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Taphonomy in Archaeology

with Special Emphasis on Man as a Biasing Factor

by NANNA NOE-NYGAARD

INTRODUCTION

Close team-work between archaeologists and palaeobiologists is of relatively recent date. From the palaeobiologist's point of view the work is exciting and challenging. The work is encouraging because of the infectious optimism of the archaeologist as to the amount of information it is possible to extract from bone material excavated at an archaeological site. On the other hand, the long tradition for careful excavation and treatment of archaeological evidence is often lacking in the case of animal bone material. Consequently, the newly opened field of contact between natural science and archaeology may lead to repeated conflicts of scientific nature. The palaeobiologist is all too aware of the incompleteness of the subfossil and the fossil material whereas the archaeologist often seems unwilling to admit discrepancies between the amount of bones left by the stone age man and the amount of bones retrieved from the site.

The role of the archaeologist is that of the optimistic interrogator asking questions like: How large was the population of prey animals around the site? How many people could the prey population sustain? How many people were inhabiting the site? For how long time was the site inhabited? At which time of the year was the site inhabited?

The palaeobiologist, on the contrary, responds cautiously with endless reservations, leaving the archaeologist somewhat frustrated by the unhelpful or incomplete answers to his many questions. Continuous, extensive communication is therefore necessary, concerning the causes of the reservations made by the palaeobiologist, in order to improve the mutual understanding between the two disciplines.

The fossilization processes have to be reconstructed from the study of the available end-products and their relations to the surrounding sediment. To a palaeontologist it is obvious that organisms are preserved as fossils only under exceptional circumstances; the incompleteness of the fossil record is almost a dogma in palaeontology (Rolfe & Brett 1969). It is essential that this fact be fully appreciated by the archaeologist as well.

The aim of this paper is to illuminate some of the several important processes involved in the conversion of a former living organism into a fossil. The science dealing with these processes was called *taphonomy* (*Taphos* = funeral; *nomos* = history) by Efremov (1940) and the subject has later been trated by Behrensmeyer (1975, 1985), Clark *et al.* (1967), Efremov (1953), Lawrence (1968), Müller (1951, 1963), Noe-Nygaard (1975 a, 1977), Olson (1971), Olson & Beerbower (1953), Schäfer (1962), Voorhies (1969), Gifford (1983) and many others. Lately Schiffer (1983) and Kristiansen (1985) have made parallel studies on identification of formation processes of archaeological material.

Taphonomy is the study of the transition in all its details of animal remains from the biosphere into the lithosphere (Efremov 1940, p. 85). It thus deals with the post-mortem relations between organic remains and their external environment. Lawrence (1968) outlined the environmental aspects of palaeontology (fig. 1). Taphonomy comprises two subdisciplines: biostratinomy and diagenesis. Biostratinomy explores the ef-

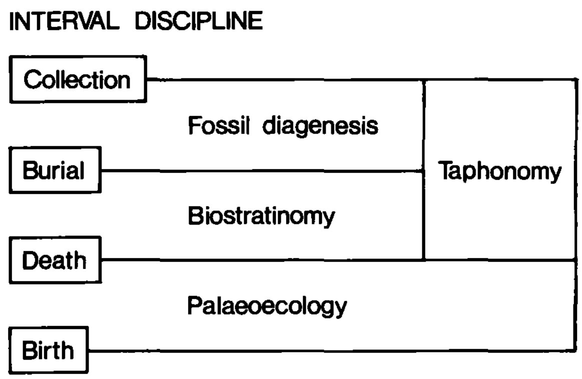


Fig. 1. The environmental aspects of palaeontology. Disciplines based upon time interval in the history of the organism or the organisms being studied (modified from Lawrence 1968).

fects of the surroundings upon organic remains in the interval between the death of the animal and its final burial. Diagenetic studies may unravel post-entombment effects upon organic remains (Lawrence 1971; Müller 1963).

Efremov (1940) expressed the relationship between taphonomy and palaeoecology very clearly. The ultimate goal of palaeoecology is the reconstruction of ancient communities, whereas taphonomy is concerned with post-mortal processes. Taphonomic considerations should be a prerequisite for palaeoecological studies, and the neglect of taphonomy leads to errors in palaeoecological results (Efremov in Dodson 1971). A major aim of analysing faunal remains from archaeological sites is the reconstruction of the palaeoecology of early man. Since taphonomic work thus by definition precedes palaeoecological work, archaeological studies would certainly benefit from more firmly based taphonomic studies of the deposits and their fossil content.

In archaeological deposits the post-mortem events comprise two types of taphonomic factors. The first is connected with a 'normal' death assemblage, such as losses through non-preservation and losses through current transport. The second type includes selective transport of special prey animals from the site and complete destruction of individuals belonging to certain species.

A flow chart showing the formation of the fossil assemblage from the death assemblage is shown on fig. 2. The influence of man is of major importance at several levels of the scheme.

He acts firstly as a biotic factor, influencing the size and composition of the animal populations by selective killing and eventually some cases even causing local or complete extinction of certain species (*e.g.* Aaris-Sørensen 1980 a). Secondly, he has interfered as a thanatic factor by the various ways of killing especially the locus of killing; and, thirdly, as a predator, responsible for the initial death assemblage.

Later the human factor plays a very important role in preventing or delaying the members of the death assemblage from entering the fossil assemblage by using the material in tool and food processing. Finally modern man is an important factor, contributing with collection and identification biases.

