2. As seen, no perceptible difference is found between the average topsoil depth at the 14 sites containing remains of constructions and the 9 without. At all localities the shallow parts of the topsoil layers are within full reach of the plough, normally running to a depth of 20–25 cm.

As expected, soil types do not show any influence on the S/E ratio. Apart from the chemically determined ability to preserve different types of material – an effect not concerning survey conditions – soil types are not to be included among the critical factors in the evaluation of survey results. The key to the areas investigated is still the terrain.

Differences in the S/E ratio between the periods. Finding that Stone Age finds were dominant among the surface finds, it could be expected that finds from this main period contributed to most of the results of trial excavations. According to table 2, this is obviously not the case. Out of a total of 39 observed sites dated within the limits of the Stone Age, 18 were excavated, yielding only 7 sites with positive results. The remaining tested sites gave 3 finds of undatable pits, while a single locality displayed affirmative artefacts in the topsoil layer, but no remains of constructions.

In contrast to this, the Iron Age sites display far more positive S/E ratios: of 23 observations, 12 were examined, yielding 11 sites containing constructions. The marked difference between the S/E ratios in the two periods might be due to substantial differences in construction depths. Pits from the Early Iron Age can hardly be destroyed by cultivation, regardless of how long they are exposed to it, whereas the depths of Stone Age constructions under tillage are not apparently always sufficient to avoid ruination. In this connection solely settlement finds are referred to. It seems that in studies of Stone Age settlement conditions, investigators mostly have to rely on surface observations as regards dating, however unsatisfactory this may be.

4. DATING OF SURFACE- AND SUBSURFACE FINDS

During the discussion of the dating limits of surface finds, a large discrepancy was pointed out between the mainly flint-dated Stone Age finds and the Iron Age localities with more exact datings due to pottery. 19 trial excavations with datable remains of constructions have not invalidated this statement. For the majority of Iron Age sites, the datings are well within the limits of the already acceptable surface datings, whereas the same narrow coincidence is found only for a few Neolithic sites from Funen (FSM 602, 603, 604). Faced with a total of 10 negative test excavations of supposed Neolithic sites, it seems as if the future dating of Stone Age sites will mainly have to rely on surface observations alone. Therefore, if operative datings are to be obtained, particularly intensive samplings are necessary at the sites, in order to procure a sufficiently representative material with a narrow chronological margin (see Strömberg 1978, p. 9).

Five sites with an otherwise positive S/E ratio in the datings, turned out to contain constructions dated to periods not indicated by the survey (FHM 1857, 1814, FSM 602, 504, 4100). Unexpected additional gains of that kind lead to the question of how far is it practicable to estimate the extent and type of the prehistoric remains hidden under the surface. The excavated material reveals several cases of misjudgement as to the extent of the sites, especially a tendency to underestimation. This is hardly surprising, considering that chances of discovery are dependent on factors like terrain and later cultivation. However, the unreliability implies some unfortunate consequences to the applicability of survey material to spatial analyses, for instance in relation to prospecting projects, in which survey observations are not verified by excavation: does a number of neighbouring artefact concentrations reflect one single extensive site or several minor sites from discordant chronological phases? How did the sites function? And so on.

5. ALTERNATIVES TO RECONNAISSANCE

A number of possible alternatives to conventional reconnaissance for rescue operations could be mentioned. The question is, however, how far they would really be able to replace perambulation.

Test pit sampling could be one of the alternatives, either as systematic sampling by means of digging test pits at regular intervals, or according to a procedure ensuring a random distribution (as to provisional experience of the first procedure, see Jeppesen T.G. 1978). To undertake sample testing of sufficient scope in a given area of investigation would clearly exceed the costs of a conventional survey.

The same objection applies to an extensive mechanical removal of the topsoil layer, besides being a problem as regards working capacity, even when using the most qualified equipment, experience from road-works has shown that the maximum of cleared area is about 950 square metres per day – or 450 metres of trial ditches 2.1 m across. A procedure like this would imply daily costs, which at the 1980 level would be equivalent to a staff of at least 3 field-workers. For economic reasons this method is hardly practicable.

Finally, any kind of subsurface investigations would come up against practical problems of every conceivable kind: compensation for damaged fields, varying ownership of the different parts of the area, general antipathy, accessibility and weather problems etc.

The pedestrian field-worker, on the other hand, is able to operate almost free of the difficulties mentioned, at a far earlier phase in the planning of engineering projects. For that reason it is difficult to point out any real alternative to walking along furrows – even when considering all the weak points of the method, mentioned in this paper.

6. CONCLUSION

Using rather heterogeneous archaeological data from three larger engineering projects, supplemented with interim results from a regional survey still in progress, it is not possible to give a conclusive evaluation of archaeological field-survey as a method. Given the limitations of the sources, the object of this essay has been to extract experiences based on existing data, leaving their validity to be tested by future investigations.

Thus reliable survey results are obtainable only by optimal field conditions: ploughed and exposed to precipitation for a period. Further, it was found that flint was predominant among the categories of surface finds, resulting in a preponderance of Stone Age Finds. Prehistoric pottery was observable from the start of the survey season until its termination in spring, but with a gradual shifting between the proportion of pottery from the different periods, which prejudiced the more fragile ware of the Neolithic and the Bronze Age. Settlement finds predominated according to expectation by virtue of their more conspicuous indicators. In areas under more constant supervision it was also possible to detect graves by reconnaissance: mainly mounds and megalithic barrows, but in level ground even cremation graves.

From the number of supposed critical factors influencing surveys, soil-type differences could apparently be omitted. The geomorphology of the landscape was picked out as the most substantial concealing or revealing factor. Even a relatively slight gradient of slope was found to bias survey results, partly by the gradual removal of highly situated sites, partly by covering up the low-lying ones. The distortion was apparently a consequence of terrain levelling due to cultivation, an erosion probably accelerated by increased ploughing depth since the mechanization of farming. In the immediate vicinity of present farmsteads, attention should be paid to the concealing effect caused by a thickening of the top soil layer due to manuring and cultivation. In spite of these negative effects, cultivation does not seem to be dislocating artefacts. Finds from the topsoil still remain safe indicators of location, regardless of the possible destruction of underlying constructions. Datings based on surface finds were not found to be equally satisfactory for all prehistoric periods. For example, dating intervals for flint producing sites usually exceeded limits acceptable for settlement analyses. Neolithic sites seemed triply handicapped: firstly, through the predominance of flint difficult to date with any degree of exactness; secondly, the considerable fragility of pottery material, and lastly, the apparently shallow depth of other traces. The presence of pottery was found to be an essential condition for reliable and sufficiently narrow datings, a fact evidently favouring sites from the Early Iron Age, further supported by substantial traces of habitation. Evidence of the problematical Late Iron Age was – as usual – absent, and surface survey alone did not seem to be the solution.

Jørgen A. Jacobsen, Fyns Stiftsmuseum, Hollufgård, Hestehaven 201, DK-5220 Odense SØ.

NOTES

The present report was written in 1980. – The English manuscript was corrected by Jean Olsen.

1. The East Jutland Motorway: Forhistorisk Museum, file no. 1550. The investigations were undertaken by Niels H. Andersen, Forhistorisk Museum, during 1973–1977.

   Motorway on Funen: The reconnaissance, carried out from December 1977 until March 1978, was led by M.A. Henning Nielsen. The trial excavations from March until April 1978 were conducted by Finn Frederiksen and Preben Rønne, both students of archaeology. Further investigations were carried out April – August by the author.

   Road extension by Ebberup: Fyns Stiftsmuseum Journal no. 600–611. The reconnaissance and initial excavations were led by Eigil Nikolaisen, assistant at Fyns Stiftsmuseum. Cand. mag. Torben Grøngaard Jeppesen terminated the investigations.

2. The East Jutland Motorway: 2.1 sq.km. Approx. 65 surface observations.

   Motorway on Funen: Approx. 0.350 sq.km. Approx. 40 surface observations.

   The Ebberup extension: 0.01125 sq.km. Approx. 11 surface observations.
3. For test 1 and 2 the Chi-squared test has been applied. The formula for the Chi-squared test is as follows

   $$X^2 = \frac{(O-E)^2}{E}$$

   where O means the observed values, and E means the expected values.

   For the applicability and limitations of the method see e.g. Dalton, Garlick a.o. 1972, in which a probability table for the distribution of Chi-squared values is found.
4. For the calculation of slope gradient see Monkhouse and Wilkinson 1973, p. 131:

   VI/HE = tg° to the angle of slope

   where HE is the horizontal equivalent and VI the vertical interval. In the present calculations the available map material, usually in the scale of 1:1,000, has been used.

REFERENCES

ANDERSEN, N.H., 1977: Arkæologi langs den østjyske motorvej: Skanderborg–Århus. *Kuml* 1976 p. 199–219 Århus. Summary: The East-Jutland Motorway.

ANDERSEN, S.H. 1973: Bro, en senglacial boplads på Fyn. *Kuml* 1972 p. 7–60. Århus. English summary.

– 1975: En Ertebølleboplads ved Vængesø/Helgenæs. *Hikuin* 2, p. 9–48. Århus. English summary.

– 1979: Aggersund, En Ertebølleboplads ved Limfjorden. *Kuml* 1978 p. 7–56. Århus.

BORNEBUSCH, C.H. & MILTHERS, K. 1935: *Jordbundskort over Danmark*. D.G.U. 3. række. Nr. 24. København.

DALTON, R., GARLICK, J., MINSHULL, R. & ROBINSON, A. 1972: *Correlation Techniques in Geography*. Philip. London.

FREDERIKSEN, F. 1978: Unpublished report on the test excavations on the motorway on Funen.

JACOBSEN, J.A., 1979: Bruneborg, en tidlig førromersk boplads med jernudvinding. In Thrane ed: *Fra jernalder til middelalder*. Skrifter fra Hist. Institut. Odense University. Nr. 27, p. 4–14, Odense.

JENSEN, S. 1979: Byhøjenes rolle i jernalderens bebyggelsesbillede. In Thrane ed: *Fra jernalder til middelalder*. p. 22–30 Odense.

JEPPESEN, T.G. 1977: Stedskontinuitet i fynske landsbyer belyst ved hjælp af den arkæologiske metode. In Thrane ed: *Kontinuitet og bebyggelse*. Skrifter fra institut for historie og samfundsvidenskab. nr. 22. pp. 76–87. Odense.

– 1978: Anvendte feltarkæologiske metoder i "projekt Landsbyen" In Thrane ed: *Bebyggelseshistorisk metode og teknik*. Skrifter fra Hist. Institut. Odense Universitet. Nr. 23. pp. 94–107. Odense.

– 1979: Bebyggelsesflytninger på overgangen mellem vikingetid og middelalder. In Thrane ed: *Fra jernalder til middelalder*. Skrifter fra Hist. Institut. Odense Universitet. Nr. 27. pp. 99–117. Odense.

JEPPESEN, T.G. & THRANE, H. 1979: Ebberup-vejen. Arkæologi på et vejprojekt. *Fynske Minder*. 1978. pp. 17–42. Odense.

MINISTRY OF AGRICULTURE. 1979 ff: *Soil Classification of Denmark*. Soil Maps 1:50.000.

LIVERSAGE, D. 1977: Landbrugsrevolutionen i det 1.årtusinde e. Kr.f. In Thrane ed: *Kontinuitet og bebyggelse*. Skrifter fra institut for historie og samfundsvidenskab. Odense Universitet. Nr. 22. pp. 18–28. Odense.

LOV NR. 314 OM NATURFREDNING. 1969. §49 Stk. 1–4. Act on the preservation of natural amenities.

MATHIASSEN, TH. 1948: *Studier over Vestjyllands Oldtidsbebyggelse*. Nationalmuseets Skrifter. København.

– 1959: *Nordvestsjællands Oldtidsbebyggelse*. Nationalmuseets Skrifter. København.

MONKHOUSE, F.J. & WILKINSON, H.R. 1973. *Maps and Diagrams*. Methuen. London.

NIELSEN, H. 1978: Unpublished report on the archaeological survey of the motorway on Funen.

STRÖMBERG, M. 1978: Hagestadundersökningen som utgångspunkt för bebyggelsehistoriska metoder. In Thrane ed: *Bebyggelseshistorisk metode og teknik*. Skrifter fra Hist. Institut. Odense Universitet. nr. 23. pp. 4–13. Odense.

THRANE, H. 1974: Bebyggelseshistori – en arkæologisk arbejdsopgave. *Fortid og nutid*. Vol. XXV. 3/4. 1973. pp. 299–321. København.

– 1976: Bebyggelseshistorie som arbejdsmetode. In Thrane ed: *Bebyggelsesarkæologi*. Skrifter fra institut for historie og samfundsvidenskab. nr. 17. pp. 5–17. Odense.

– 1978: Sydvestfynsundersøgelsen, erfaringer og problemer fra det hidtidige arbejde. In Thrane ed: *Bebyggelseshistorisk metode og teknik*. Skrifter fra Hist. Institut. Odense Universitet. nr. 23. pp. 108–119. Odense.

	Surface observations																Excavation results					
	Indicators on the surface								Soil type				Slope gradient									
	Flint	Flint and sherds	Flint and soil colourings	Flint, sherds and soil colourings	Sherds	Sherds and soil colourings	Soil colourings	Features in the terrain	Clay	Sand/clay	Sand	Sand/gravel	Flat surface	Slight slope <4°	Steep slope ≥4°	Hilltop	Finds of datable remains	Stray finds = surface observations	Finds of undatable remains	Dating = surface observations	Dating approximately as surface observations	Dating ≠ surface observations
FSM 601						●			●						●		●	●		●		
FHM 1859						●			●						●		●	●		●		
FHM 1834						●			●					●			●	●		●		
FHM 1833						●			●					●			●	●		●		
FHM 1817						●			●					●			●	●		●		
FHM 1856						●			●				●				●	●		●		
FHM 1898					●				●						●		●	●		●		
FSM 4117/20			●							●			●				●	●		●		
FHM 1780								●			●					●	●	●		●		
FHM 1831								●			●					●	●	●		●		
FHM 1857						●			●						●		●	●		●	●	
FHM 1814						●				●						●	●	●		●	●	
FSM 604			●						●					●			●	●		●		●
FSM 602	●								●				●				●	●		●		●
FSM 600			●							●				●			●	●			●	
FHM 1832						●					●		●				●				●	
FSM 603				●							●			●			●				●	
FSM 4100	●											●	●				●				●	●
FSM 4122	●								●					●			●				●	●
FSM 4105			●									●			●		●					●
FSM 4114				●					●							●	●					●
FSM 611							●				●				●		●					●
FSM 608							●			●				●					●			
FSM 4104	●										●					●			●			
FSM 4125/28	●										●			●					●			
FSM 4130	●										●		●						●			
FHM 1957	●								●					●					●			
FSM 4121							●				●			●					●			
FSM 4126/27	●									●				●				●				
FSM 605			●						●						●							
FSM 4110			●							●				●								
FSM 4112			●							●						●						
FSM 4116			●								●			●								
FSM 4101	●										●			●								
FSM 609				●					●					●								
FHM 1858					●				●					●								
FSM 610						●			●					●								
FSM 607							●		●						●							
FSM 4129							●		●					●								
FHM 1794								●				●				●						
FHM 1793								●	●							●						
∑41	9	0	8	3	2	10	5	4	20	7	11	3	6	19	8	8	22	16	6	14	7	7

Full coincidence ↕ No coincidence

Table 1. Pia Vallø *del.*

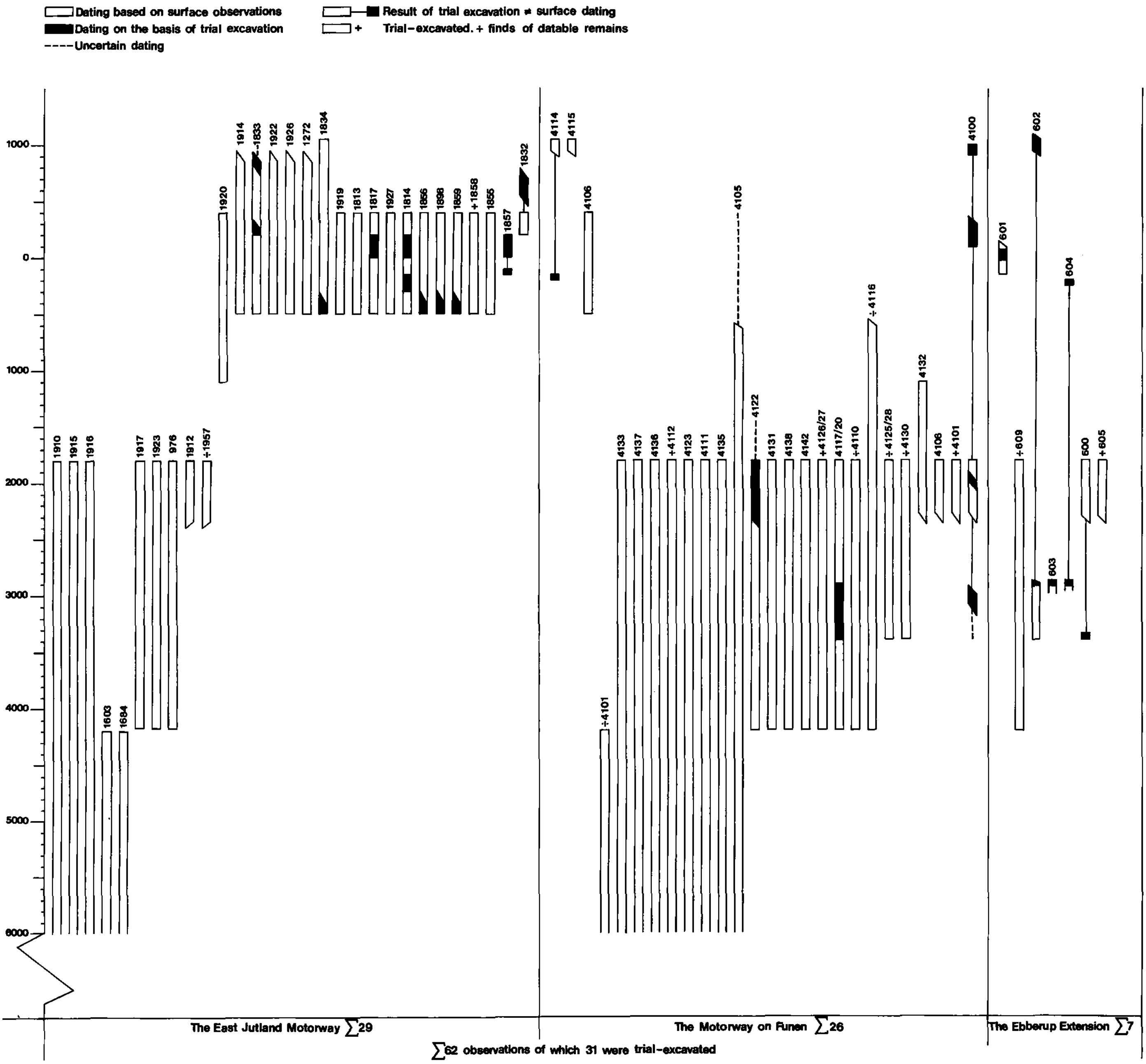


Table 2. Pia Vallø *del.*

Journal of Danish Archaeology vol. 3, 1984, pp. 199–203

Archaeological Field Survey and the Danish Natural Gas Project

by H. C. VORTING

INTRODUCTION

In 1979 it was decided to provide the Danish consumers with natural gas from the North Sea. This meant the commencement of the largest construction project so far in Danish history, and also the largest archaeological rescue operation in the history of Danish archaeology. The excavations had to be carried out within a 30-metre or 20-metre wide strip along the 2,000 kilometres of gas pipeline – 30 m at the transmission lines and 20 m at the distribution lines (fig. 1).

Since its beginning and up to January 1st 1983 the project has been administered by the Agency for the Protection of Nature, Monuments and Sites. After January 1st 1983 by the keeper of National Antiquities.

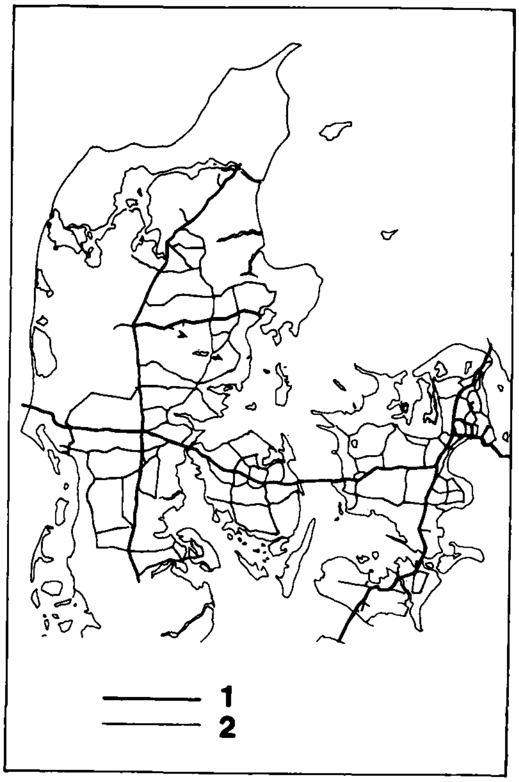


Fig. 1. Map showing the major gas pipelines in Denmark. 1. Transmission lines. – 2. Distribution lines.

A five-stage strategy has been employed:

1) In the planning phase, the administration acts in close collaboration with the natural gas company. All monuments within a 700-metre zone of the planned gas pipeline are mapped in. Today this is done by computer. The company will then alter the planned course of the pipeline to avoid any known monuments.
2) When the line has been marked out in the field, all monuments are inspected and precisely localized. The company will then again adjust the planned course of pipeline to avoid any visible monuments. As a result only very few visible monuments are, or will be affected by the pipeline when it is laid over the full distance of 2,000 km.
3) The third step includes field-surveys along the 30 or 20 m wide construction zone of the pipeline for any indications of ancient settlement. (Barrows have already been avoided, cf. point 2).
4) Small preliminary trial excavations are carried out in order to determine if a full excavation shall be undertaken.
5) Full excavations are undertaken at well preserved sites.

The project opens up fresh perspectives for research. For example, it provides across-section of settlement types, their location, size, etc., through all the major topographical zones of Denmark. It also enables new methods of survey and excavation to be developed and tested, including sampling and air photography. This has been done as the preparations for laying the pipeline progressed, not only to improve techniques but also, when possible, to improve the economical basis for these investigations. Consequently, surveying and trial excavations have so far (in 1982) become 50% cheaper – with no loss of information – than at the com-

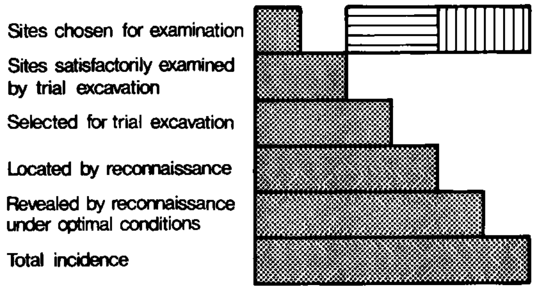


Fig. 2. Table showing how sites worth excavating were missed by the preliminary field-work due to inadequate methods. The proportions are fictive (worked out by J.Aa. Pedersen).

mencement of the project in late 1979. Thus more money can be spent on final excavations. Research reports on this methodological development have been published only in Danish (1).

In this paper, some preliminary analyses of field-surveying methods are to be presented, as it is believed that they apply to most other North European lowland areas (see also the article by Jørgen A. Jørgensen, this volume).

During the first phase of the project in Southern Jutland all sites with settlement indicators were test excavated in order to establish a comparative material which, when analyzed, would allow a more selective approach to test excavations and final excavations: the object being to exclude "negative sites" as early as possible. The folowing analysis was designed mainly to fulfil this goal. We are fully aware that many factors not considered have a significant impact on the results presented – e.g. surveying method, (intensive/extensive) number of surveys, weather and time of the year, experience and personal bias etc. It should also be added that in the first phase field surveying was not supplemented with alternative methods, e.g. sampling. However, certain sections of pipeline were inspected after the machinery had removed the soil and dug the trench, in order to test how good or bad the survey had been. Although it was extremely difficult to make observations because of the disturbance caused by heavy machinery, only very few sites not already recognized during field-walking were observed in the trench. Yet it must be admitted that the field-walking method was less favourable in Zealand due here to heavy soils, and in some areas we were forced to add stratified sampling (based on topographical criteria) as an extra precaution. In the following, we will concentrate upon analyzing the relationship between observed settlement indicators on the ground and their relation to underlying settlement structures. Thus, we leave the question of settlements without settlement indicators out of consideration.

RECONNAISSANCE

To the trained observer, many ancient monuments and remains concealed in the ground will often betray themselves in the cultural landscape through increasing disintegration or some other cause. Therefore, thorough field-work in the form of surface survey is in our opinion the best and most serviceable method of finding new evidence of past human activity, well knowing that some types of ancient remains cannot be found in this manner. The aim of such reconnaissance is to piece together as complete a picture as possible of the location and extent of past activity in a given area. The collected data will then provide the basis for deciding whether further examinations should be made, beginning with a trial excavation.

There is no doubt, however, that the evidence recorded by field-surveys is of scientific and culture-historical value, whether or not further investigations are undertaken. It must be recognized in principle that all prehistoric artefacts over and above a minimal limit are indications of some kind of early activity in a given place, provided there is no evidence to the contrary such as earth filling from elsewhere, gravel quarrying, etc. And, of course, providing that the material has been reliably and professionally collected.

The timing of field-surveys is of great importance, and it is possibly the only serious limitation of the method. Not many observations can be made during the summer months when crops cover the fields, and even after the principal harvest, there still remain fields of beet and maize which make reconnaissance difficult. Winter cereals are increasingly sown in Denmark, and areas with these crops present some difficulty when field surveying during the autumn and winter. Meadows permanently under grass are of course out of the question for field-work of this nature.