In the attempt to estimate human beings as a taphonomic factor in archaeological deposits it is of importance first to understand the taphonmic factors working

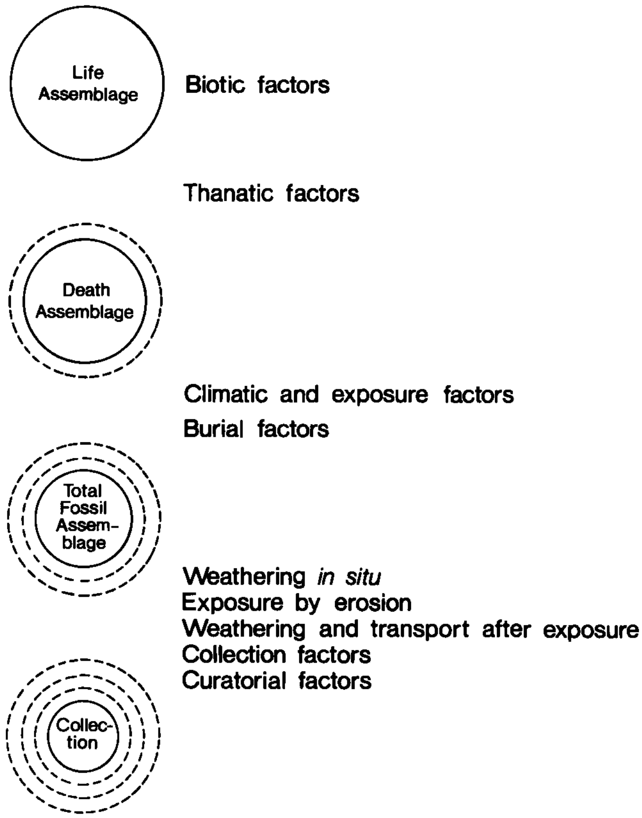


Fig. 2. The possible pathway from a living population to a sample of fossils. The different factors act differently on each species in each sample. The diameter of the circles is thus not representative for the assemblages (modified from Clark *et al.* 1967).

on a natural death assemblage. The processes of preservation and transport must be understood before definitive reconstructions can be made at a higher level of complexity. It is of equal importance to have a firm knowledge of the mode of life and habitat requirements of the animals. In the following each of the factors listed in fig. 2 will be highlighted with emphasis on the role of man.

BIOTIC FACTORS

Biotic factors are defined by Clark *et al.* (1967, p. 155) as those factors which determine whether or not a population of any particular species will inhabit an area.

The age structure of the life assemblage is determined by the relations between birth rate, death rate, growth rate and the start of sexual maturity (Craig &

Oertel 1966). Reliable data on population dynamics are only available for a small fraction of modern mammal species and for an even smaller percentage of fossil species. An example is the detailed study of population dynamics of subfossil cave bear by Kurtén (1953).

In palaeoecological studies of Quaternary vertebrate faunas, the advantage of dealing with living species is obvious as opposed to the problems dealing with faunas of extinct vertebrate species from earlier geological periods.

The palaeoenvironment of the Quaternary species should be reconstructed, however, on the basis of a broad spectrum of geological disciplines, such as geomorphology, sedimentology, geochemistry, and palynology in addition to deductions based on the subfossil bone material alone. It is therefore advisable to combine modern population studies on the species concerned, with the knowledge of the palaeoenvironment deduced from the geological information.

Many factors must be taken into consideration in order to evaluate the preservation potential of a given species, and to interpret the reasons for its presence at a site correctly. When dealing with vagile animals, immigration and emigration may have an important influence together with the fundamental population characteristics. A detailed population study on red deer from the island of Rhum, Great Britain, was made by Clutton-Brock *et al.* (1985), and Koike (1987 a, 1987 b) made a comprehensive study of estimating Prehistoric hunting rates based on age composition of Sika Deer. Strandgaard (1972) undertook a population study on modern roe deer from Kalø in Jutland, Denmark. This last mentioned investigation might serve as an example of the kind of population study that is a necessary premise for the palaeoecological reconstruction based on the extremely biased samples collected in postglacial deposits, and it will therefore be reviewed in some detail.

The aim of Strandgaard's investigation was to determine the factors regulating the size of the roe deer population in an area of 400 hectares of suitable biotope. No shooting took place within the investigation period of 3 years. The area of investigation comprised 165 hektares of forest land and 235 hectares of farmland. During the whole period from 1966–68 there was a total of 156 individuals of an age of 6 months or more in the area. The size of the population per year varied between 96 and 112. The roe dear is a stationary territorial animal; thus gains to the population almost exclusively comprised fawns born and reared in the area. Population losses could be ascribed to different reasons, the most important of which were emigration and death caused by accident or illness. The reasons were both age and sex specific. For 1–2 year males and 1 year females emigration was the only important factor, while the majority of losses was due to death resulting from illness or accidents for the 3–11 years old males, and for the 2–13 years old females. The sex ratio of fawns was close to 1:1 until nine months of age. Among the adult animals the populaton had stabilized at a ratio of one male to two females.

On the basis of this information it is possible to draw a curve of the theoretical age distribution in a population where emigration is unhindered and where no shooting takes place (fig. 3). It can be seen from the figure that the annual emigration rate is higher for males than for females in the ½–1½ year class. It is almost 50% for males as opposed to 30% for females in the same age class. From the two curves in fig. 3 it is possible to calculate the number of animals in each age class that are lost from the population.

The emigration factor which regulates the size of the population is of a different nature in the two sexes. In the case of males the same territory can be held for the adult life span of an individual. If none of the older males dies, there will thus be no chance for young bucks to establish themselves within a certain territory, and they will have to migrate to find a new territory in a suitable biotope, sometimes far away. These emigrating young males often have to pass through areas with only little cover and they are therefore more exposed to attacks by enemies such as man and other predators.

In the case of females the relationship between mother and daughter ceases to be friendly when the mother is going to give birth to the new fawn, and the young female has to leave the mother and find her own foraging range.

The population regulating factors are thus partly of social character, but the available food is also a major regulating factor. In areas where feeding conditions are favourable the population density may be high. In the Kalø population grass and clover are the most important food plants. During spring and early summer the cover of grass and herbs in the still open forest is of great importance. The white wood anemone is particularly important as a source of vitamin-C, as the roe deer is unable to produce this vitamin itself (Lydiksen 1972). During winter time, buds and shoots serve as the main food source, not to mention the beet heaps.

Within the area examined at Kalø a stable population of 100 animals, was able to exist where three quarters of the territory was covered with grass when there was the supplementary possibility of feeding on beet heaps. A further premise was that there was no shooting and that migration was free.

In the Mesolithic period in Denmark the grass-covered areas were probably not as extensive as they are in the open farm land of today, but rather the dense mixed forest covered large areas leaving limited space for grazing areas (Troels-Smith 1942; Iversen 1967). Migration was as free as the forest allowed but the growth of the human population led to increased hunting pressure. This combined with the increasing density of the forest might have resulted in reduction in the population size of game animals. Certain species such as aurochs and to some extent elk, as well as some birds, were totally eradicated by the combined effects of man and environmental changes.

For comparison it should be mentioned that today 35,000 roe deer are shot every year in Denmark, and the population has never been so large as it is now owing to the large areas covered by farm land (Strandgaard, pers. comm. 1975). In the Mesolithic period where the feeding possibilities were less favorable than today, the territories had to be larger, to sustain the same number of animals. The available biotopes were fewer in number, and they could not house so many animals. The total population of roe deer in Denmark probably was thus considerable smaller in the Mesolithic period than it is today.

Lack of food might lead either to expansion of territories or, where this is not possible, to reduced fertility. In order to avoid overpopulation the females may give birth to only one fawn instead of the normal two (Strandgaard 1972, p. 167). The climatic factors are of importance in winter time when food becomes scarce, and it is not uncommon to find animals starved to death in early spring after a period of severe frost. Most of the modern roe deer population survive on the beet heaps in the farm land areas and on the heather *Calluna* in the moor areas during winter time. In the Mesolithic period winter foraging might have been difficult in the dense forest. Red deer and roe deer might have been forced to gather in great numbers around lakes, water courses and at the edge of woods. They would thus have been an easy targets for the Mesolithic hunter who in this way might have contributed to the postulated decrease in game animals during the Atlantic period.

Predators on roe deer in modern Denmark are fox, stray dogs and man. The effect of man has been mentioned and no available data exists about the influence on the roe deer population of fox and dog, although a considerable number of premature dead roe deer was recorded as killed by dog in the records at the Game Biological Station at Kalø. Probably they play only a negligible role in a healthy population. If predation occurs, it will probably affect the juveniles and thus increase the already considerable mortality in this part of the population, as previously stated.

THANATIC FACTORS

Thanatic factors are defined by Clark *et al.* (1967, p. 155) as the factors surrounding an animal's death determining whether or not its body will arrive upon the surface as a member of the death assemlage (fig. 2). As thanatic factors mortality relative to age, causes of death and locus of death should be mentioned. The normal causes of death are disease, physical accident, poison, starvation, predation and when man is involved killing by weapon and traps.

Causes of death

From a relatively stable living population, such as the one described from Kalø by Strandgaard (1972) with known emigration and immigration rates, it is possible to calculate the age composition of the bodies derived from it by constant death. Like many other species, the roe deer had a high juvenile mortality (fig. 3). In the population of 42 males the loss from the ½–1½ year group was 19 = 42%, most of them were shot or otherwise killed.

Different types of mortality may result in death assemblages with different age composition in relation to the life assemblages. Three types can be distinguished:

1. Mass mortality caused by instant killing of the whole population resulting in a death assemblage identical to the life assemblage. As examples can be mentioned poisoning, flooding or massacre such as total slaughtering of a herd of e.g. bison. The latter herds