However, from November – and in some cases a little earlier – when the amount of uncropped land is greatest (and not freshly ploughed or harrowed), and until

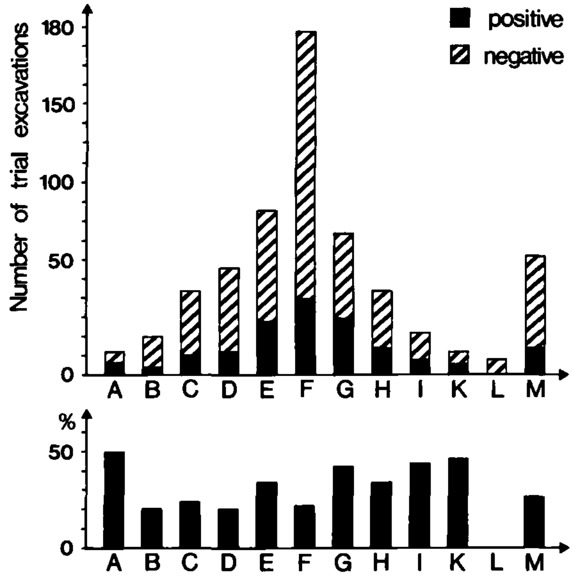


Fig. 3. The composition of stray finds and their distribution on sites worth excavating (positive localities). – Table above: Finds recovered by field-surveys, divided into categories (indicators); their incidence on sites where trial excavations were undertaken. All stretches of pipeline 1979–1980. – Table below: Distribution of the same indicators on positive sites expressed as percentages.

A – Bifacially retouched tool types
B – Axes and axe fragments
C – Blade and flake cores
D – Blades
E – Other flint tools
F – Flint waste
G – Datable prehistoric potsherds
H – Fire shattered stones
I – Slag
K – Hammerstones
L – Other potsherds
M – Burnt flint

March, sometimes slightly later, field reconnaissance yields satisfactory results provided the terrain is not buried under snow. Weather and light conditions obviously affect results.

In spite of these difficulties we have so far managed to undertake the reconnaissance of between two-thirds and three-quarters of the terrain affected by the construction of the natural gas pipeline, and the remainder has largely been grassland. At worst, over short distances, the unsuitable areas constituted up to half, but elsewhere they amounted to less than one-quarter of a given distance.

In B2, the preliminary report (see note 1) dealing with the investigative method, two concepts were launched; namely, the *intensive* and the *extensive* field-survey. It is arguable whether indeed the terms are valid, as "extensive" could imply a less thorough survey than the intensive survey, which is by no means the case. It is in principle a matter of two theoretical extremes. By intensive reconnaissance is meant that the area is evenly reconnoitred at a steady speed, regardless of the terrain and frequency of finds. Whereas extensive reconnaissance means passing lightly over unlikely places, but carrying out a more thorough search in localities where finds would be expected.

If consistently undertaken, intensive reconnaissance ought to be the more objective method because, if all else were excluded, the results from different tracts of land would be directly comparable. Yet a large number of variables will always prevail; for example, tillage conditions, weather, light, and last but not least, the psychological factors which can give the illusion of objectivity. The speed of reconnoitring is obviously influenced by all this and it is difficult to maintain consistency when working according to this method.

On the other hand, the extensive approach is by definition subjective, and it also requires a greater degree of prior knowledge. In any event it is extremely important to exercise great caution when deciding what to leave out or what to walk quickly across if there seems little chance of finding anything. If at all, these are decisions which can only be made by very experienced field-workers. Yet by concentrating less on unpromising areas, time is saved for more exhaustive searches in places where finds would be expected. It also allows a clearer picture to emerge of the character and extent of sites found which, in turn, provide a firmer basis for assessing whether trial excavations should be carried out.

A combination of both methods is generally adopted, although the more inexperienced the field-worker, the more closely he or she ought to follow the guidelines for intensive reconnaissance. It is likewise essential to realize that no criteria will be entirely objective.

The time taken to accomplish a field-survey varies according to weather conditions, the terrain, soil conditions, and particularly the frequency of finds. As already mentined, the last point does not affect the intensive method, as relatively restricted localities will be recorded by this method. But if the extensive method is used a number of the small localities will tend to merge, giving fewer but larger localities. Regardless of which of the two methods is adopted, the average speed along the construction zone of the pipeline should preferably be about 2 km daily, across a breadth of 20 m – 30 m. Sometimes it can be an advantage to repeat a field-survey, for example if the first has been undertaken in bad conditions, and the opportunity to make a second attempt arises.

PRELIMINARY RESULTS

The next stage after the reconnaissance is to decide where to try an exploratory excavation. What are the criteria? Is there any connection at all between stray surface finds and the probability of finding archaeological traces or remains in the ground? The answer is surely that without some conviction that this is indeed the case one might as well abandon field reconnaissance. Yet the relation between surface finds and archaeological remains in the ground is not entirely straightforward, and a deeper statistical analysis of the collected data will be necessary before the stage can be reached when it will be possible to select sites for trial excavation, and be secure in the knowledge that archaeological remains will be discovered.

In the first place, an analysis of the first 195 trial excavations showed that there are some surface indicators (groups of finds) which signify to a greater extent than others, the likelihood of a positive trial excavation, i.e. leading to further excavations. This is shown, for example, in fig. 3., although it is evident that indicators are not in themselves entirely reliable.

Secondly, it is apparent that the greater the number of indicators, the better is the chance, roughly speaking, of a positive trial excavation (fig. 4).

Thirdly, the analyses demonstrate that it is possible to lay down certain minimum criteria before selecting a site for trial excavation, without a loss of positive sites. These criteria are as follows: a surface showing of at least 2 indicators, one of which being datable prehistoric potsherds or 10–20 flint flakes. Or 3 indicators, one of which being a single or several tool(s).

Experience has shown that a couple of trial excavations started on the basis of 3 indicators could have been omitted, as well as a certain amount on the basis of 2 indicators, and all in places with only 1 indicator. Here it should be stressed, however, that burnt flint is not included as an indicator in fig. 3, because preliminary sample analyses showed that it held no significance in the given context.

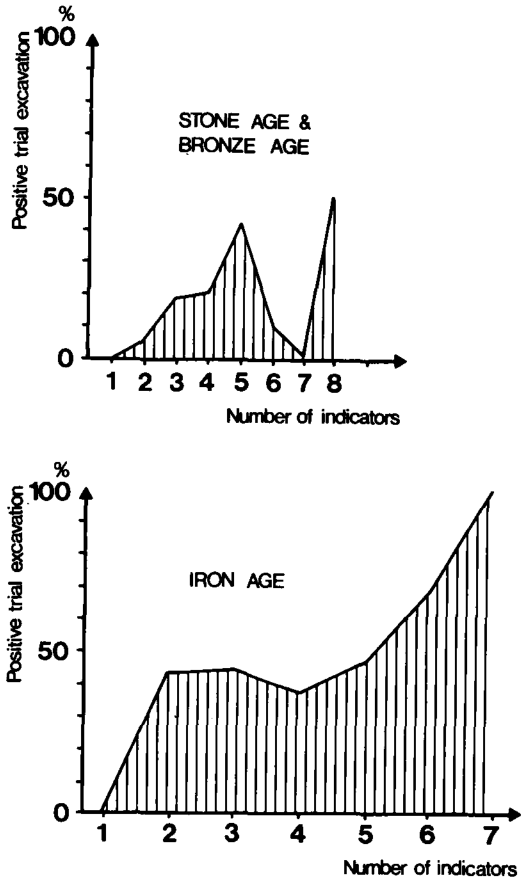


Fig. 4. Ratio between sites worth excavating and number of (datable) types of surface finds collected during reconnaissance (worked out by Peter B. Christensen).

Moreover, apart from the group with 10–20 flint flakes, the number of items in each group of indicators has not been taken into account. It will also surprise some people to hear, for example, that in localities where flint flakes have been found the degree of "positivity" does not increase in proportion to the quantity of flint – the reverse is sooner the case, whereas potsherds in large amounts is an almost certain indicator.

In conclusion, a few remarks are called for about the reliability of the present material. It ought not to be accepted all too uncritically. From the start, it has been a question of material, subjectively assessed, full of unknown quantities and difficult to formulate. It is all the more surprising, then, that some statistical analyses (with known and unknown uncertainties and inaccura-

Stretch	Length	Sites localized	Sites pr. km.	Sites chosen for trial excavation	No. of trial excavations	Positive trials	No. of positive trials per km
Frøslev-Egtved	90	ca. 100	1.1	79=79%	68	18=26.5%	0.2
Nybro-Egtved	55	24	0.4	15=62.5%	15	3=30.0%	0.05
Sønderborg-Nordborg	28	95	3.4	43=45.5%	22	5=22.7%	0.26?
Kærgård-Egtved	75	12	0.2	8=66.7%	12	1= 8.3%	0.013
Egtved-Fredericia	45	44	1.0	30=68.0%	30	9=30.0%	0.2
Tønder-Tinglev	25	24	1.0	16=66.7%	14	4=28.6%	0.28
Frøslev-Sønderborg	37	100	2.7	46=46.0%	42	10=23.8%	0.27
Egtved-Ll. Bælt	34	(122)	(3.6)	(60=49.1%) 39	(47) 34	(11=23.4%) (9=26.5%)	0.26
Egtved-Koelbjerg	32	(66)	(2.1)	(33=50.0%) 25	(33) 25	(8=24.2%) (6=24.0%)	0.19

Fig. 5. Schematic table of site frequencies along the construction line. Note the somewhat weak representation in West Jutland.

cies) nonetheless produced some firm results. But for the time being in any event, these should be considered indicative: a reflection of certain tendencies. There must still be room for individual assessment.

Finally, one or two more general observations ought to be briefly mentioned. It is quite interesting to compare the distribution of recorded sites in the National Museum's central register (chiefly barrows) with the localities detected by field-survey (chiefly settlements). Although by and large two different categories of monument, our preliminary analyses suggest a significant link between them. It appears that known monuments serve to some degree as indicators of the intensity of prehistoric settlement in a given area, and this is useful in the preliminary stages of a field-survey, but obviously subject to considerable local variations.

It was also found that while field-surveys seemed to indicate that the proportion of Neolithic, Bronze Age and Iron Age sites was more or less equal, trial excavations reduced the number of Neolithic and Bronze Age settlement sites, and that after the concluding excavations there would be a preponderance of iron Age settlement traces, some from the Bronze Age, and extremely few from the Neolithic. Therefore, in many cases, a site localized through neolithic finds of flint proved, when under final excavation, to be largely of the Iron Age. One explanation is that the same localities were chosen for settlement throughout antiquity. The latest and usually the most extensive form, namely the settlements of the Iron Age have thus helped to obliterate traces of former habitation.

Obviously, the cultivation of the same soil through the millenia is also a substantial cause of the destruction of earlier settlement traces. And it is self-evident that the earliest settlement on arable land is almost always the most fragmentary. Only worked flint on the surface and, in exceptionally fortunate circumstances, a few potsherds, can give us some idea today of the frequency and distribution of Stone (and Bronze) Age settlements in the landscape.

Hans Christian Vorting, *Rigsantikvarens arkæologiske Sekretariat*, Frederiksholms Kanal 12, DK-1220 København K.

NOTE WITH REFERENCES

1. BEKMOSE, M., PEDERSEN, J. AA., RIECK, F., STERUM, N. & VORTING, H.C.: *Naturgasprojektet og arkæologien*. 1. delrapport: Forundersøgelsesmetodik. Fredningsstyrelsen *Rapport B2*. 1980.
BEKMOSE, M., BIRKEDAHL CHRISTENSEN, P., PEDERSEN, J. AA. & VORTING, H.C.: *Naturgasprojektet og arkæologien*. 2. delrapport: Forundersøgelsesmetodik. Fredningsstyrelsen *Rapport B6*. 1982.
ANDERSEN, B., BANG, J., BIRKEDAHL CHRISTENSEN, P., PEDERSEN, J. AA. & VORTING, H.C.: 3. delrapport: Slotsholmsmødet. Fredningsstyrelsen *Rapport B7*. 1982.

Debate

Editors' Preface

Debate is a new feature to appear regularly in future volumes. It is open for contributions – both shorter and longer ones – although the editors will try to present a specific theme in each volume of Journal of Danish Archaeology.

The objective of *debate* is to stimulate research through discussion. The editors believe that an open debate has important heuristic functions as a corrective both to specific research and to more general trends in the archaeological environment. It also has important psychological functions by offering an official forum for debate rather than the unofficial closed circles of criticism and opinion which easily develop. Or to put it in a slightly polemic way: Discussion and criticism is too important to remain a monopoly of those few who educate the future generation of archaeologists at our universities or participate in seminars and conferences – two areas where the objectives and the standards of our discipline are often moulded.

In *debate* we hope to receive contributions from a broad spectrum of archaeologists. In our first presentation we have chosen *Danish Archaeology in the 1980's* as our feature theme. The manuscript by Kristian Kristiansen was circulated to a number of archaeologists who were asked to present their opinon on the subject. The first responses are published here, and we hope to bring a few more in the next volume.

Themes for debate in volumes to come will be "The Introduction of Agriculture in Southern Scandinavia" and "The Transition from Bronze to Iron Age in Northern Europe«. But we also hope to receive more specific comments e.g. on previous articles in JDA or other periodicals, monographs, and research projects.

Danish Archaeology in the 1980's

by KRISTIAN KRISTIANSEN

INTRODUCTION

Periods of change interfere with periods of stability within any discipline. In Danish archaeology the last 2–3 generations have seen a long period of consolidated research with little need to question either the basic premises of research or the future goals of archaeology as commonly and implicitly agreed upon. The last 10–15 years, however, have witnessed rather drastic changes in the archaeological environment making a general debate of research policies urgent (e.g. Kristiansen 1978, Thrane 1982). But a discussion of Danish archaeology in the 1980's also implies a discussion of the common Scandinavian tradition of which it is part (Klindt-Jensen 1975, Moberg 1981). This raises the question: what constitutes such a tradition? Here one can mention at least two things strongly felt by many Scandinavian archaeologists – the burden of archaeological history and the burden of data. It has had a strong impact on research traditions to be one of the regions in the world with the longest history of archaeological research (Daniel 1975). Add to this the enormous number of archaeological monuments and objects preserved both in the landscape and museums. In many ways this background has been decisive for the way in which Scandinavian archaeologists have reacted to and assimilated the various theoretical and methodological trends within the New Archaeology over the past 15 years. To illuminate this I shall first give a short historical account of some major theoretical trends in Scandinavian archaeology.

THE BURDEN OF TRADITION

During the middle and late 19th century Scandinavian archaeology produced three traditions of archaeological research. 1) The chronological and spatial classification of archaeological objects into periods and cultures based on the principles of typology – 2) the ecological analysis of settlements and subsistence based on interdisciplinary research programs – 3) and the total registration of all visible prehistoric structures in the landscape by systematic field survey.

The first tradition is closely linked with the name of the Swede Oscar Montelius (Gräslund 1974 and 1976). This approach very soon became dominant in Central European archaeology as the basic tool of archaeological research and was later linked to ethnic and diffusionist interpretations of culture (Eggers 1959), representing a particularising, historical approach familar to modern political history. Although political misuses during the 1930's and 1940's and later the radio carbon revolution have led to the final collapse of this interpretative framework (Renfrew 1973), the basic methodological exercises still dominate most Central European archaeological research and also much Scandinavian research, now being dressed in a modern suit of definitions and statistics.

The second tradition is closely associated with the name of J.J. Worsaae and his botanical and geological colleagues J.J.S. Steenstrup and J.G. Forchhammer. During the early 1850's these men formed an interdisciplinary commission that discovered and documented the first evidence of a mesolithic hunting subsistence in Europe, the "Ertebølle culture" characterized by shell middens along the Danish coasts – the so-called "kitchen middens", from a Danish word that was internationally applied in the archaeological terminology at that time (Klindt-Jensen 1975, 71 f.). This ecological tradition never became dominant, but lived a quiet life as a helping tool for archaeologists often with little interest in ecology and economy, although new interdisciplinary commissions were founded again during the 1890's and during the 1930's (Fischer and Kristiansen in press). The latter resulted in the breakthrough of pollen-analysis as an independent cultural-ecological research tradition linked with the names of Johannes Iversen and Troels Smith, especially Iversen's classical study "Land Occupation in Denmark's Stone Age. A pollen analytical study of the influence of farmer culture on the vegetational development." (1941). This new research tradition, however, had a stronger impact on English, Dutch and Swedish archaeology than on Danish archaeology, in that the last generally remained loyal to the typological traditions of data classification and presentation. It was not until the appearence of the Anglo American new Archaeology in the late sixties and early seventies that a theoretical and methodological reorientation to restore the position of ecological studies began at least in Denmark (see also Andersen et al 1983). In Sweden and Norway, however, co-operation between archaeologists and geographers had led to the development of a tradition of settlement studies which in many ways preceded the New Archaeology (e.g. discussion in Norwegian Archaeological Review 1974, volume 7, no. 1. Since 1980 in Bebyggelseshistorisk Tidsskrift. Also Kristiansen in press a). (1). These studies were empirically based on the systematic recording of the many well preserved relics of barrows, cemeteries, prehistoric farmsteads and field systems in the more marginal areas of Central Scandinavia (e.g. Ambrosiani 1964, Lindquist 1968, Myhre 1972 and 1973) (2).

This leads us to the third Scandinavian tradition, namely the total registration of all visible prehistoric structures in the landscape by systematic field survey. This tradition took its beginning in Denmark in 1873 and was later adopted in several European countries (Worsaae 1877 and 1879). In Denmark the work was done by 1930, in Sweden it has only recently been finished and Norway is still on its way (see articles in Fornvännen 1978). Thus there exists in Scandinavia central registers of all known ancient monuments and sites – in Sweden approx. 500,000, in Denmark only a little more than 115,000 (Nielsen 1981, Ebbesen in press). These registers create a specific basis for landscape and settlement studies (e.g. Hyenstrand 1979 a & b, and 1981). Together with the enormous number of archaeological objects from burials, hoards, settlements etc. – accumulated during 150 years of research (Kristiansen in press b) – they constitute what I started by calling "the burden of data", but which should rather be termed the potential of a representative sample of the prehistoric past. It should be noticed, however, that this research tradition was also closely linked to a strong conservation policy rooted in a national-historical ideology that characterizes all Scandinavian countries also today (Klindt-Jensen 1975, Kristiansen 1981).

In Scandinavia we had no Roman villas, no Hellenistic temples, none of the glory of the Mediterranean civilizations. But we had a quite unusual number of prehistoric barrows and megaliths which were, and still are, a significant feature of many Scandinavian landscapes. In a period of final decline from former national and territorial greatness during the medieval period and the Renaissence, "What has been outwardly lost, should be inwardly gained" as it was said by a leading figure in the 1860's, after the final Danish humiliation and loss of Schleswig-Holstein to the Germans. Thus archaeology in Scandinavia arose in a period of decline from former greatness, which helps to explain its strong position from an early date.

These historical elements constitute part of the general background through which the new trends in archaeology of the late sixties were filtered. But before we consider how Danish research traditions were restructured as a consequence of this development, let us consider the process which has normally been given too little attention (but see Moberg 1977 and 1978 a & b).

AWAKENING FROM THE LONG SLEEP – THE IMPACT OF NEW ARCHAEOLOGY

Between 1884 and 1966 no major theoretical works appeared in Danish archaeology (Müller 1884, Jensen 1966) (3). The paradigm of Thomsen, Worsaae and especially Sophus Müller remained a firm foundation (Klindt-Jensen 1975). Archaeology was mainly practised at the National Museum, also housing a small university department, and at the new museum centre and university department at Moesgård near Aarhus. The 2 university departments produced 1 or perhaps 2 candidates a year, highly specialized after 7–8 years of purely archaeological studies spanning Europe and the Near East. The 20 or so Danish archaeologists formed a small community firmly rooted in the traditions of Müller and Brøndsted and innovations remained within the basic methodological framework (4). Müller was still within living memory. It was not until the number of students and jobs suddenly exploded during the late 1960's and 1970's that this framework began to crack and soon collapsed. Therefore, it seems appropriate to apply Colin Renfrew's metaphor "the long sleep" also to describe the Danish background of the new development (Renfrew 1982).

In several aspects the process of assimilating the New Archaeology has conformed to the sociological pattern described by Kuhn as characteristic of paradigmatic change (Kuhn 1970). A few established and respected senior archaeologists have pioneered or supported the new ideas among their students and helped to legitimize them. This was followed by a massive student mobilization among the generation to which the present writer belongs, most of us now in our mid-thirties, which resulted in the formation of an association of Scandinavian archaeology students in 1969. Since then, they have organized New Archaeology conferences each year primarily for research students, and issued a periodical twice a year consistently debating theoretical themes, read but little cited. Also new periodicals like Norwegian Archaeological Review (NAR), and books like "New Directions in Scandinavian Archaeology" (Kristiansen and Paludan Müller 1978) have followed in the wake of this development. In short the introduction of NA into Scandinavia over the last 15 years can be described as progressing from ignorance over polemics to quiet acceptance (naturally with minority exceptions). Let us, however, describe the process in greater detail.

The first phase from the late sixties to the mid or late seventies was the pioneer phase. Yet if one analyses the official archaeological publications and periodicals of those years this will not be at all apparent. They were still dominated by traditional publications of finds and chronological studies, as seen in fig. 1. One has to look to the periodical of the Nordic Archaeological Students *"Kontaktstencil"*, which during the same period issued 10–12 volumes of theoretical debate. Otherwise Danish New Archaeology during this period was mainly published in non-Danish periodicals (e.g. Mortensen 1973, Randsborg 1974 and 1975).

This picture represents not only a senior/junior dichotomy but also the separation between the major archaeological institutions in Denmark at that time: universities, ancient monument administration and museums. The New Archaeology (NA) was mainly supported by active students, seeking strength through Scandinavian co-operation and supported by a few acknowledged scholars. To those involved it was an exciting period, taking place parallel with the revolutionary changes of the universities that broke the rule of professors and brought students to power. At several university departments in Scandinavia, in Denmark especially in Aarhus, teaching was completely changed, and social anthropology, statistics, philosophy of science etc. were incorporated as obligatory disciplines.

This was also a pioneer period for museums, the most expansive time in their history due to new museum legislation in 1958 and 1977 (Betænkning nr. 152 1956, Betænkning nr. 727 1975). Most regional museums acquired professional staff for the first time, permanent exhibitions were restructured, new museums were built etc. Debates about the role of museums in

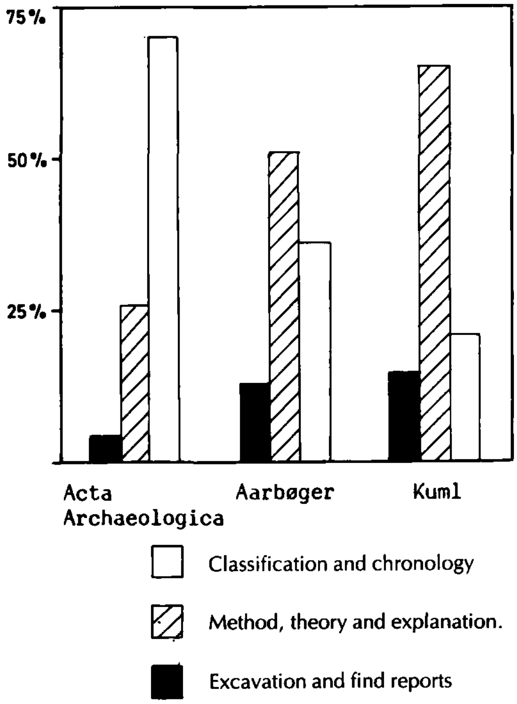


Fig. 1. Contents of the three major Danish periodicals in the period 1966–77.

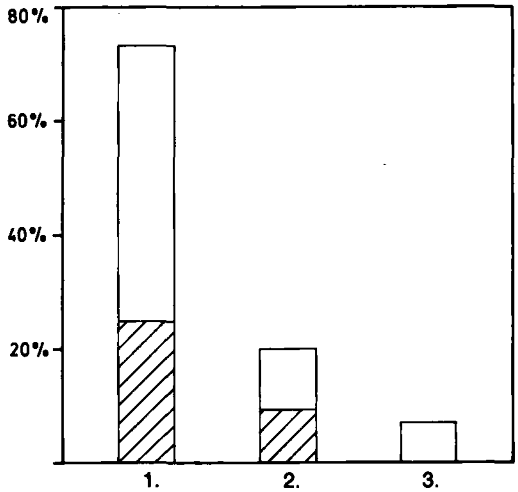


Fig. 2. Output of the three major periodicals in fig. 1 (Acta Archaeologica, Aarbøger og KUML) in the period 1966–77, classified according to:

1. University departments (Aarhus hatched, Copenhagen blank)
2. Central museums (Aarhus Moesgård hatched, National Museum blank)
3. Regional museums.

society flourished (e.g. Witt 1977), and the general preoccupation was new exhibitions. Also at the National Museum most resources were spent on a reorganization of the old exhibition, just as magazines were modernized. Little was left for research during these years. It should be noted, though, that most of those archaeologists that got jobs throughout this period had been trained according to the old university traditions with cultures and chronologies as the major objectives.

It is also characteristic that archaeologists at regional museums were scarcely represented in the official periodicals although during the seventies they soon outnumbered the central institutions (fig. 2).

For the ancient monument administration, however, this was a period of very slow expansion, although the new Conservation of Nature Act in 1969 for the first time opened up possibilities of financing rescue excavations (Betænkning nr. 461 1967). Due to this a new ancient monument department was founded in 1970 under the Keeper of National Antiquities and from 1975 under the National Agency for the Protection of Nature, Monuments and Sites. Museums, it seemed, were too busy with exhibitions fully to realize the potential of this legal reform, just as they were opposed to the central administration which they believed might threaten their own expansion. To this it should be added that ancient monument administration at that time was regarded as low status work hardly worth worrying about. Consequently, the administration was rather segregated from the general trend of expansion and new ideas.

As will be apparent "separatism" is the most appropriate term for the first phase of restructuring, every sector being busy with its own future. For the general public the only observable change was in the regional museums, whereas popular archaeology continued old traditions of culture history. Quite typically, the earlier popular outlines of archaeology by J. Brøndsted and P.V. Glob were reprinted.

The second phase which might be said to encompass the last five to seven years reflects the gradual breaking down of separatism and a general reorientation at all levels of research. As can be seen from Nordic Archaeological Abstracts these changes are also observable now in the major periodicals, while chronological studies have become less numerous, although still clearly dominant (Furingsten 1983).

At the universities a younger generation of candidates trained in the New Archaeology have come into jobs, mostly at museums and in the Ancient Monuments administration. Just as important, however, are the new types of conferences and seminars which have stimulated new directions of research also among more traditionally trained archaeologists. This is especially true of the annual settlement seminars, initiated by Henrik Thrane since 1975 with widely circulated, cheap and quickly published conference reports.