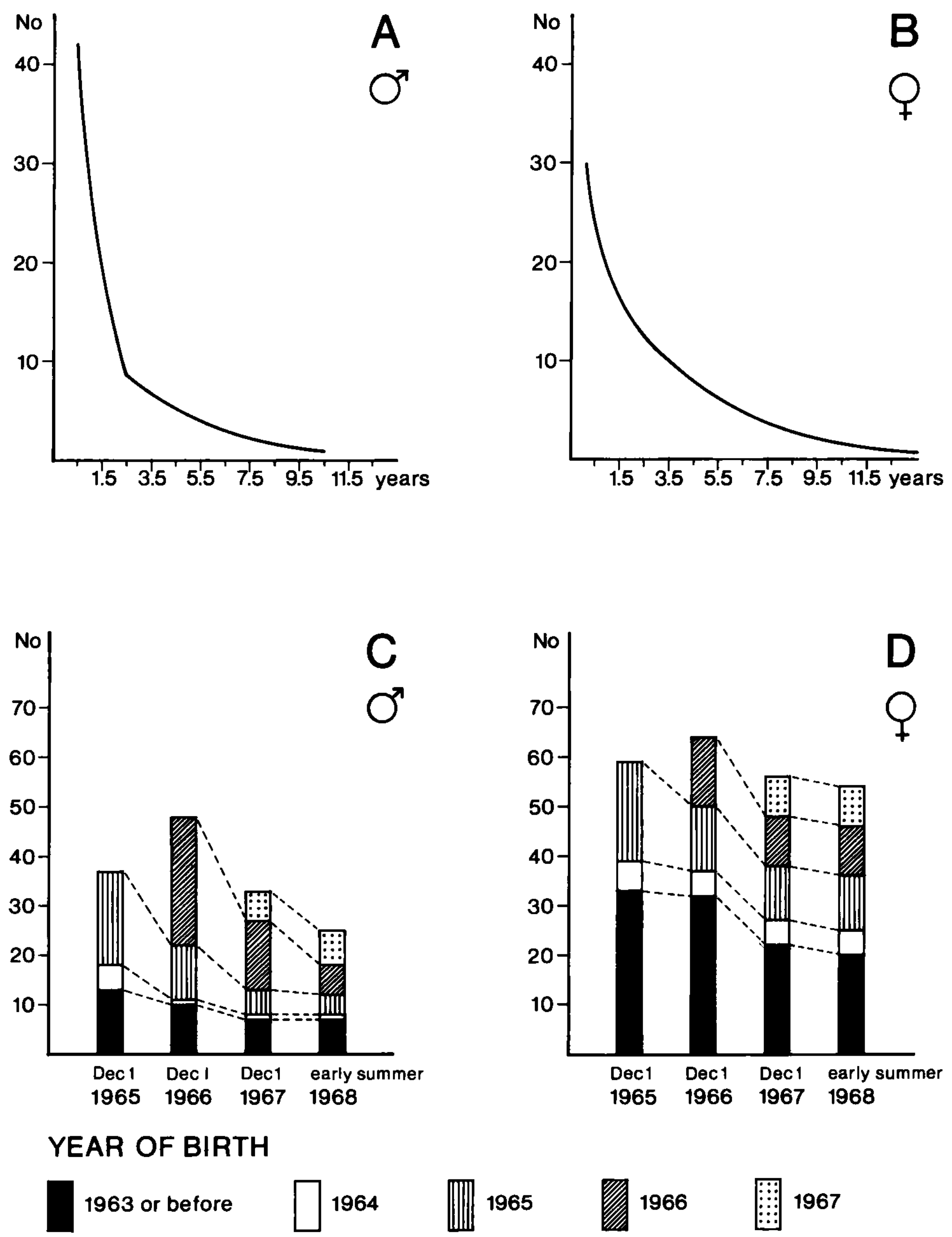


Fig. 3. A, B: Theoretical curves of age class distribution in a roe deer population free from shooting and with unhindered emigration. C, D: The turnover in the male and female roe deer population of the Ringlemose Forest, Kalø (modified from Strandgaard 1972).

commonly included thousands of animals of all age groups.

2. The attritional mortality owing to steady death within the population throughout the year. The resulting death assemblage of this natural mortality thus results from the combined effect of birth rate, growth rate and death rate.

3. Seasonal mortality is a variety of the natural mortality. It is caused by pronounced fluctuations in the mortality rate throughout the year. Factors causing seasonal mortality may be drought, freezing over of the feeding grounds, or seasonal hunting by man.

Thus a death assemblage composed of individuals that have died in a mass mortality directly reflects the age composition of the living population. A death assemblage composed of individuals that died naturally reflects the age composition of the turnover in a population. A death assemblage composed of animals that died seasonally reflects neither the age composition of the natural population nor the age composition of the long-term turnover. It is thus important in the analysis of the population dynamics of fossil material to be able to distinguish a seasonally accumulated death assemblage from the others. This is in many cases possible by careful examination of the seasonal indicators in the fossil fauna. Seasonal mortality may often be the prevailing type in accumulations influenced or made by man. The various seasonal indicators are described below.

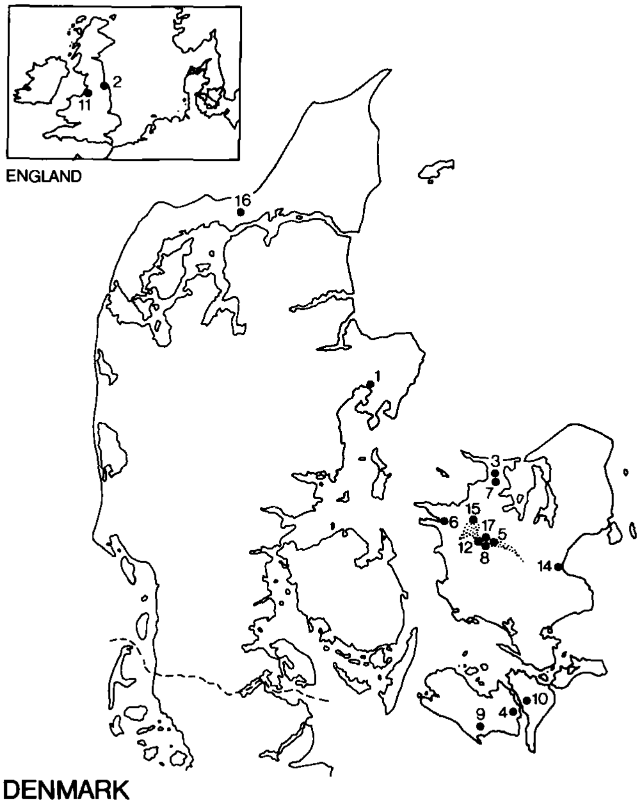


Fig. 4. Map showing the geographic position and dating of the sites mentioned in the text. 1, Kalø. 2, Star Carr. 3, Vig. 4, Grænge Mose. 5, Muldbjerg. 6, Aldersro. 7, Prejlerup. 8, Storelyng VI. 9, Skottemarke. 10, Taaderup. 11, High Furlong. 12, Præstelyngen. 13, Aamosen (shaded area). 14, Ølby Lyng. 15, Kongemosen. 16, Brovst. 17, Ulkestrup Lyng.

Time of death

It is of importance to be able to distinguish between the different types of death assemblages. Only assemblages caused by mass mortality or by natural, attritional mortality can be used directly in population studies. Assemblages influenced by seasonal mortality may give useful information on the ecology of the involved species but it is too variable to give useful information about population dynamics. Analysis of seasonal indicators can be used as a method to distinguish the different types of death assemblage.

Several taphonomic factors are acting on a death assemblage comprising seasonal accumulations of bones. Firstly, different animals are available at the various seasons throughout the year. Secondly, the human interest in the various animals commonly change with the different seasons. During the winter deer antlers may be the aim of the hunters as well as fur animals, whereas the main target during the summer is the soft skin of the calves, fish and birds, and in both cases the food of course. Thirdly, the effect of the weathering and exposure on the bones varies with the ontogenetic age of the bones, and the duration of exposure, the juvenile bones being more easily weathered than the hard bones of adult animals. Fourthly, the rate at which the bone material is buried may change with the season. During winter time it is likely to take longer to cover the bones with sediment. The bones may be accumulated on the ice of a lake or if deposited in water the slow rate of sedimentation will delay the burial of the bones.

The seasonal migration of some animals such as birds, reindeer, salmon and trout, influences the composition of the population on a certain locality at a given time and thereby on the selection available to the stone age hunter. The palaeobiologist's sample will show a bias with over-representation of some species and under-representation of others when compared with a sample representing the annual average. On the other hand it is of paramount importance to be able to determine from the bone deposits at which time of the year a certain site has been populated in order to establish the interrelationship between the hunter and his surroundings. It is important to realize that some seasonal indicators are more easily recognized than others (Noe-Nygaard 1969, 1977, 1983; Payne 1972).

Summer time indicators are several, such as the occurrence of seasonally migrating animals and juveniles of both birds and deer. Winter time seasonal indicators are fewer and less easily recognized. Of the few positive indicators, certain migrating species, and skulls with unshed antlers of red deer, elk and reindeer should be mentioned. It is even more difficult to determine whether a particular site has been inhabited only at one season, or repeatedly, at the same season, over several years. Furthermore, the same site may show signs of both winter and summer habitation without necessarily having been permanently inhabited, e.g. the preboreal Star Carr site (Noe-Nygaard 1975a, b). The site may have been visited on several occasions throughout the year for different purposes.

Migrating species as seasonal indicators. In many countries, such as Denmark, bird migration is of considerable importance to the seasonal standing population. A great number of summer visitors arrive to breed in spring, but fly south for the winter; other species arrive as guests from the north to winter in Denmark. Some species visit the country only briefly in transit during the spring and autumn migrations, while still other species are basically resident the whole year, although their numbers may increase dramatically by the addition of migrating individuals at various seasons. Furthermore, the climate of Denmark in the Mesolithic period was altogether warmer than now, leaving the possibility for more species to winter in the country (Løppenthin 1967). It is thus obvious that extreme care has to be taken in deductions based on only one or a few fragments, and in the light of possible differences between seasonal behaviour of birds today and in Mesolithic Denmark. It happens that a species changes its way of living during time; a resident bird may become a migrator and vice versa; other birds may have changed biotope, particularly in response to environmental changes caused by man. A comparable illustration example among the insects is the beetle *Bembidion glacialis* which is nocturnal in Denmark, whereas the population introduced into Greenland has changed its life habit to day activity on south facing escarpments (Henriksen 1933).

Among fish the extensive migration of the salmon and the eel are well known and involves both fresh water and the sea; but the former spawns in fresh water and the latter in the sea. Many other fish change biotopes during the year and may only be used with caution as seasonal indicators. Several mammals also migrate; an obvious example is the reindeer, but various sea mammals are also migratory.

The breeding period. In most animals the breeding period is short and clearly defined. This is true for most of the birds, and finds of juvenile bones and even egg-shells are good seasonal indicators. The leather-like egg-shells of the water tortoise *Emys orbicularis* have been found in several Mesolithic deposits, e.g. in the Aamose Bog (fig. 4) (Degerbøl & Krogh 1951).

Daily growth lines and spawning rings observed between the year rings on bivalve shells may be used to establish the time of the year at which they died, assuming that the time at which a year ring is formed is known for the species (Coutts 1970; Deith 1983; Koike 1980; Meehan 1982; Noe-Nygaard *et al.* 1987).

The most common prey animals in the Mesolithic period in Denmark are red deer, roe-deer, wild boar, elk and aurochs. They all have a short birth period of about one month except for aurochs. The occurrence of juvenile bones or teeth in eruption in skulls of these animals are important seasonal indicators (Noe-Nygaard 1969; Richter in Andersen *et al.* 1982). With knowledge of the biology of the different species it is often possible to estimate the time of year at which such young animals were killed within a couple of months.

Epiphyseal fusion. It is of great importance to be able to distinguish juvenile and adult bones and to precisely estimate the ontogenetic age of the juvenile bones. Characteristic features of juvenile bones are the loose epiphyses, the porous structure of the bone wall, and the rough mat surface of the bone. There are no marked muscle attachments and the marrow cavities are filled with marrow with red corpuscules and spongy bone tissue at the ends. The longitudial fusion of the metapodial bones in the Cervidae is not completed in very young animals. In contrast, bones from adults have a shining hard surface with well developed muscle attachments. The epiphyses and the diaphyses are furthermore completely fused, sometimes with obliteration of the articulation seam. The marrow cavity is wide, free of spongy tissue, filled up with marrow and the bone walls are thick. The adult bone is heavy whereas in theherontic bone resorption of the bone wall gradually reduces the weight of the bone and produces a very wide marrow cavity (fig. 6).