Most regional museums have initiated various types of settlement projects, thus basing their research on the local area and making possible a better integration with rescue archaeology. Moreover conservation archaeology has undergone a rapid development both administratively and economically. Museums are engaging themselves more seriously in rescue administration, a precondition for expansion, and from 1979–1980 the economic framework for rescue archaeology consequently trebled. The ancient monument administration itself has also initiated a stronger co-operation with both regional museums and the National Museum with respect to new projects: monument and site registration, computer projects etc., just as they founded their own periodical in 1977 (Antikvariske Studier 1977 ff). The earlier conflicts were resolved by the setting up of a government committee in 1979, which in 1982 recommended that rescue archaeology should be transferred to the Keeper of National Antiquities (Betænkning nr. 953, 1982), thus creating an administrative separation between rescue excavations (museums) and conservation of monuments in situ (nature conservation authorities). This was implemented 1st January, 1983.

In print this development is reflected in various ways, e.g. new types of publications, in seminar reports (Thrane 1975 ff), and in this journal responding to the needs of regional museums. From a strategic point of view it was important that polemics should become official (e.g. Kristiansen 1978, Becker and Jensen 1979), just as traditional chronological research was critically analysed (in Hikuin no. 4, 1978). Also in popular archaeology the new generation has made its apperance, resulting in a series of books presenting new perspectives on Danish prehistory to the general public (e.g. Jensen 1982, plus 8 volumes of a new popular presentation of danish prehistory for the general reader, lavishly illustrated).

The final result has been neither a rapid nor deep-going revolution, but rather a gradual reorientation within all fields of research: from chronological studies towards settlement- and social studies; that is, a change in research priorities and a very gradual application of new analytical methods. Chronological studies no longer give a priori scientific merit. Due to this gradual change a better coordination of research between Museums, the Ancient Monument Administration and Universities has gradually developed. This trend, however, deserves to be discussed in more detail in order to delineate the preconditions for its future success.

THE PRESENT FRAMEWORK – PROBLEMS AND PROSPECTS

As starting point let us consider the resource base as reflected in the number of archaeologists and their distribution in museums, universities and in ancient monument administration, as this represents both the potential and the limitations of what can be achieved. (Kristiansen 1983, fig. 2) As can be seen, the strongest single research resource is regional museums. This implies that any future growth of Danish archaeology demands co-operation between regional museums and other institutions such as the National Museum, the Administration of Ancient Monuments and Universities. Having stated this, the first question to ask is: what are the unifying elements? The answer, in my opinion, is the history of the cultural landscape. This gives a scientific foundation for research priorties in rescue archaeology, and for explaining the landscape and the monuments to the public. Thus both museums, universities and administration must change their priorities towards ecological orientated settlement studies, and this is gradually happening. It further implies that the traditional role played by these sectors in research and protection should be reconsidered and proposals for the development of future research should be formulated. Let us therefore in the folowing consider the implications of such an approach in more detail.

The Ancient Monument Administration must put a high priority on research. The implicit and prevailing assumption that the protection and management of monuments can be carried out in isolation has to be refuted. Administration without research priorities and a clear research perspective too easily becomes a waste of resources. However, in order to link administrative ends to research goals it is necessary to develop new types of research: to explore and analyze surveying methods, excavation methods, the history of the cultural landscape, the care and management of monuments etc. etc. There is a whole sector of applied research that has only started to develop very recently (e.g. Cherry, Gamble and Shennan 1978, Schiffer et al 1978, Hyenstrand 1981, in Denmark a new report series published by the Ancient Monument Administration since 1980). To support a development of this kind it is also important for scientific merit to be attached to this type of research.

This underlining of research priorities as a guiding principle for conservation or Cultural Resource Management (CRM) – does not mean that administration should be disregarded. Quite the opposite. Also within this field, professionalism is highly necessary. The indifference during the 1960's and early 1970's to administrative professionalism was *one* of the reasons that conservation archaeology did not develop significantly in Denmark until the later 1970's.

At the other end of the scale popularization and information about the monuments should not be forgotten, as this is a precondition for the future support of archaeology. Also here professionalism is much needed. In conclusion, an ancient monument administration which is active in research and publicly informative is essential for maintaining the support of the population, for protecting our archaeological heritage, and for integrating museums and universities in rescue archaeology, which represents 80–90% of all excavations in Denmark, and thereby determines a major part of our future archaeological data base.

At *museums* the trend towards settlement studies should be strengthened because museums thereby create a foundation for linking research to their local area. This implies that they are able to explain the settlement history of their local area in exhibitions rather than by repeating the general prehistory of Denmark over and over again as still not uncommon in many museums. It also means that archaeologists at regional museums can maintain research without being dependent upon comparative studies and travels, necessary when dealing with chronological and diffusionist studies, but normally impossible for them. Finally, it creates a basis for research priorities of rescue excavations.

In order to support this development *universities* must also change their priorities. At the more general level: from objects and cultures as a basic objective to social units and structures – from a diffusionist framework to a social system framework, thereby linking research and education to the Ancient Monument Administration and museums through landscape and settlement studies. This can be further supported by more actively engaging research projects and Ph.D. papers to regional and local museums. A development which has only taken place very gradually. It therefore seems important that the two university departments more consistently and explicitly define their research policy in relation to museums and the administration of ancient monuments.

The general research policy which I have sketched above naturally needs support and implementation in several other sectors (4). One of the most important among these is publication, which will therefore be considered in more detail.

Within any discipline publication should as far as possible transmit a representative sample of research. When basic changes are taking place within a discipline, as in archaeology within the past 15 years, it is important that the structure of publication is adjusted to these changes. This will often demand some restructuring of the publishing policy which mostly takes place by degrees and at random. Very rarely has an analysis of publication structure been carried out as a basis for planning and formulating present and future needs; this is very unfortunate (but see Lavell 1981).

In Denmark an analysis carried out some years ago by the present author showed some basic discrepansies in the publication structure. It led to the formulation of a proposal for a future publication structure, e.g. leading to the foundation of this journal (4). The main elements of such a structure should be:

1. Catalogues of the type of Aner and Kersten (but less ambitious presentations will also do), comprising total regional presentations of groups of finds, that can be regarded as representative because most finds are already in our museums and future ones will not change the representation significantly. That is mainly graves, burial finds and hoards. To this category also belong full monographs of single monuments and sites of extreme importance.

   Such catalogues serve extremely important functions at a time when more and more archaeologists will have less and less opportunity to travel around and look at the finds themselves. Thus they represent the future basis for research. They help to make research more efficient and also more democratic by making the data available in a systematic way to both local and international groups of archaeologists. They help to improve scientific standards as research results can be verified and finally, they serve to internationalize research and break down monopolies and barriers based on access to unpublished data.
2. At the next level we should find research journals that appear regularly with short articles and notes on new finds, discussions, reviews etc. like JDA. The objective is to keep actual results and the published knowledge in line, and to stimulate discussion as a basis for research priorities. More important finds will be published here, either as a supplement to the above regional catalogues or as a basis for later final publications. Thus such journals serve integrating functions between Museums, Universities and Ancient Monument Administration.
3. Finally, we have the traditional in depth comparative studies which have normally dominated archaeological monographs and journals. With a change of priority from chronological studies towards settlement and social studies such primarily in depth research articles will often serve as a starting point for planning and priorities on the one hand, and for popularization on the other hand. It is through them that new problems and hypotheses are formulated which could well serve as a catalyst to future research.

Thus the 3 levels of publication given here represent different but complementary levels of research: from total (often regional) documentation, over selected presentation and discussion to general, comparative research (6). Since 1974, Nordic Archaeologic Abstract has served national and international researchers.

If we look around Europe, we note that a publication structure similar to the one proposed here, is already on its way or in existence. Perhaps most developed in Northern Germany. However, it is important to plan future publications as part of an explicit research strategy at both regional and national levels, thereby integrating the work of both museums, Ancient Monument Administration and Universities. Such an explicit approach and planning must also include a discussion of levels of documentation, techniques of presentation etc. Subjects that have been badly neglected in archaeology.

CONCLUSION

In the preceding pages I have tried to summarize some of the major changes that have taken place within Danish archaeology during the last 15 years. In order to understand the way in which Danish archaeology responded to these changes I started by sketching the historical traditions of Danish and Scandinavian archaeology as I believe that any deep-going reorientation of a discipline demands a critical re-evaluation and re-structuring of previous research. Thus after the first stage of destruction and breaking down follows inevitably a period of reconstruction. What can be used and what has to be left behind. In Scandinavia, with the burden of archaeological history upon our shoulders, such re-evaluations must necessarily become historical in scope, and due to the strong ideological impact archaeology has had in society, it must also by necessity include a re-evaluation of the role of archaeology in Scandinavian society (Kristiansen 1981). Thus archaeology in society has been analyzed from the perspective of the founding of museums and their role in society (Kjer 1980), as well as from the perspective of the peasant proletariat making a living as barrow robbers to supply wealthy collectors and museums (Thorsen 1979).

Another major concern, especially in Danish archaeology, has been the analysis of the effect of post-depositional factors in order to illuminate the representativeness of the major find groups: burials, settlement and hoards throughout later prehistory (e.g. Kristiansen 1976). Danish archaeologists have carried out such analyses covering the period 1805–1975 (Kristiansen in press (b)). This type of historical source critisism is especially important in a region where the accumulation of archaeological data has taken place over a period of nearly 200 years under various circumstances. Thus the utilization of this historical data base, which represents perhaps 2/3 of the available evidence even today, demands a historical and critical evaluation of how representative it is.

A third major reorientation is witnessed within settlement archaeology and ecologically inspired research as described above. Interdisciplinary settlement projects have thus been promoted in all Scandinavian countries throughout the seventies, and today this is the dominant trend also in Danish archaeology (7). To this should be added experimental archaeology which after a pioneer phase during the 1960's and 1970's (Coles 1973) is now expanding its scientific scope, and will probably achieve increasing importance during the 1980's (e.g. Fischer et al 1979, Lund 1981, Vemming and Madsen 1983).

Thus the situation in Denmark should be characterized as a mixture between that of Central Europe and England. Tradition is still very strong, and most archaeologists support it, there is only a small group of "pure" New Archaeologists. However, the NA in Denmark is also building on the earlier traditions of both settlement- and ecological studies, and as the data base is highly representative, it has gradually become acknowledged that we can actually reach an understanding of past societies in social and economic terms. Thus today most Danish archaeologists are implicitly influenced by NA in their research priorities, and this reflects a gradual change taking place on all levels both at Universities, in Museums and in the Ancient Monument Administration. In a few years everybody will probably have forgotten the polemics of the seventies. The pioneers will state that they introduced and implemented the new trends, and the more traditional archaeologists will claim that they saved them from speculation. Thus it is the combination of a strong data base and practically applied or "middle range" theory which constitute what I regard as a special Danish or Scandinavian profile within the general stream of New Archaeology. As the average Danish archaeologist is in his or her mid- to late thirties, this will probably remain our profile throughout the 1980's – perhaps longer.

Kristian Kristiansen, The National Agency for the Protection of Nature Monuments and Sites, Fredningsstyrelsen, Amaliegade 13, DK-1256 Copenhagen.

NOTES

This article originates from two presentations of Scandinavian and Danish archaeology. At the 4th TAG (Theoretical Archaeology Group) conference in Durham in December 1982 I had kindly been asked to organize and introduce a Scandinavian session. Later in February 1983, I attended an informal meeting in Unkel, south of Bonn in Germany, organized by a group of more theoretically orientated German archaeologists reacting against the burden of tradition in German archaeology. I want to thank the organizers of the two meetings for giving me the opportunity not only to present but also critically to re-examine Danish archaeology in the 1980's. It should be noted that medieval archaeology is not treated. The reader is referred to a recent survey by Olaf Olsen (1977) and theoretical debates in META a small periodical from Lund.

1. In Denmark a similar tradition could have been founded upon the work of Gudmund Hatt. However, this chance was abandoned by the prevailing research traditions during the 1940'es and 1950's (Stumann 1982). After the completion of the Paris surveys a few significant studies illustrated the potential of this data base (e.g. Müller 1904, La Cour 1927). Although new regional field survey projects were initiated in the 1940's (Mathiesen 1948 and 1957) their potential was never explored as no methodological development had followed the earlier work of Müller, La Cour and Gudmund Hatt. Also in this field tradition was carried on outside Denmark, especially in Sweden.
2. The archaeological exploration of the vast marginal areas of Northern Scandinavia has also been the focus of research during the 1960's and 1970's (e.g. Baudou and Selinge 1977, Selinge 1979 and recent volumes of Norwegian Achaeological Review) leading to the foundation of archaeological university departments in Umeå in Sweden and in Tromsø in Norway.
3. It should be stressed that "the long sleep" is referring to a theoretical stagnation. In terms of archaeological excavations, new techniques etc. major developments took place, just as in the natural sciences. This development is most recently described by C. J. Becker (1977).
4. An important methodological clarification of the foundations and limitations of typology and classification took place during the 1950's and 1960's, presented in a few studies of outstanding quality by Almgren (1955), Malmer (1963) and Ørsnes (1969). This also resulted in the formulation of new methodoligical standards (definitions, quantification, the use of statistics etc.) which have only gradually been applied during the 1970's, but mostly by ignoring the basic methodological problems originally raised especially by Almgren and Malmer.
5. Complete qualitative and quantitative national surveys of the archaeological environment (institutions, research, education, publication etc.) are unfortunately very rarely published. I only know of one (Chapelot, Querrien and Schnapp 1979 and 1984). Such surveys may serve both comparative international objectives (see Cleere in press) or serve as a platform for national planning proposals: and as such most of them remain internal government reports known only by a small group of people.
6. The major archaeological *periodicals* in Denmark are:
   Aarbøger for Nordisk Oldkyndighed og Historie
   This is the oldest among the periodicals and has been issued since 1866 by the Royal Society of Northern Antiquaries.
   Acta Archaeologica
   was founded in 1930 by a group of Scandinavian archaeologists. This is the only Inter-Scandinavian international archaeological journal publishing both prehistory, classical and medieval archaeology.
   Kuml
   was founded in 1951 by the Jutland Archaeological Society. It contained both social anthropology and archaeology, but is dominated by prehistoric archaeology.

Hiquin
was founded in 1976 and has been dominated by archaeology, in recent volumes by medieval archaeology.
Antikvariske Studier
has been published since 1977 by the National Agency for the Protection of Nature, Monuments and Sites. It contains articles on archaeology, historical buildings and cultural resource management.

Finally, the *Journal of Danish Archaeology* was founded in 1982 in response to the expanding needs of the many regional museums and as a vehicle for discussion and review, much needed in Danish archaeology.

Monographical series:
Nordiske Fortidsminder
is the oldest founded in 1889 and is issued by the Royal Society of Northern Antiquaries.
Jysk arkæologisk Selskabs Skrifter
is the monographical series published by the Jutland Archaeological Society.
Arkæologiske Studier
is a monographical series published by the Department of Archaeology at the University of Copenhagen since 1973.

Besides these monographical series, major monographs have also been published, especially by two regional museums: Fyns Stiftsmuseum in Odense – monographs on the Iron Age in Fyn; and the Langeland Museum – the early monographs on the neolithic excavations in Langeland by Winther later succeeded by Berg and now Jørgen Skaarup.

The National Museum also publishes archaeological monographs from time to time.

Apart from these national and regional archaeological periodicals and monographical series we find a great number of local and regional museum periodicals whose output in the period 1966–77 represented nearly 20% of the total archaeological output published in Denmark in this span of time. Archaeological monographs represented 24% and the major archaeological periodicals mentioned above reached the same figure. The last 33% was represented by popular archaeology, most of it written by professional archaeologists. This is a noteworthy feature of Danish archaeology.

7. It should be noted that the basis for this planned, selective publication structure, are the central registers of the National Museum containing (in principle) all archaeological information in Denmark, including full excavation reports that are normally delivered within one year after the completion of the excavations. Thus the central registers serve as a data base available to researchers. During the 1980's a major part of it – the Parish Register of all archaeological site and find localities in Denmark – has been computerized. Phase 1, the digitizing of find maps, is already finished (Hansen 1982).
8. Bertha Stjernquist has recently summarized the Swedish projects (Stjernquist 1979). The Inter-Scandinavian "Bebyggelseshistorisk Tidsskrift" issued since 1979 by the Department of Human Geography in Stockholm (Review of Settlement History) stresses the increasing importance of settlement archaeology in Scandinavia. Its potential for contributing to world archaeology was also recently pointed out by Moberg (1981).

REFERENCES

ALMGREN, B. 1955: *Bronsnycklar och djurornamentik vid övergången från vendeltid till vikingatid.* Uppsala.

AMBROSIANI, B. 1964: *Fornlämningar och bebyggelse.* (English Summary). Uppsala.

ANDERSEN, S. TH., AABYE, B, & ODGAARD B.V. 1983: Environment and Man. Current Studies in Vegetational History at the Geological Survey of Denmark. *Journal of Danish Archaeology*, vol. 2. Odense University Press.

BAUDOU, E., SELINGE K.G. 1977: *Västernorrlands Förhistoria.* Motala.

BECKER, C.J. 1977: Efterskrift til J. Brøndsted *"De ældste tider".* Danmark indtil år 600. Politikens forlag.

– 1979: Arkæologi i Danmark – igår, idag og imorgen. *Fortid og Nutid*, vol. 28, no. 1. Copenhagen.

BETÆNKNING NR. 152 1956: *Betænkning om en nyanordning af de kulturhistoriske lokalmuseers forhold.* Copenhagen.

BETÆNKNING NR. 461 1967: *Betænkning om naturfredning I–II.* Copenhagen.

BETÆNKNING NR. 727 1975: *Betænkning afgivet af udvalget vedrørende revision af museumslovene.* Copenhagen.

BETÆNKNING NR. 953 1982: *Betænkning om samarbejdet mellem fredningsmyndighederne og museerne.* Copenhagen.

CHAPELOT, J., QUERRIEN, A., & SCHNAPP, A. 1979: L'archéologie en France. Les facteurs d'une crise. *Le progrès scientifique*, pp. 57–110.

– 1984: *Second rapport sur la política de la recherche archeologique en France* – Centre cooperatif de recherches et de diffussion en anthropologie. Fondation de la Maison des Sciences de l'Homme. Paris.

CHERRY, J.F., GAMBLE, C., SHENNAN, S. 1978: *Sampling in Contemporary British Archaeology.* BAR British Series 50, Oxford.

CLEERE, H. (ed) In press: *Approaches to the Archaeological Heritage.* A comparative Study of World Cultural Resource Management Systems. Cambridge University Press.

COLES, J. 1973 *Archaeology by Experiment.* Academic Press.

DANIEL, G. 1975: *150 Years of Archaeology.* Duckworth. London.

EBBESEN, K. In press: *Fortidsminderegistreringen i Danmark.* (Summary: The Registration of Ancient Monuments in Denmark). Fredningsstyrelsen, Copenhagen.

EGGERS, H.J. 1959: *Einführung in die Vorgeschichte.* R. Piper & Co. München.

FISCHER, A. et al 1979: *Stenaldereksperimenter i Lejre.* Working Papers No. 8. National Museum Press. Copenhagen.

FISCHER, A., & KRISTIANSEN, K. (eds.) In press: *The Transition from Hunting to Farming in Northern Europe.* To appear in Edinburgh University Press.

FURINGSTEN, A. 1983: Nordisk arkeologi – traditionell eller nytänkande? Skrifter i Nordic Archaeological Abstracts 1974–1980. In *Arkeologi i Sverige 1980.* Riksantikvarieämbetet och statens historiska museer, Rapport 1983: 3. Stockholm.

GRÄSSLUND, B. 1974: Relativ datering. Om kronologisk metod i nordisk arkeologi. TOR 16. Uppsala.

– 1976: Relative Chronology. Dating Methods in Scandinavian Archaeology. *Norwegian Archaeological Review* 9. 69–82. Oslo.

HANSEN, B. P. 1982: EDB og arkæologi (EDP and Archaeology). *Antikvariske Studier 5*, Copenhagen.
HYENSTRAND, Å. 1979a: *Arkeologisk regionindeling av Sverige*. Riksantikvarieämbetet. Stockholm.
– 1979b: *Ancient Monuments and Prehistoric Society*. Riksantikvarieämbetet, Stockholm.
HYENSTRAND, Å. (ed) 1981: *Dokumentation – forskning* (English Summaries). Riksantikvarieämbetet. Stockholm.
IVERSEN, J. 1941: *Land Occupation in Denmark's Stone Age*. A Pollen Analytical Study of the Influence of Farmer Culture on the vegetational Development. D.G.U. II. Række, nr. 66, Copenhagen.
JENSEN, J. 1966: Arkæologi og kulturforskning (English Summary). *Historisk Tidsskrift 12. række, bind 2, hæfte 1*, Copenh.
– 1979: En kommentar til debatten om dansk arkæologi – fortid og fremtid. *Fortid og Nutid*, vol. 28, no. 1. Copenhagen.
– 1982: *The Prehistory of Denmark*. Methuen. London, New York.
KJER, B. 1980: "Gamle Thomsens" børnebørn. Om oprettelsen af de første provinsmuseer i Danmark. *Fortid og Nutid* Bd. XXVIII. Hefte 3.
KLINDT-JENSEN, O. 1975: *A History of Scandinavian Archaeology*. Thames and Hudson, London.
KRISTIANSEN, K. 1976: En kildekritisk analyse af depotfund fra Danmarks yngre bronzealder (periode IV–V). Et bidrag til den arkæologiske kildekritik. *Aarbøger for nordisk Oldkyndighed og Historie 1974*.
– 1978: Dansk arkæologi – fortid og fremtid. *Fortid og Nutid XXVII*, 279–319, Copenhagen.
KRISTIANSEN, K. & PALUDAN-MÜLLER, C. (eds.) 1978: *New Directions in Scandinavian Archaeology*. National Museum Press, Copenhagen.
KRISTIANSEN, K. 1980: Dansk arkæologis publikationsbehov. *Fortid og Nutid*, vol. 28, no. 3.
– 1981: A Social History of Danish Archaeology (1805–1975). In *Towards a History of Archaeology*, edited by GLYN DANIEL, Thames and Hudson.
– 1983 Rescue Archaeology in Denmark 1870–1982. *Journal of Danish Archaeology* vol. 2. Odense University Press.
– (ed.) In press (a): *Settlement and Economy in Later Scandinavian Prehistory*. BAR International Series.
– (ed). In press (b): *Archaeological Formation Processes*. The Representativity of Archaeological Remains from Danish Prehistory. National Museum Press, Copenhagen.
KUHN, S. 1971: *The Structure of Scientific Revolutions*. Second Edition, enlarged. University of Chicago Press.
LA COUR, V. 1927: *Sjællands ældste Bygder*. København.
LAVELL, C. 1981: *Publication: An obligation. Archaeological Documentation in Britain Today*. Bulletin no. 18 of the Institute of Archaeology. London.
LINDQUIST, S.O. 1968: *Det förhistoriska kulturlandskapet i Östra Östergötland* (mit deutscher Zusammenfassung). Studies in Northern European Archaeology 2, Stockholm.
LUND, J. & THOMSEN, V. 1981: Toftinghuset. Om rekonstruktion af et jernalderhus (on the Reconstruction of an Iron Age House). *KUML*, Aarhus.
MALMER, M. P. 1963: *Metodproblem inom järnålderns konsthistoria*. Acta Archaeologica Lundensia. Series in 8°, No. 3.
MATHIASSEN, T. 1948: *Studier over Vestjyllands Oldtidsbebyggelse* (Studies of the Prehistoric Settlements of West Jutland). Nationalmuseets Skrifter. Arkæol-Hist. Rk. II.
– 1959: *Nordvestsjællands Oldtidsbebyggelse* (The prehistoric Settlement of Northwestern Zealand). Nationalmuseets Skrifter. Ark.-hist. rk. VII, København.
MOBERG, C. A. 1977: Archaeology today: The old World. A Scandinavian perspective. In *"New Perspectives in Canadian Archaeology"*. Ottawa.
– 1978a: Some Developments in North European Prehistory in the period 1969–1976. *Norwegian Archaeological Review*. Vol. 11, No. 1, Oslo.
– 1978b: Traditioner i arkeologi. In T. FORSER (ed.) *Humaniora på undantag? Humanistiske forskningstraditioner i Sverige. En antologi*. Stockholm.
– 1981: From Artefacts to Timetables to Maps (to Mankind?): Regional traditions in Scandinavia. *World Archaeology*, Vol. 13, No. 2.
MORTENSEN, P. 1973: On the reflection of Cultural Changes in Artefact Materials – with special regard to the study of Innovation contrasted against type stability. In *The Explanation of Culture Change*, edited by COLIN RENFREW. London.
MYHRE, B. 1972: *Funn, fornminner og ødegårder. Jernalderens bosætning i Høyland Fjellbygd*. Stavanger Museums Skrifter 7.
– 1973: Iron Age Farms in Southwest Norway. *Norwegian Arch. Review*, Vol. 7, No. 7.
MÜLLER, S. 1884: Mindre Bidrag til den forhistoriske Archæologis Methode. *Aarbøger for nordisk Oldkyndighed og Historie*, Copenhagen.
– 1904: Vei- og Bygd i Sten- og Bronzealderen. *Aarbøger for nordisk Oldkyndighed og Historie*. Copenhagen.
NIELSEN, P. O. 1981: Hundredtusind fortidsminder. Om den arkæologiske kortlægning af Danmark. *Nationalmuseets Arbejdsmark*, Copenhagen.
OLSEN, O. 1977: Perspektiver for dansk middelalder arkæologi. *Hikuin* 3, Aarhus.
RANDSBORG, K. 1974: Social Stratification in Early Bronze Age Denmark: A Study in the Regulation of Cultural Systems. *Praehistorische Zeitschrift* 49. Band. Berlin.
– 1975: Social Dimensions of Early Neolithic Denmark. *Proceedings of the Prehistoric Society*, vol. 41. Cambridge.
RENFREW, C. 1973: *Before Civilization*. The Radio Carbon Revolution and Prehistoric Europe. Jonathan Cape.
– 1982: Explanation Revisited. In *Theory and Explanation in Archaeology*. Eds. C. RENFREW, M. ROWLANDS and B. ABBOTT SEGRAVES. Academic Press, New York.
SCHIFFER, M. B. & GUMMERMAN, G. J. 1977: *Conservation Archaeology*. A Guide for Cultural Resource Management Studies. Academic Press.
SELINGE, K.G. 1979: *Agrarian Settlement and Hunting Grounds*. Theses and Papers in North-European Archaeology 8, Stockholm.
STJERNQUIST, B. 1978: Approaches to Settlement Archaeology in Sweden. *World Archaeology*, Vol. 9, No. 3.
STUMMANN, S. 1982: Gudmund Hatt – The Individualist against his Time. Paper given at the *4th TAG Conference* in Durham, Dec. 1981.