With the different species the adhesion and later fusion of the epiphyses to the diaphyses takes place at different times for the various bone elements. It is necessary to know the species in order to determine the ontogenetic age of a juvenile bone. In species with marked

Table 1 | **Epiphyseal fusion**
Sex: Female | *Capreolus capreolus*

Age in months	*0.25*	*0.5*	*6*	*10*	*10*	*12*	*18.5*	*20*
Maxilare tooth row	*dp2* *dp4*	*dp2* *!* *dp4* *(m1)*	*dp2* *dp4* *m1*	*dp2* *dp4* *m1* *(m2)*	*(d)p2* *(d)p4* *m1* *m2*		*p2* */* *m3*	*p2* *m3*
Dentale tooth row	*dp2* *dp4*	*dp2* *dp4* *(m1)*	*dp2* *dp4* *m1*	*dp2* *dp4* *m1* *(m2)*		*(d)p2* *(d)p4* *m1* *m2*	*p2* */* *m3*	*p2* *m3*
Cervical vertebrae, prox.	/	-	-	-	+	-	-	+
Cervical vertebrae, dist.	-	-	-	-	+	-	-	/
Thoracic vertebrae, prox.	/	-	-	-	+	-	-	/
Thoracic vertebrae, dist.	/	-	-	-	/	-	-	/
Lumbar vertebrae, prox.	-	-	-	-	/	-	-	-
Lumbar vertebrae, dist.	-	-	-	-	+	-	-	-
Scapula	-	-	+	+	+	+	+	+
Pelvis	-	-	+	+	+	+	+	+
Humerus, prox.	- d	- d	-	- /	- +	/	?	
Humerus, dist.	- d	- d	+	+	+	+	+	
Radius, prox.	-	-	+	+	+	+	+	
Radius, dist.	-	-	-	-	-	-	/	
Ulna, prox.	-	-	-	-	-	/	/	
Femur, prox.	- d	- d	/ d	-	-	/	/	
Femur, dist.	- d	-	-	-	-	-	/	
Tibia, prox.	- d	-	/	-	-	-	-	
Tibia, dist.	-	-	-	-	-	-	+	
Metacarpus fused	+	+	+	+	+	+	+	
Metatarsus fused	+	+	+	+	+	+	+	
Metacarpus, prox.	+	+	+	+	+	+	+	
Metacarpus, dist.	-	-	-	-	-	-	/	
Metatarsus, prox.	+	+	+	+	+	+	+	
Metatarsus, dist.	-	-	-	-	-	-	-	
Calcaneus	-	-	/	-	-	+	+	+
Phalanges	-	+	+	+	+	+	+	+

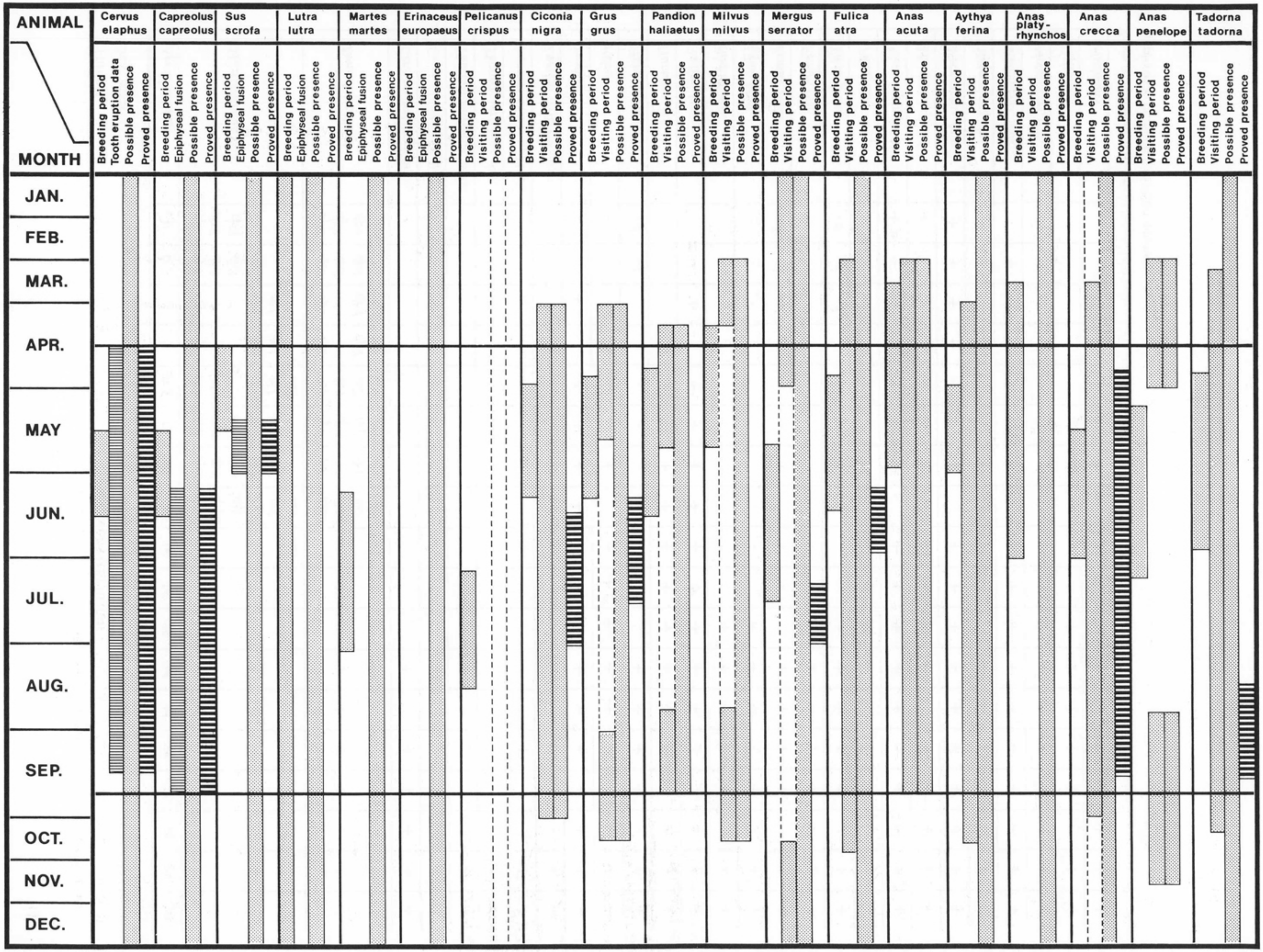
Table 1. The time in month of epiphyseal fusion for female *Capreolus capreolus*. - = not fused; + = fused; / = fused but with wide open suture; d = the epiphysis in question is divided into two.