THORSEN, S. 1979: Opofrende venner og farlige fjender..." 1890'ernes højplyndringer, og et bidrag til arkæologiens socialhistorie. *Fortid og Nutid*, Bd. XXVIII, hefte 2.
THRANE, H. 1975 ff: *Settlement Archaeological Seminar Reports*, issued yearly since 1975 in Danish on Odense University Press.
– 1982: Towards a Research Policy for Bronze Age Settlements. *Journal of Danish Archaeology*, Vol. 1. 45–50, Odense University Press.
VEMMING, P. & MADSEN, B. 1983: An Experimental Investigation of a Neolithic Axe Manufacture Site at Hastrup Vænget, East Zealand. *Journal of Danish Archaeology*, Vol. 2. Odense University Press.
WITT, T. 1977: *Hvad med museerne*. Wormianum.
WORSAAE, J.J.A. 1877: Om Bevaringen af de fædrelandske Oldsager og Mindesmærker i Danmark. *Aarbøger for nordisk Oldkyndighed og Historie*. Copenhagen.
– 1879: *On the Preservation of National Antiquities and Monuments in Denmark*. Read before the Society of Antiquaries 1879.
ØRSNES, M. 1969: Südskandinavische Ornamentik. *Acta Archaeologica*, vol. XL.

Comment

by HENRIK THRANE

From Kristian Kristiansen's (KK in the following) survey I have picked some problems of special interest to my own situation.

The national interest in the preservation of ancient monuments for future generations has loomed large in the development of our registration of antiquities and was used as a strong argument whenever these registrations were financed – and they were all financed by special funds. I agree that it is preferable to regard this great mass of information as a potential which still remains to be utilized for integrated regional studies. This realisation is not new, however (Mathiassen 1949, Ambrosiani 1964).

The national resurgence movement after 1863 was an explicable reaction to the loss of an important part of the realm, and the registration of ancient monuments can be seen as part of this movement. Without the popular support, which in part must be attributed to the high schools (Danish: Højskoler) I doubt if even an energetic agitator like Worsaae with his useful connections in the upper levels of society could have persuaded the government to invest in ancient monuments.

I think that KK exaggerates "the long sleep". It was felt in the archaeological society that the down to earth methods of Sophus Müller had preserved Danish archaeology from the ideological misfortunes that befell our German colleagues. The Müller tradition was revered and accepted as a still useful base for new work. The tacit accept of the belief in objectivity – in the field as well as in the study of the material – was a main feature of the fifties and sixties. Work was done at a rate per caput which probably outrates the present day literary production per archaeologist. While KK may think that the Müller tradition collapsed in the 1960'es and 1970'es, I do not agree. Work is still being produced in that solid Danish tradition though it is realized that objectivity is impossible even in the field. It is, however, still regarded as a goal to do a good objective registration of the features which the excavator selects as the relevant ones.

Danish Archaeologists with an interest in methods have shown an early interest in New Archaeology and can boast of sections and heretics just as they can further west, e.g. Trigger, Flannery and others.

I don't regard the publication of what KK calls New Archaeology papers in foreign journals as signifying a rejection on the part of the Danish editors. It rather shows an interest in presenting the results internationally and also shows the personal links of the relevant authors.

It may sound absurd, but actually it was customary in the 1950'es to include social antropology, ethnology, medieval and classical archaeology in the study of Prehistory because the study plan was so elastic – too elastic for some – that each student could compose his own study. Up to 1970 or even later it must be fair to say that most students were brought up on the old tradition sprinkled with bits of New Archaeology.

The reason why regional archaeologists have not published much may have been that they were too busy in the field – especially after the 1969 law. Even by 1970 there was no more than a balance between Copenhagen and the provinces. There was a marked tendency to stay in Copenhagen or Århus if one wanted to do research. That was simply where the collections were. Archaeologists who went to the smaller museums had poor libraries and little additional facilities for producing more than excavation reports.

I disagree strongly with the contention that local museums did not use the opportunities presented by the 1969 law. They plunged into rescue archaeology as soon as the first few years of reticence on the part of the national administration had been overcome. Some museums had by 1969 done rescue archaeology for 30 years on end! Several museums are now no more engaged in rescue archaeology than they already were in the 1970'es. Unfortunately the conflicts of the 70'es have not been resolved by the switch back to the National Museum of part of the national administration.

The most bitter struggle arose over the allocation of the preventive rescue work on the gas pipeline across Denmark. KK is partly to blame for this cleft which has become more important than the original issue. The local museums were not allowed to continue their earlier practice of doing the job from start to end. The central administration forced a division so that survey and trial excavations were made by staff from the central administration, while the museums were only allowed to do the eventual final excavation.[1] This completely irrational procedure has been upheld by the administration after its

THORSEN, S. 1979: Opofrende venner og farlige fjender..." 1890'ernes højplyndringer, og et bidrag til arkæologiens socialhistorie. *Fortid og Nutid*, Bd. XXVIII, hefte 2.

THRANE, H. 1975 ff: *Settlement Archaeological Seminar Reports*, issued yearly since 1975 in Danish on Odense University Press.

– 1982: Towards a Research Policy for Bronze Age Settlements. *Journal of Danish Archaeology*, Vol. 1. 45–50, Odense University Press.

VEMMING, P. & MADSEN, B. 1983: An Experimental Investigation of a Neolithic Axe Manufacture Site at Hastrup Vænget, East Zealand. *Journal of Danish Archaeology*, Vol. 2. Odense University Press.

WITT, T. 1977: *Hvad med museerne*. Wormianum.

WORSAAE, J.J.A. 1877: Om Bevaringen af de fædrelandske Oldsager og Mindesmærker i Danmark. *Aarbøger for nordisk Oldkyndighed og Historie*. Copenhagen.

– 1879: *On the Preservation of National Antiquities and Monuments in Denmark*. Read before the Society of Antiquaries 1879.

ØRSNES, M. 1969: Südskandinavische Ornamentik. *Acta Archaeologica*, vol. XL.

Comment

by HENRIK THRANE

From Kristian Kristiansen's (KK in the following) survey I have picked some problems of special interest to my own situation.

The national interest in the preservation of ancient monuments for future generations has loomed large in the development of our registration of antiquities and was used as a strong argument whenever these registrations were financed – and they were all financed by special funds. I agree that it is preferable to regard this great mass of information as a potential which still remains to be utilized for integrated regional studies. This realisation is not new, however (Mathiassen 1949, Ambrosiani 1964).

The national resurgence movement after 1863 was an explicable reaction to the loss of an important part of the realm, and the registration of ancient monuments can be seen as part of this movement. Without the popular support, which in part must be attributed to the high schools (Danish: Højskoler) I doubt if even an energetic agitator like Worsaae with his useful connections in the upper levels of society could have persuaded the government to invest in ancient monuments.

I think that KK exaggerates "the long sleep". It was felt in the archaeological society that the down to earth methods of Sophus Müller had preserved Danish archaeology from the ideological misfortunes that befell our German colleagues. The Müller tradition was revered and accepted as a still useful base for new work. The tacit accept of the belief in objectivity – in the field as well as in the study of the material – was a main feature of the fifties and sixties. Work was done at a rate per caput which probably outrates the present day literary production per archaeologist. While KK may think that the Müller tradition collapsed in the 1960'es and 1970'es, I do not agree. Work is still being produced in that solid Danish tradition though it is realized that objectivity is impossible even in the field. It is, however, still regarded as a goal to do a good objective registration of the features which the excavator selects as the relevant ones.

Danish Archaeologists with an interest in methods have shown an early interest in New Archaeology and can boast of sections and heretics just as they can further west, e.g. Trigger, Flannery and others.

I don't regard the publication of what KK calls New Archaeology papers in foreign journals as signifying a rejection on the part of the Danish editors. It rather shows an interest in presenting the results internationally and also shows the personal links of the relevant authors.

It may sound absurd, but actually it was customary in the 1950'es to include social antropology, ethnology, medieval and classical archaeology in the study of Prehistory because the study plan was so elastic – too elastic for some – that each student could compose his own study. Up to 1970 or even later it must be fair to say that most students were brought up on the old tradition sprinkled with bits of New Archaeology.

The reason why regional archaeologists have not published much may have been that they were too busy in the field – especially after the 1969 law. Even by 1970 there was no more than a balance between Copenhagen and the provinces. There was a marked tendency to stay in Copenhagen or Århus if one wanted to do research. That was simply where the collections were. Archaeologists who went to the smaller museums had poor libraries and little additional facilities for producing more than excavation reports.

I disagree strongly with the contention that local museums did not use the opportunities presented by the 1969 law. They plunged into rescue archaeology as soon as the first few years of reticence on the part of the national administration had been overcome. Some museums had by 1969 done rescue archaeology for 30 years on end! Several museums are now no more engaged in rescue archaeology than they already were in the 1970'es. Unfortunately the conflicts of the 70'es have not been resolved by the switch back to the National Museum of part of the national administration.

The most bitter struggle arose over the allocation of the preventive rescue work on the gas pipeline across Denmark. KK is partly to blame for this cleft which has become more important than the original issue. The local museums were not allowed to continue their earlier practice of doing the job from start to end. The central administration forced a division so that survey and trial excavations were made by staff from the central administration, while the museums were only allowed to do the eventual final excavation.[1] This completely irrational procedure has been upheld by the administration after its move to the National Museum and will, I am afraid, be a continuous sore spot in the collaboration between local museums and central authorities.

The great archaeological innovation of the 1960'es was the mechanization of large scale area excavations which made the dreams of the fifties come true. No longer did economy or time forbid the excavation of whole villages – albeit without floors and find layers. This has opened up completely new vistas of our understanding of Prehistoric societies and has made it possible to speak of villages with certainty in some cases and with plausibility in other cases.

New machinery has increased the effectivity of the removal of the topsoil manyfold and other mechanical excavators have been applied to the heavier soils of East Jutland, Funen and Zealand so that now we are getting settlements outside the Jutish sand areas too. The eschewed legal/financial situation has led to awkward situations where e.g. a 30 m. wide strip across a village can be dug for public money because road or other authorities have to pay for it. The rest of the settlement may only be excavated if private funds can be raised in some clever way. This practice of digging segments of cemeteries of settlements on pipelines or motorways is really only a slight improvement on the old hit and run tactics where a single pit or a few odd graves were excavated and no more. Soon we shall have a long list of sites which ought to be excavated because of their potential information on settlement structure and economy of obscure periods or terrae incognitae. A reasoned policy for the solution to this problem will be one of the eminent problems of the next decade.

The very hard economic line taken by the administration of the natural gas pipeline excavations may be responsible for another problem which has already begun to make itself felt. It has become current usage to calculate all excavations in kr. pr. m^2 and to use the norms from the pipeline excavations for any sort of excavation. This is naturally a fallacy, as every excavation should be judged by its own conditions. It will be a loss not only of innocence but of substance if archaeology permits itself to be regulated by strict squaremeter prices based on rescue excavations whose standards must necessarily be below the desirable, not to speak of the optimal. Not only does this tendency exist in the minds of the people who are responsible for the budget, but there is a danger that it may contaminate the minds of the excavators so far that they will be unable to excavate in any other way.

If the object, the problem, and the conditions are present for a full scale oldfashioned scientific excavation it would be a disaster if it were to be ruled by the standards of rescue excavations. There should still be room for quality as well as for quantity.

This leads on to some of the questions I have put elsewhere (Thrane 1982). I have no doubt that excavation of entities rather than more or less accidental fragments of sites will be a major objective for the archaeology of the eighties. The main problem will however be carried over from the sixties and will only be slightly improved by the many trial excavations on pipe lines etc. This is fundamentally a problem of choosing the right site. i.e. the typical site.

By this I mean that archaeologists for generations have jumped at any site which looked exciting one way or the other. We have never bothered about which sites might be typical for a given period or a given region. If the great competition for funds for the total (and still expensive) excavation of whole settlements with their cemeteries, fields etc. is to end in something better than the survival of the smartest, serious consideration must be given to this problem. A better knowledge of potential sites will only come after concerted efforts at total registration with all available methods within regional frameworks.

We need a net of well excavated settlements with their cemeteries etc. from all major periods covering all major Danish landscapes. Furthermore we need a greater awareness of the subtleties of excavation, i.e. the application of the proper technique and strategy to each problem (e.g. Jeppesen 1981 for the use of trial pits to solve a specific problem).

In the sixties an attempt was made to interest the National Museum in a central archive for archaeological air photographs. This provoked no response at all. Now the National Agency for the Protection of Ancient Monuments has taken a laudable initiative towards the registration of ancient field systems (Sørensen 1982 and 1984). The task is probably even more imminent now than 20 years ago. Archaeological air photography will be indispensable in the effort to optimize our information about potential sites from which to pick the right ones for excavation. We urgently need research on the special Danish soil conditions which cannot be prepared immediately with the classical English chalklands or the French loesses (CBA 1983).

I would like to see a central effort to do a series of experiments on representative samples of Danish soils instead of each local museum having to make its own trial and error efforts. The bewildering multitude of films, cameras, soils, growth conditions etc. is not easily mastered by local archaeologists with enough to do already.

A similar problem concerns our knowledge (or lack of same) of what happens to the ploughland and to the overploughed monuments now that deep ploughing has characterized the Danish landscape during 30 years (cf. Jacobsen 1984).

This comment is another witness to a new trend in Danish Archaeology. Perhaps the very smallnes of the archaeological society before the job explosion in the early sixties accounts for the old reticence from criticising one's colleagues. Norwegian Archaeological Review has pointed the way and I hope that Journal of Danish Archaeology will live up to this refreshing line. It is clear that our explanations are no more sacrosanct than the logics behind them and the material supporting them. Great archaeologists have had their less good days like everyone else. The critical review has been an art rarely practised seriously in Danish archaeology.

It is good to see the head of the Ancient Monuments Service express a sense of unity with the regional study of landscapes as the central interest. This is precisely what several of the regional museums have tried to do over the last ten years in strong opposition to the policy of the Central Administration – *vide supra*. The local museums were let down by those institutions which might have supported the local efforts, the result being that we had to go abroad to have our phosphate analyses, pollen analyses, etc. done. I guess that a re-orientation at least of the Geological Survey potential for palynology is under way and this could probably prove the starting point of a most important trend in the 1980'es. Leading back to the organisation of the 1940'es when archaeologists and scientists worked closely together with a common goal. Perhaps the scientists felt that they were subordinated to the archaeologists. This could explain the emancipation trend of the peatbog laboratory of the National Museum.

I should like to know how many regional museums have settlement projects going. I think KK overemphasises their number. Let me mention the fact that my predecessor Erling Albrectsen broke the tradition of local replicas of the National Museum all over the country by concentrating on the prehistory of the region Fyn (Albrectsen 1951, Thrane 1980). Fyn is still the best example of what a small regional museum is (was) able to do by a sustained effort (Albrectsen 1954–73). His publications are good examples of the possibilities as well as the limitations of an isolated provincial archaeologist working in the Müller tradition. There is still a great need for corresponding publications of other Danish regions.

It has been the pride of Danish archaeological university education that schools were not found. This is another relict of the Müller tradition, which has had great advantages but which has left the departments without their own research profiles. I agree with KK that it would be time for Copenhagen and Århus to formulate overall policies. A crucial question for the coming years will be the uniting of efforts and pooling of resources for a joint archaeological policy. Danish archaeologists have not been used to this sort of restraint on their own wishes and today no common forum for a formulation of a common policy exists. The new Archaeological Board could become the nucleus of such a forum, provided it is given the scope necessary for a leading role in policy making. One of the first things to do will be to create an overall view of what is going on and what is wanted in the various archaeological periods. This will have to be discussed generally and openly by all archaeologists in Denmark so that a consensus of opinion may be reached. This could become the most important innovation in the archaeology of the 1980'es where the continued pressure of land use and perhaps a revival of the building activities of Danish society, augmented by the metal detector bug, will mean that even increased central funding will be insufficient for many years to come.

Henrik Thrane, Fyns Stiftsmuseum, Hollufgård, DK-5220 Odense SØ.

NOTE

1. It is a euphemism when KK (1983, 204) writes "regional museums carried out final excavations". The fact is that these museums were only allowed to do the final excavations as their share. There is no methodological reason for separating survey and (or) trial excavations from the final excavation of pipeline or any other sort of archaeology. It is deplorable that the Archaeological Council (now Board) has not been willing to change this unhappy practice introduced by the National Agency for the Protection of Ancient Monuments and Sites. It will take some time before the bitter resentment caused by this unscientific practice can be overcome.

REFERENCES

ALBRECTSEN, E. 1951: Oldsagssamlingen i ny dragt. *Fynske Minder* 1951, 50–52.
– 1954: *Fynske Jernaldergrave I. Førromersk Jernalder*. Odense.
– 1956: *Fynske Jernaldergrave II. Ældre romersk Jernalder*. Odense.
– 1968: *Fynske Jernaldergrave III. Yngre romersk Jernalder*. Odense.
– 1971: *Fynske Jernaldergrave IV. Gravpladsen på Møllegårdsmarken ved Broholm*. Odense.
– 1973: *Fynske Jernaldergrave V. Nye Fund*. Odense.
CBA 1983: *The Impact of Aerial Reconnaissance on Archaeology*. Research Report No 49. Edited by G. S. MAXWELL. London.
JACOBSEN, J.A. 1984: A Contribution to the Evaluation of Archaeological Field-Surveying. *Journal of Danish Archaeology*, vol. 3.
SØRENSEN, P. HARDER 1982: The Use of Air Photographs in Celtic Field Studies. *Journal of Danish Archaeology*, vol. 1.
– 1984: 'Luftarkæologi – hvilke oplysninger giver soilmarks.' *Skrifter fra historisk institut, Odense Universitet*, Odense.
THRANE, H. 1980: Efter en Menneskealder: Nyopsætning af Fyns Oldtid. *Fynske Minder* 1979–80, 48–62. Odense.
– 1982: Towards a Research Policy for Bronze Age Settlements. *Journal of Danish Archaeology*, vol. 1.

Danish Archaeology in the 1980's – beyond theoretical poverty?

by DITLEV L. MAHLER, CARSTEN PALUDAN-MÜLLER & STEFFEN STUMMANN HANSEN

1968 was in many ways an important year. The anti-authoritarian movement swept over cities and universities all over the industrialized world. Also Danish universities were affected – with minor exceptions. There was quiet at the institutes of archaeology, where nobody challenged the established structure and content of the studies, nor did anyone enquire into the role of archaeology in contemporary society.

But still the late 1960's, and early 1970's saw the beginning of a gradual reorientation within Danish Archaeology. This development was in concordance with, and stimulated by similar developments elsewhere, responding to growing tions which might have supported the local efforts, the result being that we had to go abroad to have our phosphate analyses, pollen analyses, etc. done. I guess that a re-orientation at least of the Geological Survey potential for palynology is under way and this could probably prove the starting point of a most important trend in the 1980'es. Leading back to the organisation of the 1940'es when archaeologists and scientists worked closely together with a common goal. Perhaps the scientists felt that they were subordinated to the archaeologists. This could explain the emancipation trend of the peatbog laboratory of the National Museum.

I should like to know how many regional museums have settlement projects going. I think KK overemphasises their number. Let me mention the fact that my predecessor Erling Albrectsen broke the tradition of local replicas of the National Museum all over the country by concentrating on the prehistory of the region Fyn (Albrectsen 1951, Thrane 1980). Fyn is still the best example of what a small regional museum is (was) able to do by a sustained effort (Albrectsen 1954–73). His publications are good examples of the possibilities as well as the limitations of an isolated provincial archaeologist working in the Müller tradition. There is still a great need for corresponding publications of other Danish regions.

It has been the pride of Danish archaeological university education that schools were not found. This is another relict of the Müller tradition, which has had great advantages but which has left the departments without their own research profiles. I agree with KK that it would be time for Copenhagen and Århus to formulate overall policies. A crucial question for the coming years will be the uniting of efforts and pooling of resources for a joint archaeological policy. Danish archaeologists have not been used to this sort of restraint on their own wishes and today no common forum for a formulation of a common policy exists. The new Archaeological Board could become the nucleus of such a forum, provided it is given the scope necessary for a leading role in policy making. One of the first things to do will be to create an overall view of what is going on and what is wanted in the various archaeological periods. This will have to be discussed generally and openly by all archaeologists in Denmark so that a consensus of opinion may be reached. This could become the most important innovation in the archaeology of the 1980'es where the continued pressure of land use and perhaps a revival of the building activities of Danish society, augmented by the metal detector bug, will mean that even increased central funding will be insufficient for many years to come.

Henrik Thrane, Fyns Stiftsmuseum, Hollufgård, DK-5220 Odense SØ.

NOTE

1. It is a euphemism when KK (1983, 204) writes "regional museums carried out final excavations". The fact is that these museums were only allowed to do the final excavations as their share. There is no methodological reason for separating survey and (or) trial excavations from the final excavation of pipeline or any other sort of archaeology. It is deplorable that the Archaeological Council (now Board) has not been willing to change this unhappy practice introduced by the National Agency for the Protection of Ancient Monuments and Sites. It will take some time before the bitter resentment caused by this unscientific practice can be overcome.

REFERENCES

ALBRECTSEN, E. 1951: Oldsagssamlingen i ny dragt. *Fynske Minder* 1951, 50–52.
– 1954: *Fynske Jernaldergrave I. Førromersk Jernalder.* Odense.
– 1956: *Fynske Jernaldergrave II. Ældre romersk Jernalder.* Odense.
– 1968: *Fynske Jernaldergrave III. Yngre romersk Jernalder.* Odense.
– 1971: *Fynske Jernaldergrave IV. Gravpladsen på Møllegårdsmarken ved Broholm.* Odense.
– 1973: *Fynske Jernaldergrave V. Nye Fund.* Odense.
CBA 1983: *The Impact of Aerial Reconnaissance on Archaeology.* Research Report No 49. Edited by G. S. MAXWELL. London.
JACOBSEN, J.A. 1984: A Contribution to the Evaluation of Archaeological Field-Surveying. *Journal of Danish Archaeology,* vol. 3.
SØRENSEN, P. HARDER 1982: The Use of Air Photographs in Celtic Field Studies. *Journal of Danish Archaeology,* vol. 1.
– 1984: 'Luftarkæologi – hvilke oplysninger giver soilmarks.' *Skrifter fra historisk institut, Odense Universitet,* Odense.
THRANE, H. 1980: Efter en Menneskealder: Nyopsætning af Fyns Oldtid. *Fynske Minder* 1979–80, 48–62. Odense.
– 1982: Towards a Research Policy for Bronze Age Settlements. *Journal of Danish Archaeology,* vol. 1.

Danish Archaeology in the 1980's – beyond theoretical poverty?

by DITLEV L. MAHLER, CARSTEN PALUDAN-MÜLLER & STEFFEN STUMMANN HANSEN

1968 was in many ways an important year. The anti-authoritarian movement swept over cities and universities all over the industrialized world. Also Danish universities were affected – with minor exceptions. There was quiet at the institutes of archaeology, where nobody challenged the established structure and content of the studies, nor did anyone enquire into the role of archaeology in contemporary society.

But still the late 1960's, and early 1970's saw the beginning of a gradual reorientation within Danish Archaeology. This development was in concordance with, and stimulated by similar developments elsewhere, responding to growing frustrations with the inconsistencies, and obvious naivity of traditional archaeological analysis and explanation of prehistoric processes.

One important factor, often mentioned in this context, is the calibration of the C-14 datings, that dealt a serious blow to much of the traditional diffusionist framework.

But still more important – though seldom mentioned – was the declining star of the traditional humanistic disciplines, fading against the sparkling achievements of the "hard" sciences with their prominent role in the rapid development of the economic basis of the industrialized world. The very same hard sciences that provided archaeology with so much vital, and puzzling information, also set the standards for scientific work which many archaeologists wanted to make their own.

The apparent objectivity of the natural sciences exercised a compelling influence, the demands for exactitude had long been recognized in the excavations. But during the 60's, and 70's they gained a strong role also in typological analyses, where earlier impressionistic type-definitions were readily accepted. Likewise, new methods of spatial analysis were employed. The classic example of the penetration of these new methods are found in Malmer's "Jungneolitischen Studien" from 1962.

But archaeologists, also in Denmark, wanted a greater share in the quasi-objectivity of hard sciences. They wanted new standards to be applied also in the socio-historical interpretation and explanation of the prehistoric record.

In response to similar currents in the Anglo-Saxon countries a "new" archaeology was developed under the influence of neo-positivism, which had strong ties with the hard sciences. This development became a main source of inspiration for a new generation of Danish archaeologists. And hence during the last decade the local archaeological literature saw an upsurge of a new conceptual frame of reference. Old, vaguely defined concepts such as diffusion, migration, trade and culture gradually went out of use, and new ones became regarded as meaningful: adaptation, population pressure, surplus, status, prestige-goods,exchange, competition, consumption, band, tribe, chiefdom, big-man, chief, and elite are among the terms now regarded, also in Danish archaeology, as passwords to scientific respectability.

But evidently the mere use of a new terminology, without theoretical clarification, does not constitute a sufficient advance into the realm of science.

The typological system, into which the prehistoric societies of prehistory were classified, was the band-tribe-chiefdom-state model of neo-evolutionism. And to "explain" the transition from one stage to the next, reference was made to concepts such as "population-pressure", and "competition", as if these possessed an inherent explanatory value. This resembled only too closely previous abuses of magic formulas such as "migration" and "diffusion", to explain changes in the prehistoric record. Just like the old concepts, these new ones cover phenomena, that are parts and/or products of social behavioural patterns, which themselves call for an explanation.

If we as archaeologists are willing to accept resource crisis or competition as explanations per se of, for examples, the rise of inheritable political leadership, we have also doomed our discipline to a role as a normative and conservative undertaking, in which we refrain from any serious attempt to achieve a deeper insight into man's social behaviour. We will then end up with a mechanistic "correlation archaeology".

In our opinion archaeology is in an advantage-position, and therefore obliged to penetrate into essential questions such as: what are the (social) forces that stimulate population growth and the depletion of resources? – What is the nature and origin of social inequality?

Is social inequality a necessary precondition for the intensification of production beyond a certain level, or is the intensification beyond such a level a necessary, but insufficient precondition for social inequality? To cope with such questions archaeologists must engage on a much more profound level in the development of theories about the dynamics of prehistoric societies.

For the authors of the present paper there can be no doubt that such theories are best developed within a historical-materialistic framework, because this provides the most coherent vision of societies in their dynamic totality. Surely, however, we are not calling for a flood of pseudo-theoretical literature, or case-studies claiming allegiance to historical-materialism by the employment of yet another ill-defined vocabulary. Many of the traditional concepts of historial-materialism were never developed to cope with the phenomena reflected in the prehistoric record. Key concepts such as "class", "production", "reproduction", and "surplus" need serious rethinking in order to be of genuine relevance to us.

Some important work in this direction has already been going on for quite some time within French anthropology, and lately also within the Anglo-Saxon. This engagement is slowly beginning to percolate into archaeological writings of varying profundity.

It surely will be useful, if archaeologists and anthropologists can join forces in the development of a new conceptual framework for the analyses of pre-state/early state societies. Such an integrated effort is – whether it be historical-materialistic or not – is necessary, for we need better guidance in our praxis as archaeologists, if we want to cultivate the many promising methodological innovations of New Archaeology.

Without well-defined theoretical models of past societies, there will for instance be little sense in discussing source criticism. If we have no idea about the economic basis of a given society, and of the constraints this imposed on society as a whole, how can we then talk about what is representative of that society?

Surely a statistically representative sample of e.g. bronze hoards is not necessarily the same as a historicaly representative "sample" (expression) of Bronze Age society's determinant features. As long as we know and think so little about the content, and structure of Bronze Age subsistence economy, and about the mechanisms by which it was linked up with the production, flow, and consumption of bronze goods, how can we then hope to evaluate the historical significance of observed changes in bronze finds?

With its strong empirical foundation Danish archaeology should recognize particular obligations in the dialectical development of a theoretical framework for the analyses of prehistoric processes. Hitherto the mechanistic, neo-evolutionist inspired New Archaeology has been unable to meet this obligation. This lack of historical perspective in the analysis of the past is matched by the inability to discuss, and understand archaeology's role in relation to contemporary society.

The neo-evolutionistic trends grew up during an economic boom, and this meant that many of the demands made in the archaeological institutions could be met. The expansion of the social welfare state was matched by an explosive expansion of museums, and other antiquarian institutions. Legislation underlined the growing state-involvement also in this sector of Danish society. The expansion and optimism in many ways offered a favourable background for a radical shift in the archaeological discipline.

The reaction against the "traditional" archaeology was in many ways directed against uniformity and conformity, and the pessimistically narrow view of archaeology and its possibilities. These features were very much identified with the old, centralized scientific, and educational environment. But with the simultaneous growth, and expansion of the archaeological institutions this object for critical evaluation seemed to vanish. The expansion, and here in particular the professionalization of the regional museums was at least a formal opening up of the archaeological milieu, and as such it also represented a decentralization.

In this way, it could be said that the rise of New Archaeology correlated with the "anti-authoritarianism" of '68, but this correlation can hardly be ascribed any direct causal significance. The new Archaeology never took up the other aspect of the '68-movement: the social, and political critique.

It is symptomatic that while major parts of the progressive elements within social and humanistic sciences discussed Marx-inspired theories, then at the same time "progressive" archaeologists discussed mechanical evolutionary theories, inspired by Service and Sahlins. This is perhaps one of the best indicators of archaeology's academic isolation nowadays. A foundation in historical materialism would have implied a useful critical evaluation of the institutional and ideological content of archaeology, and its context.

The expansion during the 1970's in the educational system made a restrictive internal centralism impossible. The academic staff was multiplied several times but there were no systematic courses in *historical* theory and method. The result of this is that the discipline today, even more than earlier, is characterized by an almost irresponsible lack of theory and therefore ridden by methodological inconsequences.

The satisfaction with mere quantitative expansion is also found in the internal discussions of the administrative, and economic structures of archaeology. Here the distribution of authority in connection with rescue archaeology was the subject of violent disputes between various archaeological institutions, whereas very little interest indeed was paid to the question of how to make use of the disputed authority. Nobody seemed interested in discussing the aims and content of rescue archaeology, not to speak of the general role and content of archaeology in relation to general cultural-political perspectives.

Symptomatically archaeology seems to restrict its own cultural-political perspective in a period, where the general public shows a growing interest in history. Archaeology's inability to see itself in a historical perspective has also made it impossible for it to respond seriously to the public interest in history. On the one hand, popularization has been developed in a direction where quantity seems to be the main guiding criterion, without open discussions of content and significance. On the other hand, the professional strategy and tactics of archaeological institutions have solely aimed at demonstrating "responsiblity", and "modesty", to the political decision-makers. The negotiations about the rescue-archaeological project under the Ancient Monuments Administration in connection with the establishment of gas pipelines is a typical example. Many archaeologists felt uneasy about the professional justifiability of conducting the project under the conditions imposed by the interests behind the gas pipelines. But nobody dared to discuss the matter in public, for fear that this would attract the anger of political decision-makers.

In our opinion that kind of logic has little justification, and the same can be said about the kind of archaeology, which is guided only by these considerations. It will inevitably end up with archaeology being conducted for its own sake or as a service industry. Instead we should promote a general public understanding of the necessity of archaeology as part of our collective memory to help us act in today's chaotic mass-society. The interests of the general public, and not the political decision-makers should be the aim and justification for archaeological work. And let it be a comforting thought for pragmatic minds, that a strong popular backing has often proved the best argument in discussions with the political decision-makers.

Neo-evolutionism produced a succession of general type-models for the classification and analyses of prehistoric societies, and their members. These models reflect a mechanical, ahistoric view of society which has gradually revealed its stereotyped shortcomings. In much the same way, it has become clear that the archaeological situation today is much too complex to be described merely as an antithesis to traditional archaeology. We believe that if the contrasts between "traditional" and "new" archaeology are allowed to remain an isolated question of methods, then New Archaeology will gradually merge with and vanish into the traditional. If on the other hand, contrasts could be developed into a question of *fundamental* theoretical differences, then we might get a chance to see archaeology develop into a humanistic discipline, and a science of history with an ability to engage people rather than merely to entertain them.

Ditlev Mahler, Ny Kongensgade 21, DK-1557 Copenhagen V.
C. Paludan-Müller, Gilleleje Museum, Rostgårdsvej, DK-3250 Gilleleje.
Steffen Stummann Hansen, Ahornsgade 8B, DK-2200 Copenhagen.

Reviews

MANFRED RECH: *Studien zu Depotfunden der Trichtbecher- und Einzelgrabkultur des Nordens.* Offa-Bücher 39. Karl Wachholtz Verlag, Neumunster 1979. 134 pp., 12 plates, 7 maps.

Since 1948, when C.J. Becker published his disputation *Mosefundne Lerkar fra yngre Stenalder* (*Neolithic Pottery in Danish Bogs*, Aarbøger for nordisk Oldkyndighed og Historie 1947), nobody has attempted to publish a comprehensive study of the various sacrificial finds from the Neolithic Period in South Scandinavia. Becker's starting point was the finds of pottery in the bogs, but his dissertation went on to include certain propositions about other types of deposits, hoards of flint and amber.

Manfred Rech provides in his book a comprehensive overview of those types of deposit which in time have been categorized as hoards, votive finds, sacrificial finds, and sacrificial sites. Only sacrificial finds in megalith graves, and "certain deposits on settlement sites" are excepted. The geographical range is South Scandinavia and North Germany, the traditional "nordischer Kreis" (Nordic area). Chronologically, the finds of the early and middle Neolithic are considered: i.e. the Funnel-beaker and Single-grave cultures.

It is the find contexts which differentiate hoards from other sources. Rech's term "Depot" thus covers "every deliberate deposit, as long as it is not a case of grave-furnishing or settlement finds". Single objects are therefore reckoned as *Depotfunde* in those cases where the find circumstances qualify them as "deliberately deposited". They do not however appear in the book's basic subject-matter on equal terms with finds containing several artefacts simultaneously deposited.

Studien zu Depotfunden contains a survey of types of find which are otherwise found dealt with on their own in the literature. The primary subject-matter is hoards of flint and stone, and of amber. There are detailed catalogues of these two groups of material. Although there is no complete registration of all finds in all museums, the lists comprise a substantial portion of the material. The former group alone comprises 436 finds, mostly deposits of thin- and thick-butted flint axes. For finds of different composition, the study proceeds mostly by reference to already published finds – for the pottery from the bogs, by reference to Becker's catalogue of 1948. Besides the above-mentioned types of find, hoards of copper goods, bone tools, wooden objects (vessels, axe-shafts, wheels, dug-out boats, and complete wooden constructions), and finds of animal and human bones, are also examined.

This is the first time that all these types of find have been considered on an equal basis. Earlier works, that have ended up remembered as interpretative models, such as Müller's, Rydbeck's, and Becker's, have taken a starting point either in "closed finds" or in the bog-finds. One therefore reads Rech's book with great anticipation, as it promises a general survey of the same scale as Geisslinger's *Horte als Geschichtsquelle* of 1967.

The first major chapter deals with finds from dry land, the second with finds from bogs. Together, these two chapters comprise over half of the book's text. The principal thesis is that there is no difference in the composition and whole character of the finds from dry land or near water. Yet they are dealt with separately. These two chapters are followed by one on finds in and near springs, and one on finds in watercourses, after which geographical and chronological parallels are drawn. Then follows the long and important chapter *Interpretation*, after which the book is concluded with a short summary. The catalogue is as full as one could expect without the documentation being overwhelming. Different soil-types are marked on the 7 distribution maps, but the basic soil map is so simplified that the information this conveys is very limited. Finally the 12 tables, with certain exceptions, depict finds which are also illustrated elsewhere.

The neolithic hoards from this area form a rich and multifaceted find-material. They are a rich source for chronological studies in particular. The dating of the individual types of hoards is important if the culture-historical conclusions are to have any substance. For a reader with C.J. Becker's chronology and M.P. Malmer's fine typological methods behind him, Rech's use of typology and find-combinations appears comparatively thin and superficial. Rech uses already identified artefact-types with little accuracy, and does not establish any new classification of the material. The result of the chronological treatment of the hoards is thus far from impressive: the earlier, and most numerous, of the hoards are placed in "the thin-butted axes' period" (dolmen period), the later in "the thick-butted axes' period" (passage-grave period).

It is clearly the religious aspect of the deposits which has most interested Rech. The description of the sacrificial sites in the bogs takes a central place in his dissertation. Some unpublished material is used here, and this section thus supplements C.J. Becker's 1948 publication of the pottery from the bogs and their find contexts. In the *Interpretation* section, the reasons for deposit are discussed, first for the closed finds of flint and stone tools, next for the bog-finds containing pottery, and animal and human bone. An excellent discussion of interpretative possibilities is presented in connection with the former group, with considerations for and against the possible sacred and secular causes evaluated. The author allows one consideration to decide the case, as already S. Müller had argued, that the hoards comprise unusually large objects, artefacts which therefore may be presumed to have been made for ceremonial use. In the same section, the discussion of the interpretation of bog-deposits of animal and human bone is carried further, and parallels drawn with other religious deposits in northern and central Europe, with considerable reference, *inter alia*, to finds of human bones in and outside settlement sites. The result, in summary, is: "Although one does not attain clarity in individual cases, the common idea which must lie behind the finds becomes clear" (p. 91). The author consequently interprets all forms of deposits (with the exception of hoards of flint blanks and the large wooden objects in the bogs) as sacrificial finds. The discussion halts here, and one may ask oneself, what form of complex institution gave rise to such multifaceted activities on a single ideological basis. There is no answer to such questions in Rech's work. He restricts himself to a discussion of the material and would appear satisfied to have presented a possibly religio-historical source-material.

There are many points in this book, some important, some less important, which invite further discussion. I shall limit myself to a few.

Amongst the more important conclusions must be reckoned the demonstration of the point that, working from the religious deposits, no continuity between the late Funnel-beaker culture and the Single-grave culture can be shown. This assertion is quite acceptable as far as the bog-finds are concerned (although there are some single-grave pots found in bogs), but the problem with regard to the flint deposits is not so simple. There are three reasons for this:

1. There are a number of North German hoards with thick-butted flint axes which are difficult to attribute either to late Funnel-beaker culture or the early Single-grave culture, since they consist of coarsely dressed roughed-out works, which are difficult to classify.
2. Deposits of thick-butted flint axes of types which chronologically fall together with the early part of the Single-grave culture, but which are not otherwise anchored in any certain cultural context, are found in eastern Denmark and southern Sweden. They do not, however, belong to the Funnel-beaker culture (cf. Aarbøger for nordisk Oldkyndighed og Historie 1977 pp. 41–47).
3. A comparatively small number of hoards with flint and battle axes are known from the Single-grave culture in Jutland (cf. K. Ebbesen in Acta Archaeologica 53, 1982).

A radical break in the practice of depositing such objects of flint and stone can not therefore be certainly shown within the whole area under consideration. The changes which happen occur rather as culturally determined, qualitative changes, which at the one time influence to different degrees the composition of the hoards, and the frequency of deposits, within individual areas.

In many places, the utilization of find-combinations in the hoards with regard to chronology is dubious. The find from Forst Mützelburg, Kr. Ueckermünde, for example, is used to establish contact between the late *Bandkeramik* culture groups and the northern Funnel-beaker culture (p. 18). The pointed-butted stone axe in the find, however, cannot be directly compared with the late *Bandkeramik* culture's pointed-butted slate axes. The similarity is too general for one to postulate contemporaneity. The discussion of the find-combinations (p. 26), and the combination-statistics (fig. 5), also show that Rech is uncertain about the Danish finds, on the subject of both source-criticism and the dating of artefact-types. Thus several finds from dolmens are used which are not certainly closed finds. The find from Blandebjerg with a thin-butted flint axe and a flint halberd is incorrectly placed in the early group of finds. Both the flint axe and the halberd are middle-neolithic.

In his discussion of the earliest finds of wooden disc wheels (p. 60), Rech attributes these to the Funnel-beaker culture, in contrast to other researchers who, with the help of C 14 datings, place them in the Single-grave period.

In judging the work one must also take into account the fact that it has been a long time coming. The dissertation was presented in 1973, the manuscript for the book finished in 1976, and it finally appeared in 1979. In the course of the 70's much has occurred which has changed the picture of the cultural relationships and chronology in the early and middle Neolithic of southern Scandinavia. Nowadays the dating of the types discussed by Rech would be based upon a finer chronology, worked out on the basis of C 14 dates and analysis of find-combinations. Nowadays fresh elements would be brought into the discussion of sacrificial practices in the Neolithic – *i.a.* causewayed enclosures, first and foremost Sarup, with its many sacrificial pits with cereals, pottery, and axes.

Studien zu Depotfunden will undoubtedly maintain its value, if not for its chronological section, at least for its assemblage of the comprehensive comparative material, which forms a background for the consideration of the Scandinavian hoards, and for its detailed discussion of interpretative possibilities.

Poul Otto Nielsen

INGEGERD SÄRLVIK: *Paths Towards a Stratified Society. A Study of Economic, Cultural and Social Formations in South-West Sweden during the Roman Iron Age and the Migration Period.* Stockholm Studies in Archaeology 3. Stockholm 1982. (125 pp., illustrated, plus a 25-page bibliography and a summary in Swedish).

Introduction

The monograph under discussion is divided into four parts:

1) Introduction (9 pp.),
2) Economy and settlement (48 pp.),
3) Material culture (46 pp.),
4) Social formations (9 pp., plus 2 maps).

Each of these main parts contains several sections, some of which are divided into subsections. In all, the book contains 44 subsections. Parts 2, 3 and 4 all end with a summary.

Part 1 presents an outline of previous research into the Iron Age of South-West Sweden, a discussion and definition of the concept of culture based on Clarke's work in *Analytical Ar-*

chaeology (1968, revised 1978), together with an account of the author's theoretical position, which takes the form of a discussion of Sanders and Webster: "Unilinealism, Multilinealism, and the Evolution of Complex Societies" (1979) (in *Social Archaeology: Beyond Subsistence and Dating*, ed. Redman et al.). The latter work is an attempt to broaden the application of the neo-evolutionary model of development, primarily on an ecological and deterministic basis. The main emphasis is placed on the interaction between potential food production and the size and density of the population, as well as the technological level of society.

Part 2 presents the natural and geographical conditions of settlement in South-West Sweden, e.g. in the sections dealing with soils, climate, flora and fauna. There is a brief description of the archaeological evidence of settlement (graves, sites etc.) in each of the areas of Halland, Västergötland and Bohuslen, and the location of settlements in these areas is outlined in terms of their specific natural and geographical factors. The following sections discuss a number of individual elements that make up the general subsistence economy of iron Age settlements: agriculture, animal husbandry, hunting, fishing, iron and pottery manufacture, bone and leather work etc.

Three districts in South-West Sweden are selected for special examination: Southern Bohuslen, the area of Varnhem in Central Västergötland, and Käringsjön in Southern Halland. In each district the natural environment is examined within a radius of 1 km from a number of sites. The results of these investigations are shown in a diagram specifying the ecological resources of each locality within the area. This makes it possible to determine how settlements were placed within a varied natural environment, and how many ecological resources were available. The majority of settlements are invariably found on fertile soil; in Bohuslen and Halland there is also a considerable expansion towards areas with scarcer ecological resources – an expansion which in Central Västergötland took place as early as the end of the Late Bronze Age/Pre-Roman Iron Age. The possibility of seasonal occupation is discussed. In Västergötland the investigations also show that not all fertile soil is exploited. The relationship between the carrying capacity of the land and Iron Age technology is considered briefly. Finally the author makes a number of demographic calculations based on existing grave sites. In Bohuslen, for instance, each burial site is said to represent between 7 and 12 co-existing people, i.e. the population level of isolated farms. In the district of Varnhem, by contrast, the population is calculated to have been 16 or 17 co-existing individuals. This would have been an adequate population level for small villages during the Roman Iron Age and the Migration period. The third district examined, Käringsjön, is a swampy area where natural conditions are unpropitious and where permanent settlement probably did not occur.

Part 3 discusses the various cultural elements: burial customs, hoard finds, settlements, and material finds classified according to gold, silver, bronze, iron, amber, organic material, and ceramic ware. This section is accompanied by a number of general distribution maps and diagrams showing the presence of specific grave types and grave material in the investigated area, which is here divided into five sections. The section on votive finds goes through all known weapon deposits from the area. The section on settlements contains an account of existing traces of settlements within each district.

These three sections on graves, deposits and settlements are primarily a descriptive account of the archaeological material, centred on regional variations in distribution. Thus the author demonstrates, for instance, that graves containing weapons and graves with Roman imports are concentrated in Västergötland, that weapon deposits are also concentrated in this area, whereas votive finds of pottery ("bog pots") show a more scattered distribution. As far as housing is concerned, excavations show that Iron Age houses were long houses with living quarters and livestock stalls under the same roof. Only single farmhouses have been found. Sites manufacturing iron have been found in Västergötland, Halland and Dalsland, but not so far in Bohuslen.

However, the author abstains from any kind of detailed analysis of the archaeological material. Thus the passage on hoard finds is primarily a catalogue of sites containing weapon deposits, with some discussion of "bog pots"; similarly the passage on settlements is a description of the locality of sites – all accompanied by distribution maps.

The section on material finds is restricted to objects that can be safely dated to the Roman Iron Age and the Migration period. Here, too, each subsection merely describes what objects have been recovered and where they were located geographically within the area investigated. Thus the author demonstrates that there are many large finds of gold from Västergötland and many small ones from Bohuslen. Finds of silver are fairly few. Most of the bronze objects are fibulae, of which the cruciform fibula is the most common. Roman imports as well as weapons are discussed earlier (in the passage on burial customs) and are therefore not considered in the section on material finds. The pottery comes mainly from Bohuslen and Southern Halland. The total of 300 pottery vessels are analysed in terms of shape and ornamentation. These fairly detailed analyses show a wide discrepancy between pottery from different sites. The author feels able to conclude that pottery was produced locally.

The many factual details presented in part 3 lead to an interpretation of cultural elements of South Scandinavian (Zealand), Jutlandish or Norwegian origin, respectively. The South Scandinavian element includes graves oriented north-south, amber beads, pottery vessels with handle spouts, and vessels with meander ornamentation. These elements are present in Halland, Västergötland and Southern Bohuslen (map 11). The Jutlandish element includes graves oriented west-east, a single silver cup and a cruciform fibula found in Bohuslen and Central Västergötland (map 12). The Norwegian element comprises graves oriented east-west, cruciform fibulae, embossed pottery, bucket-shaped pottery vessels and flat hair pins made of bone. Their distribution is concentrated in Northern Bohuslen, but they are also found in Northern Halland, Dalsland and Central Västergötland (map 13).

The author is thus in a position to conclude that Northern Bohuslen belonged culturally with Norway; that Halland was part of a South-Scandinavian culture and that Central Västergötland with adjoining areas of Western Västergötland formed an independent culture with contacts in all directions. This conclusion is reinforced by the existence of two types of cruciform fibulae which, according to Reichstein (1975), originate in the area.

Part 4 is entitled "Social Formations". It is divided into the following sections:

1) Access to basic resources and specialization (2 pp.),
2) Cultures and social formations (1½ p.),
3) Chiefdoms and tribal societies (1 p.),
4) Evolution into a stratified society (3½ pp.).

This part presents the conclusions about the Iron Age society of South-West Sweden which the author feels justified in drawing from her investigations. The Iron Age society of South-West Sweden must be regarded as a society with a low density of population inhabiting isolated farmsteads (in theory conditions exist in Central Västergötland for village settlement). The distribution of valuable objects indicates no actual stratification of society, but rather that certain areas were more affluent than others. There is some relation between areas with varied natural resources and the presence of valuable objects.

The author discusses evidence of specialized production but reaches the conclusion that everything from the production of iron and pottery to weaving and woodwork took place locally. The first signs of specialization appear only during the Migration period, and then in handicrafts only.

On the assumption that the presence of weapon deposits, small fortifications and votive offerings reflect a more highly developed social organization, the author regards Central Västergötland as more developed than the rest of the area examined.

Finally, the author relates the results obtained to her theoretical starting point, Sanders and Webster's model of the development of complex societies. Central Västergötland is the area with the highest density of population, the greatest affluence, the most weapon deposits, and incipient specialization in handicrafts: criteria that are all consistent with Sanders and Webster's definition of a chiefdom. Halland and Northern Bohuslen show a certain resemblance to Västergötland, and thus to a chiefdom as defined by Sanders and Webster. The remaining areas of South-West Sweden may still have been organised as tribal societies. According to Sanders and Webster's model of social evolution (in Meso America), the development from an egalitarian society to a state is faster in small, ecologically heterogeneous areas and slower in large homogeneous areas. By contrast, the present study of South-West Sweden seems to indicate that the reverse was true: the homogeneous Central Västergötland exhibits the characteristics of a chiefdom, whereas the more heterogeneous areas are better interpreted as tribal organizations.

The treatise ends with some reflections on why Västergötland must have been a chiefdom rather than a stratified society, which, according to Sanders and Webster's model, is the only path towards the development of a state. However, a prerequisite of the development of a stratified society is that all natural resources in the area are exploited, and that is far from being the case in Västergötland. The path towards statehood is a long one, and the transition was complete only some time during the Middle Ages.

Discussion

The aim of the study is to investigate social developments in South-West Sweden during the Roman Age and the Migration period. The author attempts to test the validity of an ethnographical model (from Meso America) by applying it to archaeological primary material from Sweden. This intention determines the structure of the book: parts 1 and 4 contain the theoretical introduction and conclusion, while parts 2 and 3 present the actual empirical data. In the following these two sections will be discussed separately.

The empirical section forms the cornerstone of the book (60 pp., tables and maps). Actual analysis of the archaeological material is limited to pottery, and the emphasis is placed on the proportions and ornamentation of the pottery vessels. The fairly comprehensive analysis (c. 300 pottery vessels) leads to the conclusion that there is such variation in the shape of pottery that it must have been made locally. The ornamentation, on the other hand, is uniform throughout South Sweden – an interesting phenomenon which, however, is not discussed any further. For an assessment of the pottery analyses it is important to bear in mind that the author is not concerned with possible chronological variations. Thus, in theory, the pottery material represents more than 500 years.

There is also a preliminary analysis of grave goods when the author examines the assemblages from weapon deposits. The remaining grave goods are listed numerically in tables. As for weapons and the rest of the grave goods (Roman imported objects, coins, drinking-horn mounts, berloques etc.) the analyses comprise only directly observable geographical variations between the five main areas. Individual groups of objects are discussed as isolated phenomena, without reference to their context and regardless of chronology. Thus the accompanying tables show that there were two graves in Central Västergötland with swords, spears, lances and shields, and that the same area has yielded 4 Roman situlae, 4 glass beakers, 4 drinking-horn mounts etc. But it is impossible to decide whether, for instance, the 4 situlae and the 4 glass beakers were found in the two graves with a full set of weapons mentioned above, whether they came from one and the same grave, or whether they might have been recovered from 8 different graves – a factor of some importance if we wish to understand more fully the social variations of Iron Age society.

Though the aim of the study implies a dynamic perspective, i.e. the process of change in Iron Age society, the author refrains from a chronological analysis, which the graves in particular – with their goods which can be safely dated – would have made feasible. As a result the temporal perspective vanishes completely, and with it the chance to observe possible geographical changes when find material representing more than 500 years of burial customs is discussed collectively. What does it mean, for instance, that richly furnished women's graves are particularly numerous in one area of Central Västergötland, and weapon deposits in another? Do they reflect a chronological or a geographical difference? This important question cannot be answered because of the way the study is structured.

A treatise like the one under discussion, in which the geographical distribution of individual phenomena forms the primary analytical tool, ought to give a prominent place to a discussion and clarification of the geographical representativity of the archaeological material. For example, do the "white dots" on the distribution maps always – and in equal measure – indicate areas with no actual finds? What determines the discovery of e.g. settlement traces as opposed to finds of weapon deposits?

Ultimately, the conflict in the study resides in the relation (or lack of it) between the presentation of the archaeological material and the interpretation of it in a social perspective. This is because there is no analytical link to connect the two levels.

The theoretical section. As mentioned above, the author seeks to test the validity of Sanders and Webster's evolutionary model (based on social developments in Meso America) by applying it to Swedish material. It seems natural first of all to consider the appropriateness of this procedure, which is fairly common among archaeologists. It consists of: 1) the selection of an archaeological area of investigation, 2) the selection of an ethnographical model, 3) the mapping of archaeological data, and 4) the interpretation of these as a direct expression of the social organization within the framework of the selected model.

Any anthropological theory is debatable. This is the basic problem for archaeologists who attempt to use ethnographical models without a sufficient command of theory. As is also the case with the present study, the result is often a mechanical interpretation of social phenomena which does not increase our knowledge about prehistoric cultures, but merely adds new designations to them and forces them into a preconceived framework. To take a concrete example: the weapon deposits from Sweden's Early Iron Age do not necessarily reflect a society that is more stratified than does an area without weapon deposits. The relationship between the social superstructure and the archaeological material is not as simple and mechanical as that. Let me illustrate this with an example from the book.