Table 2
Sex: Male

Epiphyseal fusion
Capreolus capreolus

Age in months	*0*	*0.5*	*3*	*5*	*9.5*	*12*	*12*	*13*	*16*	*18*	*22*	*24*	*24*	*24*	*24*	*24*	*29*	*30*
Maxilare tooth row	*dp2 dp3 dp3 dp4*	*dp2 dp3 dp3 dp4*	*dp2 ! ! dp1 m1*	*dp2 ! ! dp4 m1*	*dp2 ! ! dp4 m1 m2*	*dp2 dp4 dp4 m1 m3*	*dp2 dp4 dp4 m1 m3*	*(d)p2 (d)p3 (d)p3 (d)p4 m1 m3*	*m3*	+	+	+	+	+	+	+	+	+
Dentale tooth row	*dp2 dp3 dp4*	*dp2 dp3 dp4*	*dp2 ! dp4 m2*	*dp2 ! dp4 m1*	*dp2 dp4 m2 m1*	*dp2 dp4 m1 m2*	*p2 p4 m1 m3*	*(d)p2 (d)p4 m1 m3*	*m3*	+	+	+	+	+	+	+	+	+
Cervical vertebrae, prox.	-	-	-		-	-	-		-	-		+	/	+	+	+	+	+
Cervical vertebrae, dist.	-	-	-		-	-	-		-	-		-	/	/	/	-	+	+
Thoracic vertebrae, prox.	-	-	-		-	-	-		-	-		-	/	/	/	/	+	+
Thoracic vertebrae, dist.	-	-	-		-	-	-		-	-		-	-	+	/	-	/	+
Lumbar vertebrae, prox.	-	-	-		-	-	-		-	-	/	-	/	+	/	/	+	+
Lumbar vertebrae, dist.	-	-	-		-	-	-		-	-	-	-	/	+	/	-	+	+
Scapula	-	-	+ /		+	+	+	+	+	+		+	+	+	+	+	+	+
Pelvis	-	-	/		+ /	+	+		+	+ /	+ /	+	+	+	+	+	+	+
Humerus, prox.	- d	- d	-		-	-	-	-	-	-	-	+	+	+	+	/	+	+
Humerus, dist.	-	-	/		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Radius, prox.	-	-	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Radius, dist.	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	/	+	+
Ulna, prox.	-	-	-		-	-	-	-	-	-	+	+	+	+	+	/	+	+
Femur, prox.	- d	- d	- d		-	-	-		-	-		+	+	+	+	/	+	+
Femur, dist.	-	-	-		-	-	-		-	-	+	+	+	+	+	/	+	+
Tibia, prox.	- d	- d	- d		-	-	-		-	-	+	+	+	+	+	/	+	+
Tibia, dist.	-	-	-	-	-	-	-		/	+	+	+	+	+	+	+	+	+
Metacarpus fused	+ /	+	+	-	+	+	+		+	+	+	+	+	+	+	+	+	+
Metatarsus fused	+ /	+	+	-	+	+	+		+	+	+	+	+	+	+	+	+	+
Metacarpus, prox.	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
Metacarpus, dist.	-	-	-	-	-	-	-		-	-	+	+	+	+	+	+	+	+
Metatarsus, prox.	-	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
Metatarsus, dist.	-	-	-	-	-	-	-		-	-	+	+	+	+	+	+	+	+
Calcaneus	-	-	-	-	-	/	/		-	-	+	+	+	+	+	/	+	+
Phalanges	-	-	-	-	+	+	+		+	+	+	+	+	+	-	+	+	+

Table 2. The time in month of epiphyseal fusion for male *Capreolus capreolus*. - = not fused; + = fused; / = fused but with wide open suture; d = the epiphysis in question is divided into two.


ANIMAL
MONTH
Cervus elaphus
Capreolus capreolus
Sus scrofa
Lutra lutra
Martes martes
Erinaceus europaeus
Pelicanus crispus
Ciconia nigra
Grus grus
Pandion haliaetus
Milvus milvus
Mergus serrator
Fulica atra
Anas acuta
Aythya ferina
Anas platy-rhynchos
Anas crecca
Anas penelope
Tadorna tadorna
Breeding period
Tooth eruption data
Epiphyseal fusion
Visiting period
Possible presence
Proved presence
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.