The author assumes that weapon deposits, major finds of gold and Roman imported goods etc. are direct evidence of a more strongly organized society. She therefore regards Västergötland as more stratified than the other South-West Swedish areas. Yet according to the model as well as ecological considerations this is not supposed to be the case – on the contrary. In other words, "centralisation" occurs in the wrong area. The theoretical value of the study would have been enhanced considerably if the author had also attempted to work out an alternative model of developments in South-West Sweden. As it is we are left with the unsatisfactory situation that the model does not work, but is used nevertheless.

Readers who expect this book to provide a fresh analytical and theoretical contribution to research in the Scandinavian Iron Age will be disappointed. The title of the book does not cover its actual content, which is a pity since it is by no means an unimportant study of the Swedish Iron Age. It appears as a valuable and meticulous account of all the data, archaeological as well as ecological and geographical, for a large area. Part 2, which deals with the ecological and economic requirements of Iron Age settlements, is particularly useful and contains a number of important investigations and observations that may serve as an inspiration for future research. However, the overall interpretation could refer to practically any area during any period from the Bronze Age to the Middle Ages.

Lotte Hedeager

HANS NEUMANN: *Olgerdiget – et bidrag til Danmarks tidligste historie.* Skrifter fra Museumsrådet for Sønderjyllands amt, 1, Haderslev 1982.

The book about the *Olgerdige* was Hans Neumann's last and most substantial contribution to Denmark's earliest history. It deals with the author's homeland in Schleswig, and is a study firmly rooted in a narrow strip of land between Urnehoved, south-west of Åbenrå, and Gårdeby, south of Tinglev. Here, at one time, *Olgerdiget* ran through the landscape, broken only by lakes and marsh, in a form which as late as the beginning of the 19th. century could still be seen in the unploughed heath, and that since has been re-discovered through archaeological excavations. Neumann undertook painstaking excavations during nine summers, from 1963 to 1972, on this prehistoric monument, and during the following nine years he was occupied with answering the problems which *Olgerdiget* set him. This led him far outside the local archaeological field of study, and deep into the marginal land between prehistory and history which is so fascinating, but dangerous to enter. For *Olgerdiget* appeared to Neumann to be a key to the understanding of the political events which from the 2nd. to the 10th. centuries led to the existence of the Danish state. Such events are not directly disclosed by the archaeological find-material, and therefore the sparse historical sources which can illuminate the situation in Scandinavia at this period are once more brought before us, analysed, and interpreted; the domestic situation is continually set in the context of the rather clearer political development of southern and western Europe. These were centuries packed with activity, during which the continental Germanic tribes gather into continually larger and larger confederacies in order finally to stand up against the western Roman empire and establish themselves in newly-formed states, and during which the Jutes, Angles, and Saxons correspondingly invade and settle Britain. All this provides a background for, and contributes to, the historical reconstruction which is built around the results of nine summers' excavations in the present work.

Along this 12 km. long stretch, investigation of the *Olgerdige* proceeded through a series of excavations at different points. Naturally these only cover a small part of the whole length, but they present a consistent picture of the form of the structure. To the west it consists of 3 – 5 rows of palisading, running parallel, formed of oak tree trunks standing close together. Some metres to the east of this there is a broad, flat-bottomed ditch, in certain places along the east side of which traces of a low bank were seen, certainly composed of the earth cast up from the ditch. The structure did not take this form all in one go: the outermost palisades, and possibly the ditch and bank, represent later extensions and reinforcement of the barrier. But the uniformity of the structure must demonstrate that in its original form it was built to its full length in very little time. It was a land barrier, covering all accessible areas between wet areas with palisades. It is estimated that altogether 90,000 oak trunks went into the whole palisade, and although in the original phase this involved a single row of stakes, this is in consequence a construction which in terms of timber and labour employed corresponds to the later Viking period's largest commercial centres, Trelleborg, Ravningbroen, etc. However *Olgerdiget* brings us back to the Roman Iron Age: although the available C 14 dates are not consistent in the dates they indicate, it appears probable that the palisade was constructed in the 2nd. century A.D., and was extended and maintained through several centuries.

It would not, in these days, have immediately been expected that this palisade should face the North-West, and therefore have been built by the folk who lived south and east of it, but close analysis of the placing of the palisade in the landscape strongly supports such an interpretation, and in further agreement Neumann is able to point to close similarities between the construction of *Olgerdiget* and the boundary-wall with which the Romans sought to consolidate their frontiers against the Germans in the 2nd. and 3rd. centuries. Here too it is a palisade which marks the frontier, later extended with a bank and ditch to the rear. It was rather ambitious for a folk-group in south-eastern Schleswig, when at some time in the 2nd. century it wished to define its territory's north-western frontier, to take the recently constructed *limes*-defences as a model. *Olgerdiget* was not, any more than the Roman *limes*-defences were, intended as a true defence work from which military attacks could be repelled – but it could make surprise attacks difficult, and facilitate the observation of the frontier and legal traffic which by this means was directed to controllable passages.

The establishment of such a frontier boundary in the east of south Jutland is not particularly surprising in the transition to the later Roman Iron Age, because the major weapon-hoards in a series of bogs in western Fyn and eastern Jutland indicate precisely this area, around the Lillebælt, to have been a "warzone" in the period from the 2nd. to the 5th. centuries, and provide furthermore an insight into the organisation and specialised ornament of some quite significant military units. The barriers of stakes by the navigable entrance to the Haderslev fjord also belong to this period, and in the other archaeological material at just this period there appears a cultural boundary which is congruent with the line of *Olgerdiget*.

It has long been recognised that the finds of the Roman Iron Age, especially on the Jutish peninsula, divide the country into a series of culture-provinces, in which, *inter alia*, the burial practices and ceramic production display unmistakable local characteristics. Such areas have sometimes been identified with different, admittedly usually anonymous, tribes. Rather more often, however, more neutral characterisations of such areas are made, as settlement or communications areas (Siedlungs- or Verkehrsgebiete), since really one does not know how far the community extended ethnically, religiously, or politically. In the earlier Roman Period, South Jutland and Schleswig, from the Skjern river to the Ejder, form one such uniform settlement area, but subsequently, through the later Roman period, one notes both in burial practices and pottery production an essential difference between the northern and southern parts of the area, and the find picture in the southern part aligns itself in this later period more closely with that of the islands of Fyn than with the neighbouring part of Jutland. The border of this province is marked by *Olgerdiget*, and further west by the Vidå.

This, then, briefly, is the archaeological basis for Neumann's further politico-historical studies. The excavation results are comprehensively presented and documented, and there are really only three points which require supplementary investigations.

Firstly, *Olgerdiget* terminates south-west of Urnehoved, where a (?)later bank, *Skansen*, covers the (?)later Army Road (Ox Road). Even if one accepts, like Neumann, that the north-south traffic in the early Iron Age followed the same route in the landscape west of Urnehoved which to all appearances was used in the Stone and Bronze Ages, it remains incomprehensible that the frontier wall should leave so obvious a weakness towards the north.

Secondly, there is a striking discrepancy between the excavation results and those descriptions of *Olgerdiget* which survive from the time when it was still visible and accessible in the heathland. Outzen and J.N. Schmidt both speak of a mighty earth bank which had a broad ditch to the *east*(!), and it is difficult to accept that both of them, familiar with the locality as they were, mistook the points of the compass. But Neumann, of course, could only describe what he saw. However new geophysical methods of analysis, if they fulfil what they seem to promise, should make it possible to determine whether at a given place a grave-mound or earth bank has been raised, even if later ploughing has removed all traces of it, and it well be intriguing to employ these methods on selected parts of *Olgerdiget*.

Thirdly, at some time, a series of supplementary samples for C 14 dating and dendrochronological analysis should be taken, because so much depends on the dating of the monument: a more accurate dating than we at present have should now be within reach.

The further archaeological evidence, both local and foreign, which is introduced into the work consists largely of well-known material, which Neumann nevertheless never fails to assess critically, thereby both supplementing and verifying earlier observations. This applies not least to the consideration of the ceramic evidence, which illustrates similarities and differences within the Schleswig/South Jutland area in the earlier and later Roman Periods respectively. Here we have new and substantial observations which correct the basis for our understanding, and it would therefore have been most welcome if the book had provided corresponding analytical studies of many further elements of the Iron Age find-material. No-one was more familiar with this than Neumann. This could possibly have clarified problems relating to Iron Age routes, because it is contentious to assume that the routes of the Bronze Age continued in use unchanged. This could have thrown light on the relationship between Fyn and Schleswig, which is ascribed such decisive significance in the later Roman Iron Age. And this could possibly, as has recently been done in other parts of the country, have thrown some light on the social stratification in the population which was capable of completing a building project of such mighty dimensions. All this lies within Archaeology's reach.

But Neumann, historian as he was as well, had quite different purposes in his book about *Olgerdiget.* Although he did not generally accept Kossina's view, formulated in 1911, that clearly bounded archaeological culture-provinces are always identical with folk-groups, he found in this material strong indications that the two later Roman Iron Age culture-provinces in South Jutland and Schleswig can be understood as tribal areas similar to those which are known and described in that part of Germania which bordered on the Roman Empire. The group which was responsible for the establishment, extension, and maintenance of *Olgerdiget* must have been united in a sufficiently stable political organisation for common business to be planned and directed by a central authority, and the necessity of a frontier barrier of such striking dimensions may well imply a comparable political power in the neighbouring area against which defence was organised. Neumann identifies the two groups north and south of *Olgerdiget* as the Jutes and Angles respectively, and thus understands the Jutes to have dominated the whole area from the Skjern river to the Ejder in the early Roman Period, while the Angles pressed them back north of the border which is delineated by *Olgerdiget* and the Vidå in the 2nd. century. Since the finds in the area of the Angles, as has been stated, show a relationship with the find-material on Fyn, it appears that the presence of the Angles in the area could be the result of an invasion from the east.

There is little literary foundation for this identification. The jutes (*eudoses, eudici*, or, in a presumed error in Ptolemy, *fundisi*), are occasionally mentioned as inhabitants of the Jutish peninsula along with the *Cimbri* and the *Harudes*, just as Tacitus (1st. century) includes the Jutes and Angles amongst the groups who worshipped Nerthus, whose sanctuary was situated on an island in the Ocean (the Baltic?). In Ptolemy (2nd. century), however, the Angles are located in Thuringia, an area the group-name is still associated with in the 7th century, and the question of the origin of the Angles has therefore produced extensive and learned debate, involving philologists and place-name specialists, as well as archaeologists and historians.

Since Germanic peoples were often involved in migrations (examples of this are legion), and since it was hardly on every occasion that whole nations left a place, it should not really be a source of any great wonder that the same group-name should turn up in different places on the map of Europe, certainly not when the classical authors have obviously had only vague notions of the groups and places involved. On this issue, as generally in the book, Neumann gives a thorough account of all divergent opinions, and one may well follow him in concluding that the Angles who took part in the expeditions against England must be presumed to have been a group with a knowledge of seafaring, and access to the North Sea. Such conditions exist in contemporary Angeln and neighbouring parts of Schleswig, and a localisation of the Angles in this area is supported by a late English source, in that Bede (c. 672–735 AD) informs us that before the invasion the Angles were settled between the Saxons and the Jutes.

But what Bede in the 8th. century relates of the Angles in the 5th. century obviously tells us only a little of their activities and location at the start of the millenium, and if, like Neumann, one takes Tacitus's statement (1st. century) to imply the location of the Angles in Jutland, alongside the Jutes, one must concurrently accept that at that time they formed part of a homogeneous settlement area, which stretched from the Skjern river to the Ejder. This naturally does not exclude the possibility that in the 2nd. century they could have won mastery over the southern part of the area by force, and on this occasion have fortified their northern frontier, but the historical sources say nothing of this – no more than they support the hypothesis of an Anglian invasion from the east.

This invasion-hypothesis is, then, also associated with another folk-group, whose introduction into the historical arena has interested Danish historians rather more. These are the *Danes*, of whom Jordanes (6th. century) relates that they were an offshoot from the *Svear* tribe who drove the *Heruli* from their lands. Of the *Heruli* we know, amongst other things, that from the 3rd. century onwards they wandered quite homeless around the continent, until a part of the tribe, after a defeat in the Balkans in 505, were permitted to settle in Illyria, while the others began a migration back towards the north. Procopius, who also was writing in the 6th. century and therefore is closely contemporary with the events described, tells of this migration. Here we follow the route of the *Heruli* up through Poland and North Germany. "After that they passed quickly by the Danes, without those barbarians doing them any harm, and came to the sea". Then they took ship, and subsequently settled on the Scandinavian peninsula close by the *Gautar*. This migration history may well increase the probability that originally – and therefore before the 3rd. century – the *Heruli* were settled in southern Scandinavia; that there was still a tense relationship between themselves and the Danes, who in their time had expelled them; and that these Danes, at the beginning of the 6th century, occupied the areas in the southernmost part of the Jutish peninsula. Evidence, not always especially reliable or chronologically well-associated, has been assiduously pursued, both in the archaeological material of Denmark and the distribution of place-names, for an invasion of Danes from the east occupying the land in the first centuries of our era. The evidence of the bog-finds for military activities around the Lillebælt in the 3rd.–5th. centuries should, in such a case, denote the war-zone where the Danes' westward advance was temporarily halted, and Neumann now adds to this his substantial evidence for a tribal area in Schleswig whose material culture points to connections in the east, and where the population quickly raised a frontier-barrier against the north.

If one assembles all this evidence in an historical reconstruction, the "culture-shift" in Schleswig becomes a result of the advance of the Danes. It is they who in the 2nd. century establish a bridgehead on the east coast and fortify the boundary against that part of Jutland which would not so easily allow itself to be overrun, and it is they who later expanded their territory right across the peninsula. Accordingly, Frankish sources from the 6th. century speak of the Jutes and the Danes as two independent nations within the Frankish king's sphere of influence, and history's first named Dane, King Chocilaicus, comes before us at the same time, because around the year 515 he was slain on a pirate raid on the Gallic coast. But what has become of the Angles in this history? They can only be fitted in if one supposes that *Angles* and *Danes* are synonymous – that the Angles are one of the groups of the Danes, or that the Danes who conquered southern Schleswig took the name of the local population and the region, which was *Angel*. Perhaps that part of the Danish empire in Schleswig was independent for at while – an *Anglia*? In the travelogues of Ohthere and Wulfstan (shortly before 900) a distinction is drawn between South Danes in Jutland, and North Danes on the islands and the mainland (Skåne and Halland) and this distinction could possibly reflect contemporary or past political realities. All this, however, is speculation, on a very slight foundation, and when Neumann insists upon identifying *Olgerdiget* with the Angles this rests only upon the place-name *Angeln*, Tacitus's vague statement, and last but not least, in the deductions concerning the origin of the Angles which English sources allow. For with the invasion of Britain by the Angles, Saxons, and Jutes in the 5th. century, these folk-names take on a new and rather more tractable significance.

The Jutes maintain a rather shadowy existence in this course of events, because, as Neumann notes, they neglected to write their own history. Their territories, moreover, were rapidly incorporated in Saxon southern England. In recent decades, however, elements have been observed in the archaeological material from Kent, the area indicated by Bede to be where the Jutes settled, which affirm connections with Jutland, or southern Scandinavia at least, and Neumann also argues for reminiscences of the Jutish power in literary sources, although Anglian and Saxon historians seem certainly to have repressed information about this. But what Neumann is particularly preoccupied with in this part of the book is the legendary tradition which is preserved in the Old English genealogies and poetry, for a similar tradition is found later in Sven Aggeson and Saxo, and it may therefore be presumed that the English and Danish legends have a common background in the culture-province between the Jutes and the Saxons whence the Angles emigrated.

In the poem *Widsith*, which was written down in West Saxon in the 10th. century, but which contains so many Anglian forms that it must have existed in an earlier Anglian recension, Neumann finds further indications that sections of the poem must have been in existence before the emigration of the Angles to Britain. Of 31 identifiable groups and places mentioned in the poem, 29 are associated with the North Sea and the Baltic, the furthest reaches of which were known to the poet, while the poem's comprehensive descriptions of northern Europe exclude only Ireland. In the list of critical battles and victories within the poem, not a word is said of the invasion of England. On the other hand one of the verses concerns the king *Offa*, who ruled *Angel*, and who won his greatest kingdom while yet a boy. With "one sword", or "by the sword alone", he accomplished "the most glorious deed" and "marked the border". This is Saxo and Sven Aggeson's Offa-tale in an Anglian version, but instead of a dual on an isle in the Ejder it tells of a campaign, which established or expanded the Anglian kingdom (across Jutland?) and secured its border (with *Olgerdiget*?). Neumann recognizes that there is no historical evidence that it was Offa of Angel who built *Olgerdiget*, but still characterises these lines of *Widsith* as the "most important source for the history of Schleswig in these centuries". It is in any case a charming idea that the poem about Offa I of Angel could have been composed for Offa II of Mercia (757–796), who himself became famous for having "marked" the border of his kingdom against Wales with the famous Offa's Dyke.

In the same way the poem *Beowulf* also betrays a comprehensive knowledge of Scandinavian legend, and the knowing manner in which the poet alludes to this in brief references presumes a corresponding knowledge of the material amongst his audience. The poem, which to all appearances was composed in the 7th. or 8th. century, revolves aspects of the Scandinavian situation in its fabulous narrative – wars between the Jutes (*Geats*), Danes, and Swedes, and their expeditions against the Franks and Frisians. One of the events can be verified: Hygelac's (= Chochilaicus') expedition against the Franks in *circa* 515. There is clearly evidence of a living historical tradition which was common to the Angles both in England and on the continent. This may well have its background in unbroken connections between these areas.

In the context of the English tale, the Jutes and Angles emerge as independent groups who were even located as far from one another as it was by then possible, and, as already mentioned, Frankish sources of the 6th. century also speak of the Jutes and the Danes as two separate groups. The division which is established around *Olgerdiget* in the 2nd. century thus seems to last this long, and as Neumann understands it this was still the situation at the end of the 9th. century. Through a close reading of Ohthere's travelogue – from North Cape to Hedeby – he notes that during his long voyage Ohthere describes the coastal lands he passes by, and mentions their political alignments. Thus we learn that Halland belongs to Denmark, just as we also learn from Wulfstan's contemporary travelogue that Bornholm has its own king, and that Blekinge, Öland, and Gotland belong to Sweden. Since Ohthere sailed down the Lillebælt, he had Jutland to starboard and the islands which belonged to Denmark to port, and came straight from there to Hedeby which also belonged to Denmark. Jutland's political situation is thus not stated – no more is Denmark's, and it is a tempting explanation that Jutland was still an independent kingdom. This situation first changed in the 10th.

century, when the king of the Jutes at Jelling, Harald Bluetooth, conquered all of Denmark and Norway, and christianized the Danes. Then, after 700 years, *Olgerdiget* first lost its significance – and became an ancient monument.

Around this monument, Neumann portrays Denmark's earliest history. In the foregoing, some major issues are picked up in order to give an impression of the subject-matter and the problems which are considered. Both the subject-matter and the problems are much more extensive than could be shown here. Denmark's earliest history resides in fragments of a pattern, which may be put together to present a whole: very small fragments of a very large whole. Many have attempted this, and one must allow Neumann that he examines and presents his source material with a highly critical sense, with the result that there are many fewer internal contradictions in his reconstruction than many earlier attempts. But in the midst of his scientific sobriety, Neumann could nevertheless be captured by his own visions. The Anglian kingdom in Schleswig, which is said to have been a military and cultural centre of power in Scandinavia for 700 years, is thus no historical reality. It lives in the book, but the historical sources which ought to document its existence are internally contradictory and far too scanty. But still it lives in the book, which despite its broad-ranging, scientific weight, is also captivating and easily read.

Mogens Ørsnes

The reviews in this volume were translated by Ole Bay-Petersen and John Hines.

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. 239 and identified by their no.

MESOLITHIC

1. VEDBÆK, VÆNGET NORD, Northern Zealand, Søllerød s., København a.
Settlement site. During the summer of 1983 the excavation of the Kongemose site Vænget Nord in Vedbæk was terminated, being part of the Vedbæk Project. Around 400 m^2 were excavated and yielded a material rich in artefacts, a somewhat smaller selection of fauna, some structures of various shape and function, some post holes with wooden remains, and the remains of stakes that had been stuck into the ground. A fragmented bow, and a moored, but poorly preserved dugout canoe should also be mentioned. Both, however, were later than the main settlement, which has been dated to approx. 5000 b.c. – Institute of Prehist. Archaeology, University of Copenhagen. – *Nationalmuseet.* Prehist. Dept. 1659/76. [E. Brinch Petersen]

2. PREJLERUP, North-West Zealand, Grevinge s., Ods h., Holbæk a.
Aurochs skeleton. In the spring of 1983 a large fragment of an aurochs skull was found in connection with drainage works in a small bog. An excavation took place in September, and the skeleton was found intact resting on its left side 20 cm immerged into a layer of calcareous gyttja approx 70 cm below the present-day surface of the bog. The skeleton turned out to be intact and extremely well preserved. It was a very large ontogenetically very old aurochs bull. Close to the bones and concentrated around its left haunch were found 17 pieces of flint representing 15 microliths which again represent at least 9 different arrows. Lying close to one of the microliths was a 4 cm long fragment of a fir arrowshaft. A C-14 analysis of 100 g bone has given the date 8410 ± 90 BP which corresponds with a pollen-analytical dating to the middle of pollen zone Vb. – *Zoological Museum*, Copenhagen, ZMK 32/1983 and *Nationalmuseet*, Prehist. Dept. 5217/83.
Lit.:
K. Aaris-Sørensen: Uroksen fra Prejlerup. – *alle tiders ODS-HERRED* 1984. Odsherred Museum. Pp. 3–10.
K. Aaris-Sørensen (ed.): *Uroksen fra Prejlerup. Et arkæo-zoologisk fund.* Zoologisk Museum 1984. 36 pp.
K. Aaris-Sørensen: Om en uroksetyr fra Prejlerup og dens sammenstød med Maglemosekulturen. *Nationalmuseets Arbejdsmark* 1984.
P. Vang Petersen & E. Brinch Ptersen: Prejlerup-tyrens skæbne – 15 små flintspidser. *Nationalmuseets Arbejdsmark* 1984.
[Kim Aaris-Sørensen]

3. STORE ÅMOSE, West Zealand. Holbæk and Sorø a.
Settlement sites. In 1982 a systematic surface-registration in the Åmose basin was initiated by the National Agency for the Protection of Nature, Monuments and Sites with the purpose of locating the still preserved Stone Age sites. Since World War II the bog has been drained and cultivated, so culture layers with well-preserved organic material are threatened with destruction. In 1983 a supervisory committee was formed to co-ordinate the archaeological efforts in Åmosen. A trial excavation was carried out on the site Kongemose A in 1983, and a thorough excavation of the site is scheduled for 1984. – *Fredningsstyrelsen* (The National Agency for the Protection of Nature, Monuments, and Sites). – *Nationalmuseet*, Prehist. Dept. 3033/80.

4. THE SOUND OFF SLOTSBRINKEN AT DYREBORG, South Funen. Horne s., Salling h., Svendborg a.
Submarine settlement site. In colaboration with Fåborg Museum of Cultural History, and assisted by amateur divers, Langelands Museum has undertaken a preliminary investigation of a submarine Stone Age settlement in the sound between Dyreborg and Bjørnø island near Fåborg. The site, which is heavily eroded, covers an area measuring approx. 60 × 40 m on the sea-bottom, extending from the coast to a depth of 2 m. All over the area there were large quantities of flint waste, blade tools, flake and core axes and a stump-butted axe belonging to the Ertebølle Culture. At the top of a gyttja sedimentation at a depth of approx. 1 m sherds of Early and Middle Neolithic funnel-beaker vessels appeared along with bones of domestic animals. – *Langelands Museum*, Rudkøbing, 11399. [J. Skaarup]

5. ØSTENKÆR, North Jutland. Tværsted s., Horne h., Hjørring a.
Settlement site. The northernmost site of the Ertebølle Culture in Denmark. The digging of a duck pond in 1983 led to investigations showing that the site had been standing on an approx. 15 m wide water course that has since filled up. The water-deposited layers contained flint, pottery, animal bones, and antlers. Among the tools were antler axes, antler pressure

flakers, bone points, and amber pendants. – *Vendsyssel historiske Museum*, Hjørring, 90/1968. [Per Lysdahl]

6. ERTEBØLLE, North Jutland. Strandby s., Gislum h., Aalborg a.
Shell midden. After the 1893–97 excavations of the classic kitchen midden at Ertebølle the southernmost third of the area was preserved. In connection with a revision of the preservation in 1980 new investigations were initiated with the following purposes: (1) to obtain a more precise estimation of the character of the site and its relation to the Stone Age fluctuations of the sea level, (2) to analyse the relationship between the kitchen midden and a possible habitation area, (3) to analyse the structure and composition of the midden, (4) to get an up-to-date test sample of the artefact contents, and (5) to get new material for biological analyses and dating, selected in relation to the layers with a known content of artefacts.

Just behind the shell midden a workshop was found where flint tools had been manufactured. It is contemporaneous with the kitchen midden and must along with it have constituted one large settlement area.

In 1983 ensued the excavation of a 28 m long cross section through the shell midden. The investigations show that the western part of the midden has been rebedded and partly washed into the old marine sediments. At the same time it has been proved that the kitchen midden has been flooded by the sea at least once, and that it is heavily eroded as regards length as well as thickness compared to its original size. Besides a series of important observations concerning stratigraphy, the presence of fireplaces, and artefacts and organic remains in relation to the separate phases of the midden, it has also been established that the investigations of the 1890s did not go deep enough. The lowest part of the kitchen midden is contemporaneous with the early part of the Ertebølle Culture (Norslund layers 3–4). Below the shell midden were marine layers with artefacts belonging to an even earlier phase of the Ertebølle Culture.

It has also been established that, unlike previously supposed, there has been no hut-site in connection with the kitchen midden.

A preliminary examination of the recovered unretouched blades (by Helle Juel Jensen) shows that they have all been used for splitting thin branches and osiers, which might suggest extensive manufacture of wickerwork and fish traps. This interpretation is supported by many traces of fish bones and the presence of concentrations thereof in the shell layers.

The investigation is to be terminated in the summer of 1984. – Institute of Prehistoric Archaeology, University of Aarhus, and *Aalborg historiske Museum*. To be published in a coming issue of *JDA*. – Lit.: *Antikvariske Studier* 6, 1983, pp. 294–99. [Søren H. Andersen]

NEOLITHIC

7. DRENGEÅS, Sejerø island, Holbæk a.
Flint workshop from the Late Neolithic located near the shore and probably seasonal. The workshop has mainly produced flint sickles. There were large quantities of waste flint, around 60–70 rough-outs and fragments of flint sickles, and 10–15 rough-outs for broad-edged axes and daggers. Furthermore, there were pottery and various other tools. The workshop was overlaid by a settlement from the Roman Iron Age. Investigation by Lars Kempfner-Jørgensen. – *Nationalmuseet*, Prehist. Dept. 3694/81.

8. MELSTED, Bornholm.
Late neolithic stone cist. In connection with the investigation of a Viking Age settlement at Melsted a stone cist was found and excavated among the later houses. The cist contained the remains of two skeletons and a flint dagger from the early part of the Late Neolithic. In a pit near the cist was a large, intact Late Neolithic earthenware vessel. Investigation by Lars Kempfner-Jørgensen – *Bornholms Museum*, Rønne, 953.

9. TØRRESØ, Funen. Krogsbølle s., Skam h., Odense a.
The site of a passage-grave. Owing to good conditions of preservation large quantities of human skeletal remains and many bone tools: chisels, points, fabricators, and beads of animal teeth and amber were unearthed. Furthermore, there were stone and flint axes, arrowheads, and potsherds. Excavation by Anders Jæger. – *Fyns Stiftmuseum*, Odense, 3554.

10. BREDHOLM. The archipelago south of Funen. Strynø s., Sunds h., Svendborg a.
Submarine settlement site. In shallow water off the southwest coast of Bredholm west of Strynø a submarine Stone Age site has been found. The finds include several flake axes, scrapers, blade tools, 4–5 thin-butted flint axes, one thick-butted axe, and one half of a polygonal axe of greenstone, besides many flakes and cores. At an earlier date a stone cist the length of a human body but without finds has been investigated on this island. – *Langelands Museum*, Rudkøbing, 11500. [J. Skaarup]

11. TOFTLUNDGÅRD, Funen. Øster Skerninge s., Sunds h., Svendborg a.
Early neolithic grave. In 1983 below a ploghed down Bronze Age mound an earth grave of the Konens Høj type was found, with deep post holes at either end. The grave was surrounded by a U-shaped ditch with its openning towards the east. The grave contained two polished, thin-butted flint axes, two transverse arrowheads, and a few potsherds. The pottery dates the grave and the ditch to Early Neolithic, Period C. – *Svendborg og Omegns Museum* 14/83. [Per O. Thomsen]

12. NØRRE KORNUM, North Jutland. Brønderslev s., Børglum h., Hjørring a.
Hoard with flint axes. During the draining of a meadow in 1983 a hoard was found consisting of 2 polished and 7 unpolished thin-butted flint axes. The axes rested in salt water mud in a previous litorina inlet. – *Nationalmuseet* Prehist. Dept. A 51075–83. – Procured by *Vendsyssel historiske Museum*, Hjørring (143/1983), where the find is kept.

13. MORUP MØLLE, North-West Jutland. Bedsted s., Hassing h., Thisted a.
Early neolithic grave. The grave was N-S aligned, measured 3.5 × 2.75 m, and was filled with stones the size of a human head. It was laid out under level ground, penetrating only 30–40 cm into the subsoil. Most of the stones lay directly on the bottom of the grave, and it may be presumed that they have originally covered a wooden coffin. The grave goods consisted of approx. 170 amber beads, whereamong were several oblong beads without perforation but with a clearly marked waistline. Beads of this type are known from Early Neolithic graves and hoards. – *Museet for Thy og Vester Hanherred*, Thisted. [Jens-Henrik Bech/ Anne-Louise H. Olsen]

14. FADDERSBØL, North-West Jutland. Hundborg s. & h., Thisted a.
Stone-packing grave consisting of a small, almost square stone pavement covering a mortuary house. East of this grave two oval, stone-filled graves were found. The mortuary house revealed two polished flint axes of the Blandebjerg/Bundsø type. The investigations will be continued in 1984 to establish whether there are more stone-packing graves in the area. – *Museet forThy og Vester Hanherred*, Thisted, 1941. [Jens-Henrik Bech/ Anne-Louise H. Olsen]

15. NØRHÅGÅRDSVEJ, North-West Jutland. Nørhå s., Hundborg h., Thisted a.
Barrow. At the top of a ploughed down barrow two skeleton graves, probably female, were found, from the Single Grave Culture. Both graves were aligned WNW-ESE and contained remains of partly carbonized log coffins measuring approx. 1.7 × 0.5 m. One grave showed that the deceased had rested in hocker-position on the left side with the head towards the east. The other body has probably rested in a similar position. Both graves contained amber discs, amber pendants, and amber beads, including a large necklace consisting of 183 amber beads and pendants. The graves probably date from the ground grave period. Below the single graves was a dolmen-like grave structure from the Early Neolithic, Period C, consisting of a partly wooden, rectangular chamber measuring 1.4 × 0.5 m on the inside, and containing a few amber beads. The chamber was surrounded by a low mound and an oval stone circle measuring 4.5 × 3 m on the inside. Furthermore, there were three urn graves from the Early Bronze Age. An Early Neolithic grave structure displaying several similarities with the above grave, and located approx. 300 m further to the NW was investigated in 1973. This grave contained a collared flask, a couple of amber beads, and a thin-butted axe. – *Museet for Thy og Vester Hanherred*, Thisted, 1678. [Jens-Henrik Bech/ Anne-Louise H. Olsen]

16. LUND, North Central Jutland. Ørslevkloster s., Fjends h., Viborg a.
Single Grave Barrows. Three heavily ploughed down barrows were excavated yielding a total of 15 inhumation graves incl. two doubtful ones. Many of these graves had a partly carbonized wooden cover. These partly carbonized covers were found in graves dug into the subsoil, graves on the original surface, and graves laid out above the bottom of the barrows. Most of the graves also displayed another common trait: the absence of grave goods. One grave, however, contained a thick-butted flint axe, and one of the later graves that did not seem to have a carbonized cover, contained an earthenware vessel corresponding to Glob's I-type. – *Skive Museum* 239A. [John Simonsen/Svend Nielsen]

17. GLATTRUP, Central Jutland. Skive s., Hinborg h., Viborg a.
Settlement Sites. On a spit of land in the northern part of Glattrup south of Skive sites from several prehistoric periods have been investigated, i.e. of the Funnel Beaker and Single Grave Cultures. The settlement from the former period is dated to MN I.This settlement has yielded pits with flint and pottery inventories. However, in three instances surface clearings revealed traces of posts that may be interpreted as the remains of small houses with a length of roughly 6 m and an EW orientation. Settlements from the Single Grave Culture are also represented by various burials of artefacts, incl. a varied material of flint tools, potsherds, charcoal, and charred grain. – *Skive Museum* 270A. [John Simonsen]

18. SKARRILD MOSE, West Jutland. Skarrild s., Hammerum h., Ringkøbing a.
Settlement Sites and Grave. On the eastern edge of Skarrild bog culture layers and various remains of human activities were excavated on a large settlement site dating from the end of the Funnel Beaker Culture. There were no remains of houses. On the settlement area, under level ground, a grave from the Single Grave Culture appeared, containing 15 amber beads. The investigated area covered a total of 1500 m^2. – *Herning Museum* 1519. [Hans Rostholm]

19. VELDBÆK, West Jutland. Esbjerg s., Skast h., Ribe a.
Single Grave Barrows. In 1983 a total of 12 barrows from the Single Grave Culture were excavated, consisting of 11 ploughed down barrows and one completely intact barrow hidden under a Bronze Age barrow. The 12 barrows contained a total of 19 graves from the ground and upper grave periods, and in one barrow the central grave had been excavated at an earlier date. Only three barrows were devoid of finds, the remainder contained 1–2 graves placed centrally in the barrow. However, two barrows contained 5–6 graves each. The most frequently represented grave goods were battle-axes type F/G, I, K, and L, and blades, and two graves contained respectively 86 and 74 amber beads. One grave contained 3 pots, whereamong a coarse storage vessel with short-wave moulding, and three other graves contained imprints of supposed beakers or vessels of organic material. Traces of skeletons were found in three graves. The filling of one barrow contained Bell-Beaker sherds, and below another two barrows were refuse pits from Early Neolithic C and Middle Neolithic I. Several of the barrows were surrounded by circular ditches with traces of posts. One of these ditches was of an unusual size with a diameter of 12.5 m and a depth of 1 m. This ditch showed traces of closely

spaced, very heavy posts with traces of a wattled wall. – *Esbjerg Museum* 980, 1329–34. [Ingrid Stoumann]

20. GELSBRO, South Jutland. Gram s., Haderslev a.
Long-barrow. This ploughed down barrow was approx. 40 m long and 6 m wide and had originally been surrounded by large stones. Situated athwart the barrow were found two inhumation graves from the Early Neolithic. Both graves were heavily disturbed, partly by the removal of the stones and partly by present-day agriculture. Originally the bottoms of both graves had been covered by a layer of burnt and chrushed flint, whereupon the bodies and the grave goods had rested. Both graves contained a blade and three amber beads. A few metres from the long-barrow was a third earth grave. This grave contained the remains of a small funnel beaker. Excavated by Flemming Rieck. – *Haderslev Museum* 1520.

21. DAMGÅRD, South Jutland. Gram s., Haderslev a.
The site of a dolmen. The site turned out to contain the remains of a small dolmen. The ground plan of the chamber could clearly be distinguished. In the grave were amber beads, transverse arrowheads, a thin-butted flint axe, an earthenware vessel, and a few heavily disintegrated human bones. At the edge of the dolmen in connection with the entrance to the chamber were large quantities of votive pottery and some material (amber beads, transverse arrowheads, battle-axes etc.) which had probably been removed from the grave. Excavated by Flemming Rieck. – *Haderslev Museum* 1344.

22. KÆMPESTEN, South Jutland. Bov s., Lundtoft h., Åbenrå a.
Long dolmens. In connection with recent construction work 4 ploughed down long dolmens were investigated, each with remains of a chamber. There were only few finds. Under one dolmen was an area with traces of ard-ploughing. Excavated by Per Ethelberg. – *Haderslev museum* 1477, 1478, 1479, 1484.

LATE NEOLITHIC AND BRONZE AGE

23. HOVER, West Jutland. Hover s., Hind h., Ringkøbing a.
Barrow and settlement site. In the spring of 1983 the excavation of a Bronze Age Barrow was ended. Below the barrow were traces of a house from the Late Neolithic with a.o. Myrhøj-pottery. – *Ringkøbing Museum.* [Jens Aarup Jensen]

24. JERNHYT. South Jutland. Hammelev s., Gram h., Haderslev a.
Barrow. In connection with gravel production a large preserved barrow was investigated. The barrow was more than 2 m high, had a diameter of approx. 20 m, and contained 6 graves, 4 of which contained no grave goods, however. Of the remaining two one was a deep, stone-lined grave from the Late Neolithic (LN C) with a very beautiful flint dagger, whereas the other was a well-equipped grave from the end of the Early Bronze Age. This contained a.o.: a bronze sword, 2 double studs, 2 razors, a fibula, and a strike-a-fire. Excavated by Flemming Rieck. – *Haderslev Museum.*

BRONZE AGE

25. GERDRUP, Central Zealand. Kirkerup s., Sømme h., København a.
Barrow. In 1983 an oak coffin from the Early Bronze Age Period 2 was excavated. The coffin was lined with seaweed and contained a female burial with full equipment of ornaments incl. collar, belt-plate, bronze finger-rings. Furthermore, there were cremation graves from Period 3. – *Roskilde Museum.*

26. ERIKSHOLM MARK, Central Zealand. Ågerup s., Merløse h., Holbæk a.
Hoard. During the draining of a bog in 1983 a hoard from the Late Bronze Age Period 5 was found, consisting of a pointed-tanged sword, 2 belt boxes, and a convex belt ornament. Investigated by *Museet for Holbæk og Omegn.* – *Nationalmuseet*, Prehist. Dept, 5218/83. – The find is kept at *Holbæk Museum* (31/83).

27. GALGEDIEL, Funen. Otterup s., Lunde h., Odense a.
Settlement site and moulds. A pit contained fragments of moulds for spearheads and collars from Period 6 of the Bronze Age. – *Fyns Stiftsmuseum*, Odense, 4520.

28. LYSEMOSEGÅRD, Funen. Nørre Broby s., Salling h., Svendborg a.
Hoard. In 1983 at the first ploughing of a bog appeared a large hoard from the Late Bronze Age Period 5, consisting of belt boxes, a convex belt ornament, a collar, bronze cuffs, spiral arm-rings, deadheads, sickles, a socketed hammer, a pointed-tanged dagger a.o. Investigated by *Fyns Stiftsmuseum*, Odense (3261), where the find's is kept. – *Nationalmuseet*, Prehist. Dept. 5095/83.

29. HOLMEBO, Funen. Øster Skerninge s., Sunds h., Svendborg a.
Barrow excavated in 1983 with a diameter of 20 m and partly preserved stone circle. At the centre was an approx. 4 m wide cairn of fist-sized stones centred around two large stones with an urn between them. This is an extremely beautiful and rare vessel of the Hallstatt-type (fig. 1). Its top half was painted bull's blood red, and the deep-cut ornamentation was inlaid with chrushed burned bone. According to professor Bogusław Gediga, Wrocław, this is probably a genuine Hallstatt vessel. Among the fragments of the urn and the burned bones was a crescent-shaped razor with animal figures from the Late Bronze Age period 6. – *Fyns Stiftsmuseum*, Odense [H. Thrane]

30. BRÆNDEKILDE, Funen. Brændekilde s., Odense a.
Settlement site from the Early Bronze Age with many post holes. It was possible to identify a.o. a structure measuring 10 × 4.5 m, probably the remains of a house with a series of posts supporting the roof. – *Fyns Stiftsmuseum*, Odense, 4623.

31. HØJBY, Funen. Højby s., Åsum h., Odense a.
Settlement site from the Late Bronze Age excavated in connection with the construction of a gas pipe-line. A house site measuring 19.7 × 7 m was excavated. The house very much resembles the large houses from the Late Bronze Age in Jutland. The modest finds include a bronze bar-button, a stone axe, a bronze spearhead, and pottery. The spearhead was apparently a faulty casting and may indicate that bronze casting took place on the site. – *Fyns Stiftsmuseum*, Odense, 4640.

32. VILE, Central Jutland. Vile s., Harre h., Viborg a.
Settlement site from the Late Bronze Age, partly investigated. A long house and some pits were excavated. Besides a largish Bronze Age settlement there were also remains of settlements from several other prehistoric periods. – *Skive Museum*, 252A.

33. KALHAVE, East Jutland, Hornborg s., Nim h., Skanderborg a.
Cairns. In connection with gravel production five cairns were excavated, one of which was intact. It was built entirely of stone and measured approx. 10 × 15 m with a height of 1 m. In the middle was a grave built of cleft stones placed on their edges, but there were no grave goods. However, it contained a secondary urn-grave from the Late Bronze Age. The next cairn measuring 10 × 10 m had a large hole in the middle, indicating that it had been robbed. The final three cairns were all untouched. In one was a grave built of cleft stones placed on their edges, but there were no grave goods. Similar stone structures could not be discerned in the other two cairns. At the top of all five cairns were large quantities of flint flakes and a few potsherds . A comparison between these cairns and those earlier excavated at Vorbasse dates them to the Early Bronze Age. – *Vejle kulturhistoriske Museum*.

34. RÅDVED, East Jutland, Hansted s., Voer h., Skanderborg a.
Barrows. In connection with motorway construction work two barrows were excavated, belonging to the series of barrows running east-west along the escarpment north of Hansted Å (river). The largest and easternmost of the series contained a robbed Bronze Age grave. The stone-lining, however, was preserved. A secondary grave in the south side of the barrow consisted of a trough-shaped bed with some dental enemal at the west end, a bronze dagger, and possibly a razor. The other barrow, situated approx. 30 m west of the first one, had been almost entirely levelled by ploughing. It contained a primary grave from the Early Bronze Age Period I and a north-south oriented grave the length of a human body with stones and burned bones. The primary grave contained the remains of a 3.3 m long log coffin with traces of human bones. The deceased person must have been at least 1.8 m tall. The following grave goods were found: a bronze dagger, a strike-a-fire, the remains of a leather pouch containing pyrote, a flint blade, a flint arrowhead, a pair of bronze pincers, 2 bronze fishing hooks, the remains of a razor, and a fibula with a circle-ornamented gold sheet disc with both back-side and pin preserved. The grave is dated to the beginning of Period 2 of the Early Bronze Age. – *Vejle kulturhistoriske Museum* and *Rigsantikvarens arkeologiske Sekretariat*. [Peter Birkedahl]

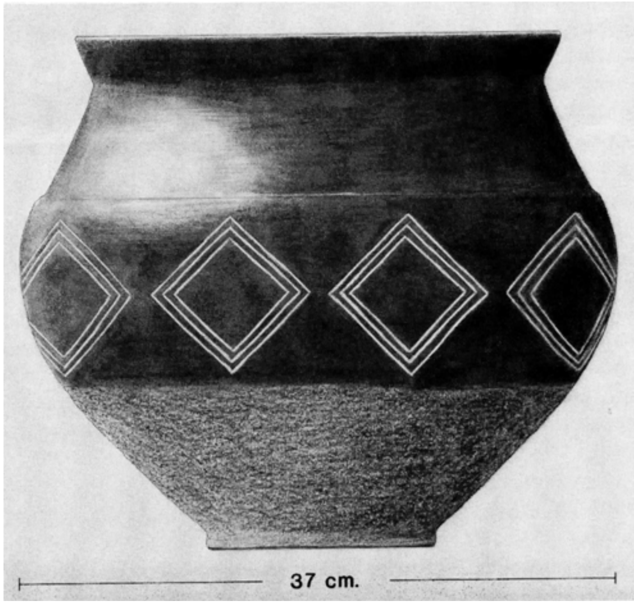


Fig. 1. Cinerary urn of Hallstatt type from Holmebo, Funen (no. 29).

35. VELDBÆK, West Jutland. Esbjerg s., Skast h., Ribe a.
Cooking-stone cairn. In 1983 a ploughed down cairn was investigated in connection with public construction work. The cairn was built on a prehistoric field-surface on an elevated area measuring 10 m in diameter and 20 cm in height. It consisted of tightly packed, burned granite stones, soil, and charcoal. The cairn contained no primary graves, and there were only a few uncharacteristic sherds. So a dating of the cairn was not possible, but a thermoluminiscent dating is in the offing. However, the cairn must be older than the three secondary urn-graves from the Roman Iron Age. Urn 1 was intact, and besides burned bones it contained a burned bone comb and a big clay bead. Urns 2 and 3 had been chrushed by ploughing, and each contained a small piece of bronce and amber. Close to the cairn is a settlement site from the 4–7 centuries A.D. – *Esbjerg Museum* 1334. [Ingrid Stoumann]

PRE-ROMAN IRON AGE

36. MORELVEJ, SANDERUM, Funen. Sanderum s., Odense a.
Settlement site, from the Late Pre-Roman Iron Age. On a level area covering 2000 m^2 south of Sanderum a settlement with four house-sites was discovered. The houses, which were surprisingly small, measuring only 7–9 m, were all oriented alike, roughly east-west. This is a rather large settlement only part of which has been touched by road construction. – *Fyns Stiftsmuseum*, Odense, 4166.

37. VANGELEDGÅRD, Funen. Stenløse s., Odense a.
Settlement site from Pre-Roman Iron Age investigated in connection with the construction of a gas pipe-line. A heavily disturbed house-site was discovered, surrounded by 7, possibly 8, square post buildings each resting on 4 square posts. These are probably storage-houses. The habitation area proper must be outside the area dug up for the pipe-line. – *Fyns Stiftsmuseum*, Odense, 4635.

38. MOESGÅRD GOLFBANE, East Jutland, Mårslet s., Ning h., Århus a.
Settlement site from the late Pre-Roman Iron Age investigated in 1983. In connection with the construction of a golf-course an area of 2500 m^2 has been investigated and has yielded rich settlements from the Pre-Roman Iron Age Period IIIa, a.o. 2 approx. 12 m long houses. – *Forhistorisk Museum*, Moesgård, 2691.

39. OMGÅRD, West Jutland. Nørre Omme s., Hind h., Ringkøbing a.
Settlement site. In 1983 a long-house divided into stalls from the Pre-Roman Iron Age Period 1 was investigated along with vast tracts of fields with traces of ard-ploughing. The house and the fields are part of a village with surrounding fields, in which five houses and several refuse pits and large field areas were investigated during 1974–76 and in 1981. Towards the south, i.e. immediately north of Omgård brook, the fields form a terraced escarpment. In several places 5–10 cm of the mould layer is preserved, a.o. a podsol area showing that heather has originally grown in the sandy areas. The area was probably broken in either at the end of the Late Bronze Age or at the beginning of the Pre-Roman Iron Age. – *Nationalmuseet*, Prehist. Dept. 1140/75. – Lit.: *Nationalmuseets Arbejdsmark* 1982 pp. 131–141. [Leif Chr. Nielsen]

40. VELDBÆK, West Jutland. Esbjerg s., Skast h., Ribe a.
Barrow cemetery. In 1983 an early Pre-Roman Iron Age barrow cemetery was excavated. All the barrows had been ploughed down, but 75–80 urns were found buried in the subsoil, 65 of which were recovered. All the urns were surrounded by circular ditches with diameters varying from 1.5 to 7 m, and had 1- 3 entrances. The state of preservation varied from totally ploughed down urns to structures where the urn was preserved, including stone lid, and with ditches up to 30 cm deep. The urns contained very few artefacts, so at the present the dating rests solely on the best preserved urns. One single skeleton grave was also found, and judging by its size it is probably a child's grave. It contained an iron knife. – *Esbjerg Museum*, 1357. [Ingrid Stoumann]

41. KROGSLUND, South Jutland, Gram s., Haderslev a.
Barrows and urn-graves. In 1983 a trial excavation was made on a naturally bounded island. Ditched barrows and ordinary urn-graves from the early Pre-Roman Iron Age were found in the excavated area, which covered 700 m^2. In both cases the urns were surrounded by flat stones. There were 19 barrows and 10 urn-graves without barrows. Along with the urns several additional pots and five bronze pins were found. – *Haderslev Museum* 1549. [Per Ethelberg]

ROMAN IRON AGE

42. SKADEMOSEGÅRD, Roskilde.
Settlement site. In 1984 in association with the construction of a gas pipe-line, parts of a settlement site were excavated. There were three long-houses, pits and fences. The pottery in the pits dates the settlement to the period around the birth of Christ. – *Roskilde Museum.*

43. SAXHØJ, Lolland. Hunseby s., Musse h., Maribo a.
Cemetery. In a cemetery from the Early Roman Iron Age an inhumation grave and 12 urn-graves were investigated. The grave goods consisted a.o. of bronze fibulae, glass beads, an eye for a hook and other ornaments, and an iron knife. – *Lolland-Falsters Stiftsmuseum*, Maribo, 800–1983–6.

44. HAMMELEV, East Jutland. Hammelev s., Djurs Nørre h., Randers a.
Settlement site with stone cellar. The finding of a small gold finger-ring led to the discovery of the first stone-built Iron Age cellar south of Limfjorden. The cellar was sunk approx. 1 m into the subsoil and built of 32 up to 1 m tall and 0.2 m thick square-hewn limestone blocks. The cellar consisted of a 1 × 3 m east-west oriented room with a sloping entrance from the west. It has been dated to the Early Roman Iron Age. A paved road is earlier than the cellar. Post holes along both sides of the road indicate a settlement. – *Djurslands Museum*, Grenå, no. 1972. [Niels Axel Boas]

45. PRIORSLØKKE, Horsens, East Jutland.
Fortified settlement. In 1983 the excavation of a settlement site from the Early Roman Iron Age was terminated. The settlement is situated on a sand bar on the banks of Hansted river-valley, and has had natural bounderies on three sides. The fourth side has been fortified by a moat and a palisade. During the investigations in the autumn 7 long-houses and 9 small buildings have been excavated. Thus the number of Early Roman Iron Age houses excavated is approx. 46, belonging to at least two settlement phases (fig. 2). There are also earlier remains on this site, e.g. a Neolithic culture layer and a number of early Pre-Roman Iron Age refuse pits. – *Nationalmuseet*, Prehist. Dept. 1180/75. [P.O. Nielsen & Fl. Kaul]

46. FRØRUP, South Jutland. Frørup s., Sønder-Tyrstrup h., Haderslev a.
Urn cemetery. In 1982–83 an urn cemetery was excavated because it was threatened by ploughing. A total of 29 urns was found with highly varied contents: a gold finger-ring, a bronze sewing needle, an iron razor with a stylized animal head at the end of the handle. Bronze fibulae, including provincial roman types, date the cemetery to the First or Second Century A.D. – *Haderslev Museum* 1445. [Jørgen Holm/ Per Ethelberg]

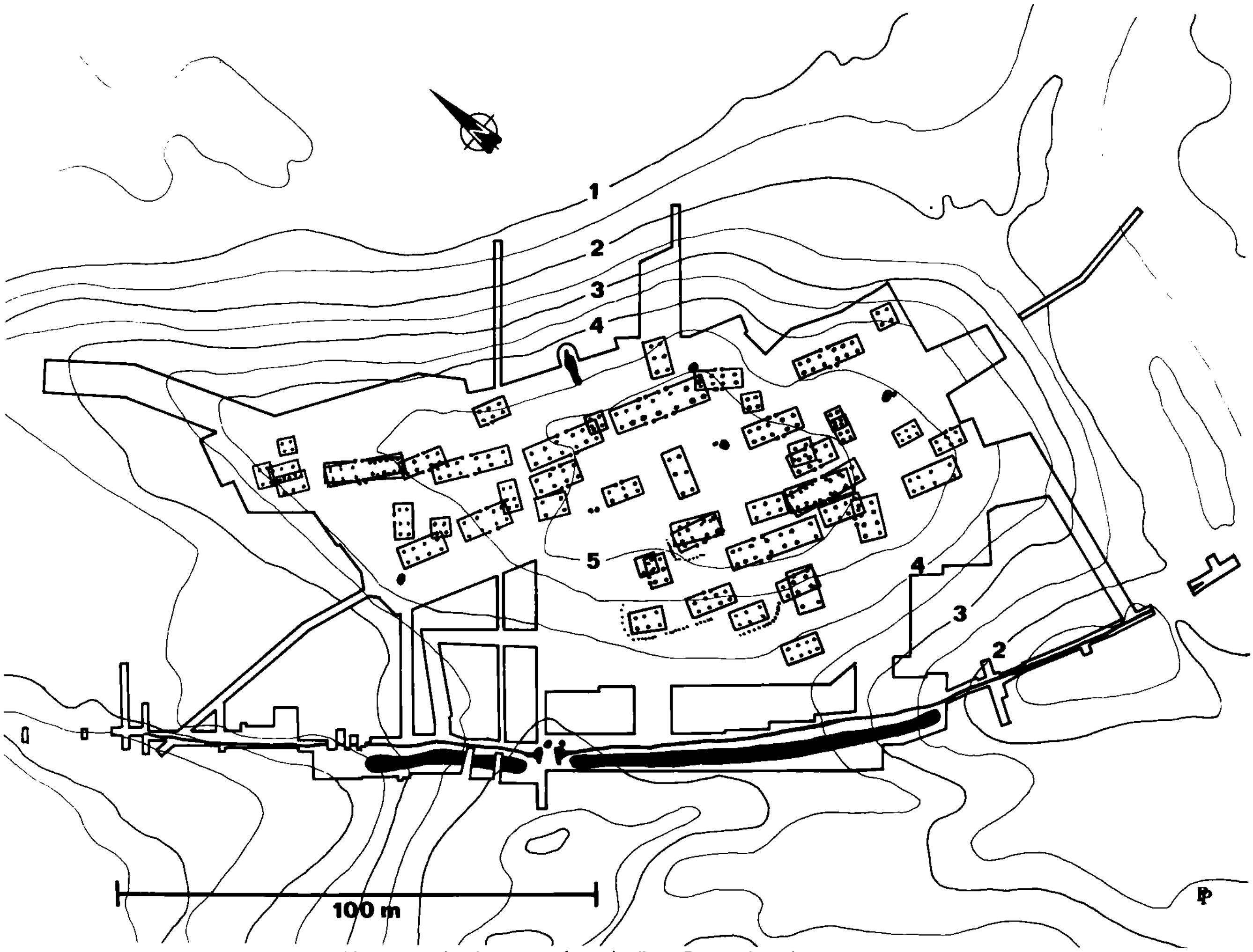


Fig. 2. The fortified settlement of Priorsløkke, East Jutland (no. 45), from the Early Roman Iron Age.

LATE ROMAN AND GERMANIC IRON AGE

47. BELLINGEGÅRD, Køge. Højelse s., Ramløse h., København a.
Settlement site. In connection with the building of a hospital an area of 12000 m^2 was dug up revealing a large number of Iron Age houses. The houses could be divided into 7 farmsteads. All the farms had been rebuilt from 2 to 5 times. The earliest houses had 4–5 sets of roof-supporting posts in two straight lines. In the later phases the supporting posts formed curving lines converging towards the gables. There were 3–4 pairs of posts in each house. Pottery dates the settlement to Early and Late Germanic Iron Age. – *Køge Museum*, 1019 [Svend Åge Tornbjerg]

48. SMØRENGEGÅRD, Bornholm. Vestermarie s.
Hoard. In 1983 on a large settlement area a total of 486 denarii was found. The coins were struck between 69 and 211 A.D., most of them in the Second Century. Along with these were a solidus coined during the reign of the West Roman Emperor Anthemius (467–72), and a silver ingot and an ingot of gold mixed with silver. The ingots and 313 of the denarii lay in an earthen-ware vessel, but the rest lay scattered. – *Bornholms Museum*, Rønne, 766. – The treasure has been handed over to The Royal Coin Cabinet, *Nationalmuseet.*

49. STØDSTRUP MARK, Falster. Eskildstrup s., Maribo a.
Settlement site. A rescue-excavation has been carried out, laying bare 7100 m^2 of an Iron Age settlement with approx. 12 houses, fences and storage pits. The position of the houses on a ridge indicates the presence of 3–4 separate farm-steads, each with several phases. The majority of the storage pits with datable objects are from the pre-Roman and Early Roman Iron Age. Others date from the latest part of the Roman Iron Age and the Germanic Iron Age; according to type the longhouses seem to derive from the last-mentioned periods. Because of the scarcity of datable objects, dating by thermoluminicence is carried out; the first result at a piece of daub from the houses

Fig. 3. The 1982 gold treasure from Gudme, Funen (no. 50). L. Larsen photo (The National Museum). 1:1.

has shown 500 A.D. – *Lolland-Falsters Stiftsmuseum*, Maribo, 800–1983–21. [Karen Løkkegård Poulsen]

50. GUDME, Funen. Gudme s., Svendborg a.
Single finds and treasures. Since 1982 a large area south-east of Gudme has yielded several hundred metal finds from the Late Iron Age and the Viking Age. The artefacts were found by means of a metal-detector. They include gold and silver coins, fibulae, fragments of ornaments, beads, ingots, belt buckles, and casting waste. Most of the finds date from the Germanic Iron Age. Of special interest are the animal figures and the animal-shaped ornaments (see *JDA* vol. 2, p. 220, no. 27). In the autumn of 1982 four gold bracteates and a gold pendant were found. The ensuing excavation yielded another 5 bracteates, a gold pendant, a silver denarius with an eye, a gold button with inlaid stones, and a spiral gold finger-ring (fig. 3). At the excavation 6 of the artefacts were found gathered in a pit or a post hole, and the remainder 4 lay scattered at a distance of up to 2 m from the pit. It is probably a treasure disturbed by cultivation. In the spring of 1984 a treasure was found consisting of approx. 1.5 kg of silver ingots, fragmented silver of provincial Roman origin, and a few gold ingots from the early Germanic Iron Age. In 1984 a trial excavation was also undertaken in an area that had earlier yielded both Roman denarii and solidi. Remains of buildings from the Early Germanic Iron Age were found, a.o. part of two overlapping long-houses with double wall-posts, and parts of 4–5 other buildings. – *Nationalmuseet*, Prehist. Dept. 2498/78 and 4620/82, in collaboration with *Fyns Stiftsmuseum*, Odense.

51. TORSHOLM, North Jutland, Havbro s., Års h., Ålborg a.
Gemstone (Alsengemme) of black and blue glass with three figures; single find. Measurements: 2.7 × 2.1 cm (fig. 4). Procured by *Vesthimmerlands Museum*, Års. – *Nationalmuseet*, Prehist. Dept. 5412/84.

52. ILLERUP, East Jutland. Skannerup s., Hjemslev h., Skanderborg a.
Votive deposit. The excavation of the large votive deposit of weaponry at Illerup bog continued in 1983. A new place of votive offering was found, some 100 years later than the so far latest, i.e. from approx. 500 A.D. – *Forhistorisk Museum*, Moesgård, 1880. – Lit: *Kuml* 1951, 1976, 1977, 1981. *Germania* 61, 1983 pp. 95–116.

53. VELDBÆK, West Jutland. Esbjerg s., Skast h., Ribe a.
Settlement site. In 1983 parts of a large settlement site from the 4th–7th centuries A.D. were excavated in connection with municipal construction work. The settlement site was found during the excavation of a cooking-stone cairn earlier in the year (see no. 35). An area of 7500 m^2 was investigated. Around 20 houses were found, most of which were long-houses dating from either the 4–5th or 6–7th cents. The settlement has consisted of farms each with several phases, but it has only been possible completely to unearth one of these farms. Most of the long-houses were of the well-known type with pairs of posts supporting the roof and rounded gables, but there was also a smaller house measuring approx. 8 × 10 m with a central row of posts supporting the roof. A series of 0.5–1.5 m wide ditches subdivided the settlement into several sections. The boundaries of the settlement were not estblished. This new-found settlement is situated only a few hundred metres north-east of an earlier excavated early Germanic Iron Age settlement on the eastern outskirts of Esbjerg, and they are probably part of one large settled area. – *Esbjerg Museum* 1358. [Ingrid Stoumann]

54. EMMERSKE SKOLE, Tønder, South Jutland.
Settlement site. In 1982 in connection with the construction of a gas pipe-line parts of a settlement from the 5th cent. A.D. were excavated. Parts of 7 long-houses were investigated. The average length was approx. 38 m and the average width was approx. 5.5 m. Besides the long-houses there were three small pit-houses that had housed workshops and 23 pits for the extraction of iron. Furthermore, there were several wells, one of which had a well-preserved curb. The finds include a cruciform bronze fibula, a berloque-shaped amber bead, and some pottery. – *Haderslev Museum* 1443. [Flemming Rieck]

VIKING AGE

55. RUNEGÅRD, Bornholm. Åker s.
Cemetery. In 1983 the investigations at Runegård were continued, and a Viking Age cemetery with inhumation graves was excavated. A total of 26 graves including at least 8 children's graves were investigated. The grave goods were sparse and consisted of Baltic ware, knives, beads, a silver coin, etc. The boundaries of the cemetery have now been found on three sides and the excavations will be continued in 1984. – *Bornholms Museum*, Rønne, 677. – Lit: *JDA* vol. 2, 1983 pp 137–48. [Margrethe Watt]

Fig. 4. Gemstone from Torsholm, Northern Jutland (no. 51). L. Larsen photo (The National museum). 2:1.

Fig. 5. Bronze pendant from Strynø (no. 57). Height: 4.5 cm. L. Larsen photo (The National Museum).

56. MELSTED, Bornholm. Gudhjem s.
Settlement site. In 1983 a Viking Age settlement site with long-houses was excavated. Besides pottery there were sherds of soapstone pots, which have not previously been found in Bornholm. Excavation by Lars Kempfner-Jørgensen. – *Bornholms Museum*, Rønne.

57. STRYNØ. Strynø s., Sunds h., Svendborg a.
Pendant. Small, tongue-shaped pendant of stanniferous bronze with inlaid silver or niello thread (fig. 5). The front-side has a gilt background with ornaments of a Carolingian nature, which dates the pendant to the 9th. cent. A.D. Found during ploughing. Investigated by *Langelands Museum*. – *Nationalmuseet*, Prehist. Dept. C 30624. The find is kept at *Langelands Museum*, Rudkøbing (11523). [J. Skaarup]

58. OMGÅRD, West Jutland. Nørre Omme s., Hind h., Ringkøbing a.
Settlement. In 1983 the western part of a large farm complex of 10th cent date was investigated (fig. 6). Three ovens were found, one of which was built into a house. The house had curving walls and pairs of huge holes at the gables for posts supporting the roof. At the south-west corner of the farm complex another long-house with central posts was found. Furthermore, a section of a north-south oriented road, and a large section of the corner of a stockade were found. Elsewhere a couple of houses were found, one from the 9th cent. and one earlier. In one of the ovens was a fragment of a rotating mill of mica schist with red garnets and a sherd of a spherical vessel, and another oven with a whet-stone of dark fine-grained shale. The investigations will be continued in 1984, concentrating on the eastern part of the farm complex in hope of achieving a thorough excavation of the entire area. – *Nationalmuseet*, Prehist. Dept. 1140/75. – Lit. *Acta Archaeologica* 50, 1979(1980) pp. 173–208. [Leif Chr. Nielsen]

59. OMGÅRD, West Jutland. Nørre Omme s., Hind h., Ringkøbing a.
Settlement. In 1983 part of a settlement from the late Viking Age – early Middle Ages was investigated, located SSW of the large farm complex from the 10th cent. (see above no. 58). A well-preserved house site was excavated (fig.7). In some of the post holes wooden remains were preserved. Furthermore, another couple of house-sites were investigated, one of which was earlier than the above mentioned one, plus a section of a road oriented north-south. – *Nationalmuseet*, Prehist. Dept. 1140/40. [Leif Chr. Nielsen]

60. GRIMSTRUP, West Jutland, Grimstrup s., Skast h., Ribe a.
Chamber-grave. In connection with a private building project in Grimstrup in 1983 the museum investigated a Viking Age horseman's grave from the 10th cent. The grave was found when sand was removed, and about 25 cm had been removed when the museum was advised. However, most of the contents

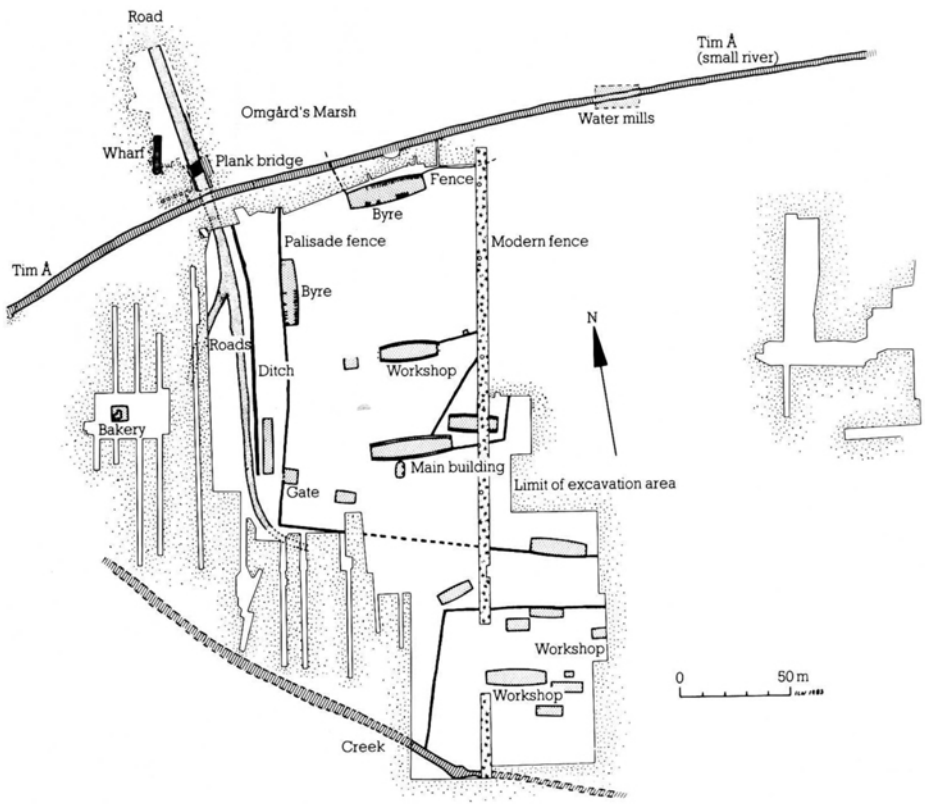


Fig. 6. The excavated parts of the 10th century farmstead at Omgård, West Jutland (no. 58).

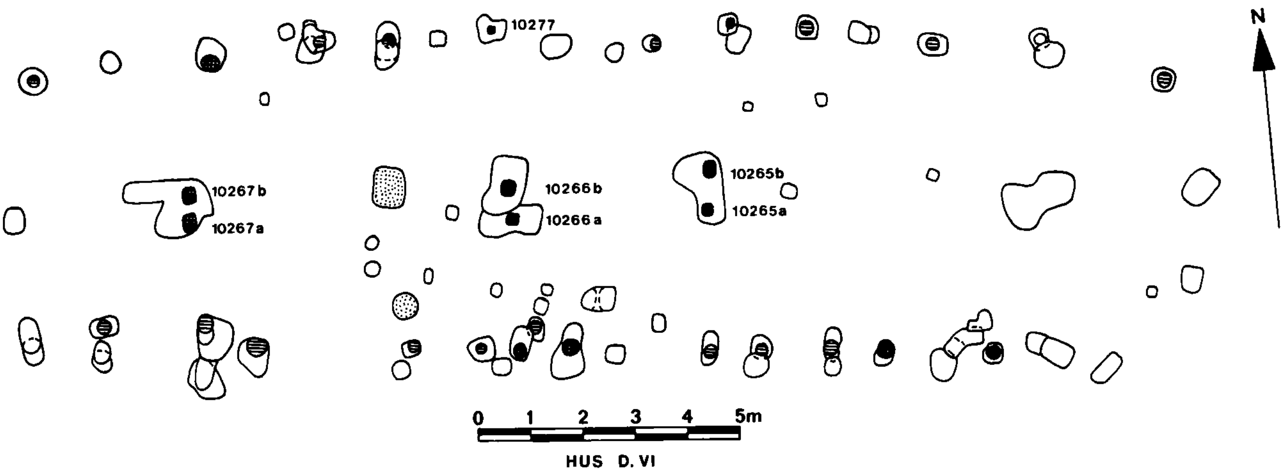


Fig. 7. Plan of late Viking Age – early Medieval long-house from Omgård, West Jutland (no. 59).

were intact. The grave consisting of a wood-covered chamber measuring 2 × 3 m had originally been covered by a mound, which had disappeared completely. In the northern half of the chamber a coffin had been built for the deceased, who rested in supine position with the head towards the west. In the coffin were an iron sword and an iron knife, both in their scabbards, a whet-stone, spurs, and a lance. On top of the body, from the skull to the pelvis, were the heavily disintegrated remains of either a skin-cover or a layer of wood, which had clearly been decorated with a band painted with spots and strokes in the following colours: grey-green, white, red-brown, on a dark-blue background. All the other artefacts were found outside the coffin in the south-east corner of the chamber. In this area the following items were found: an axe with traces of a wooden shaft, an entire horseman's outfit consisting of a curb-bit with pendant ornamental plates, stirrups, leather straps with ornamental buttons, buckles, fittings, rings, strap-ends and other belt fittings, and perhaps the remains of a wooden saddle. All these artefacts appeared to be richly inlaid with silver and copper. The horse had probably also been buried in the south-western part of the chamber, which had been destroyed before the industrial sand-digger was stopped. – *Esbjerg Museum*, 1347. [Ingrid Stoumann]

61. TRÆHEDE, South Jutland. Bevtoft s., Nørre-Rangstrup h., Åbenrå a.
Investigations of a **Viking Age cemetery** originally investigated in 1906–7 by the museum of Kiel. During the excavations in 1982 two new inhumation graves were found. One of these, an obvious chamber-grave surrounded by a ring ditch, contained an iron knife, but the other contained a collection of beads and a silver coin (Haithabu coin). – *Haderslev Museum* 1473. [Steen W. Andersen]

62. BARSØ, South Jutland. Løjt s., Rise h., Åbenrå a.
Dugout Boat. In 1982 a dugout boat was raised from a depth of 6 m in the waters SW of Barsø. The boat measuring 3.70 m in length and 0.6 m in width was made from a beech log. It has been C-14 dated to 1040±65 A.D. – *Haderslev Museum*, 1429.

MEDIEVAL AND LATER

63. ROSKILDE CATHEDRAL. The construction of a royal tomb and the rearrangement of the cathedral square in the summer of 1983 were accompanied by archaeological excavations immediately west and north-west of the cathedral. Approx. 50 burials of men, women and children were investigated. Most of them were from the Romanesque period. Noteworthy among them were graves with a stone on either side of the deceased's head, a travertine coffin, and a coffin made from a dugout trunk. West of the cathedral remains of the wall called the "Arnolds-wall" were found, and immediately outside the wall was a 1,5 m wide, round-bottomed ditch. The foundations of the Gothic churchyard wall and the Medieval grammer school were also found. The investigations were carried out jointly by the Cathedral Museum, *Nationalmuseet*, 2nd Dept., and *Roskilde Museum*.

64. THE CHURCH OF SCT. ALBAN, Odense.
During 1980–82 and 83 investigations have been carried out on the site of the Church of Sct. Alban, which was demolished in the latter half of the 1500s. Besides remains of a Romanesque, granite ashlar church there were also found traces of two wooden churches. Post holes and floor layers (simple, hard-packed earth floors) were found. One of the post holes from the latest wooden church contained half a coin from the reign of Svend Estridsen. The latest wooden church must have been fairly large, probably around 32 m long and 11 m wide. The traces of the first church are so sparse that it is hard to establish its length, but it seems not to have been more than approx. 7 m wide. The latest church has had two rows of posts supporting the roof. We may presume that the murder of Sct. Cnut

in 1086 took place in one of these wooden churches. Below the oldest wooden church, sealed by all the floor layers, were the sparse remains of a bell foundery pit. Fragments of the mould were unearthed. They indicate that the bell has had a diameter of approx. 40 cm at the lip, and judging by the depth of the pit the bell must have been approx. 55 cm high; so this bell has been of roughly the same size as the one found at Hedeby a couple of years ago. – *Møntergården*, Odense. [Eskil Arentoft]

65. SØBY VOLDE, Ærø. Søby s., Svendborg a.
Fortifications. In 1983 investigations were carried out of the huge Early Medieval fortifications. Below the up to 3/4 m thick culture layer on top of the citadel were numerous remains of structures. To the south were the remains of a wooden building measuring 4 × 4 m close to the outer wall. At this point the outer wall displayed traces of a wooden structure that might have supported a gangway. A series of large post holes in the middle of the area must derive from a heavy stockade, and a foundation ditch to the north is probably part of the gatehouse. To the west inside the outer wall was a wide, 2.3 m deep pit(cistern?), which had been filled during construction work in the 1200s. And finally, at the foot of the fortifications a 6 m wide and 2 m deep ditch with a round bottom was unearthed. Along the ditch were the remains of an outer stockade. The culture layer yielded many finds, mostly pottery and fauna. The pottery was Baltic ware and a few specimens of glazed pottery. Furthermore, there were knives, arrowheads, nails, horseshoes, iron scoria etc., and a small number of coins, which have so far been allocated to the reigns of Niels, Valdemar Sejr, and Erik Plovpenning. The material suggests that this impressive fortress was in use from the beginning of the 1100s to the end of the 1200s. – *Langelands Museum*, Rudkøbing 11364. [J. Skaarup]

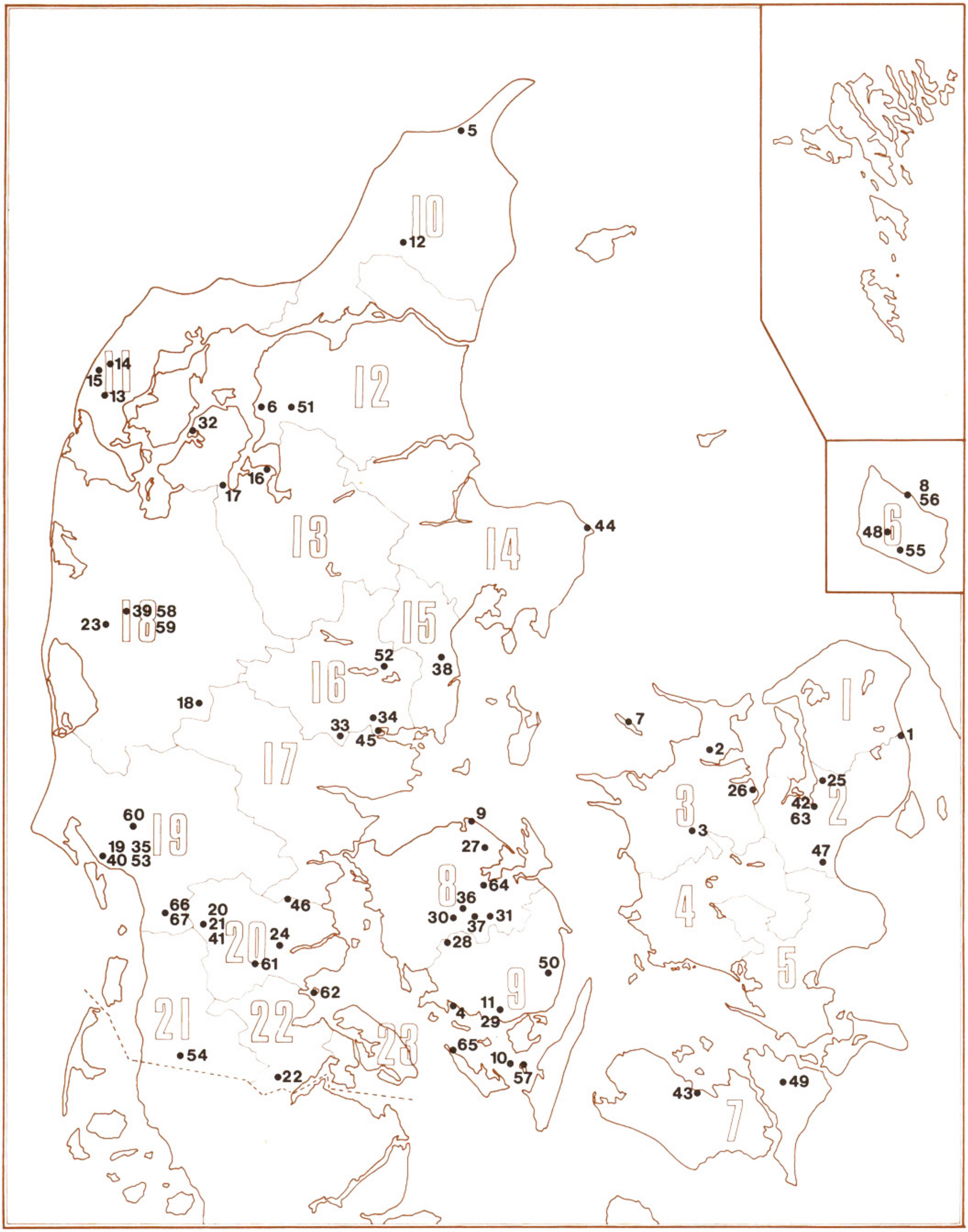
66. RIBE.
Urban Excavations. In 1983 excavations were undertaken in various places in the western part of the town. The investigations were based on the theories outlined in *JDA* vol. 2, pp. 156–70. Culture layers bear witness to activities in this part of the town from the latter half of the 12th cent. (the parish church is mentioned in 1145). Some changes in the use of the area can be seen during the Middle Ages, associated with the establishment of various church institutions. – *Den antikvariske Samling i Ribe.*

67. SCT. CATHARINAE CONVENT, Ribe.
Burial ground. At the excavation of the cloisters in 1983 approx. 65 well-preserved graves from the late Middle Ages appeared. The graves have been interpreted as a burial ground for people who had given donations to the convent. Most of the individuals were big and stout suggesting a certain social position. The convent was founded in 1228. The investigations showed that the convent was built partly on a natural bank and partly on reclaimed areas. – *Den antikvariske Samling i Ribe*, 327. [Søren Gottfred Petersen/ Per Kr. Madsen]

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	



5
10
12
14
15
11
13
6
51
12
32
16
17
8
56
13
44
14
48
6
55
39
58
23
18
59
15
52
38
16
18
7
34
33
45
1
17
2
25
26
3
42
63
2
60
9
19
19
35
40
53
3
27
47
8
64
66
20
46
36
67
21
30
31
37
4
41
20
24
28
61
50
5
9
62
11
4
21
22
29
23
65
54
10
57
22
43
49
7