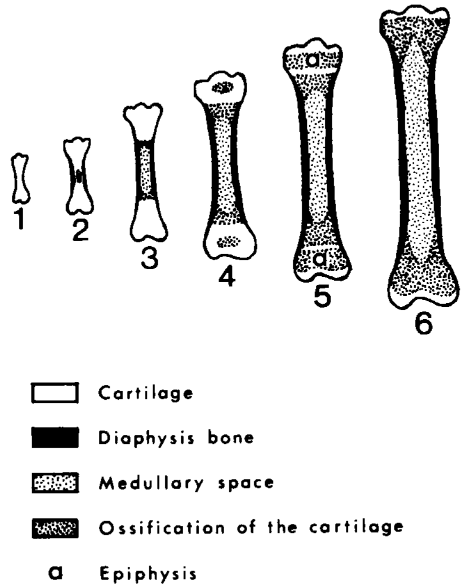


Fig. 6. Growth of long bones of mammals. During the growth of the cartilaginous bone (1) a collar of the hard bone of the diaphysis extends (2)–(3). At the ends there are formed ossified nuclei of the epiphyses (4), which increase to the epiphyseal line (5). Then the latter disappears (6). The bone has finished its longitudinal growth. The medullary space enlarges and the wall of the bone thickens by deposition of bony matter on the surface (modified from Schmid 1972).

sexual dimorphism the same skeletal element may fuse at different times in the two sexes. This has been shown to be valid for man also (Andersen 1968). With reference to animals, see also Lewall and Cowan (1963) and Watson (1978).

Epiphyseal fusion of modern roe-deer was examined by me on material collected from several places especially the neighbourhood of the game-biological station at Kalø, Denmark (fig. 4).

The day on which the animals were shot, and the ontogenetic age at the time of killing was known precisely as most of them were ear-marked at birth. Altogether 26 more or less complete skeletons were examined, comprising 18 males and 8 females, all of which aged under 2½ years (tables 1 & 2). For each animal the dentition was examined, and the degree of epiphyseal fusion was recorded for each bone. In case of bifurcation of the epiphyses their fusion was recorded as well.

The data showed that there is a marked difference in time for the fusion of the epiphyses of the various bone elements. Even within the same bone, e.g. humerus, the proximal epiphysis fuses at an age of 22–24 months, whereas the distal epiphysis fuses at an age of 3–9 months (tables 1 & 2). The hinge joints fuse earlier than the ball joints. As an example the hinge joint of the distal end of humerus and the proximal end of radius fuses at an age of approximately 3 months, whereas the proximal epiphysis of the ball joint fuses with scapula at an age of 22 months. It is thus possible to estimate at which time of the year a young roe deer was killed on the basis of the stage and nature of epiphyseal fusion (tables 1 & 2). For animals which have not yet reached the age of 2–2½ years it is possible to estimate the ontogenetic age of a bone within a range of 3 months. At the Danish Mesolithic site Præstelyngen (fig. 4) the ontogenetic age of roe deer bones was estimated on the basis of the stage of epiphyseal fusion. This can then be used as evidence of time of occupation of the site (fig. 5). After the age of 2½ years all the epiphyses are fused and no age estimation can be made on this basis. However, yearly growth rings have been described in the shaft of the long bones (Klevezal & Kleinenberg 1967; Morris 1972), but no attempts have yet been made to use this knowledge on subfossil material.

Tooth eruption and annular structures of dental cement are useful features in estimating both the ontogenetic age of a mammal and the time of the year at which the animal was killed (fig. 7). This has in Denmark been convincingly demonstrated by Grue and Jensen (1979) who also pointed out the limits of the method.

Young mammals are characterized by the possession of milk teeth. These are later replaced by permanent teeth and the eruption of the molars is initiated. The time of replacement of milk teeth and molar eruption is characteristic for each species. Red deer completes replacement and molar eruption within an age of 33–36 months (Strandgaard 1972) and Aitken (1975). It is thus possible to estimate the age of a red deer which has not obtained a full permanent dentition with the precision of two months. In Danish subfossil material the molar and mandibular tooth row is a common fragment of the skull. Ontogenetic age groups of 3–6 months, 6–12 months, 12–18 months, 18–24 months, and 24–30 months can be established on the basis of measurements of upper as well as lower tooth rows (Noe-Nygard 1969). After complete permanent dentition has been obtained age estimations can be made by evaluation of tooth wear (Lowe 1967). This method demands much experience, however, and gives rather inexact results.

Fig. 5. Determination of the seasonal inhabitation period at the Mesolithic site Præstelyngen. All available seasonal indicators are used. Dotted signature indicates breeding period, as well as possible presence of the animal on the site. Thick horizontal lines indicate the proved presence of the animal on the site. Thin horizontal lines indicate time of occupation based either on tooth eruption or on epiphysial fusion. The two long horizontal lines delimit the season in which the habitation took place.

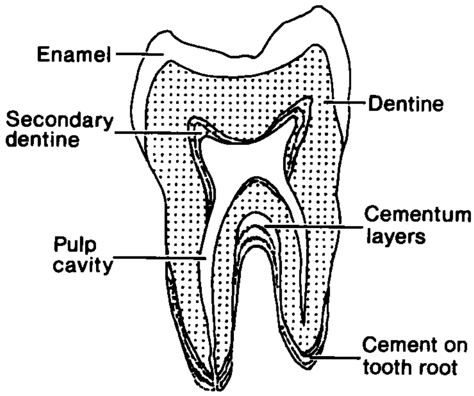


Fig. 7. Vertical section through a molar tooth of red deer showing major components and position of incremental lines in cement and secondary dentine (modified from Morris 1972).

A more effective method is to study annular increment lines in the dental tissue, in much the same way as growth increments can be measured in fish scales, fish otoliths, tree rings, and bivalve shells. Growth layers in the dental cement allow the establishment of age classes for fully grown deer. It is furthermore possible to determine at which time of year the growth layers were formed. Among the first to use the method were Sergeant & Pimlott (1959) in a study of elk, and Klevezal & Kleinenberg (1967) reviewed the whole subject of age related stratification in the structure of teeth and bone. Both Mitchell (1967) and Lowe (1967) have used this method with good results.

Both dentine and cement are characterized by appositional growth, being continuously formed around preexisting tooth material (fig. 7). The cement is laid down around the outer side of the roots to provide better anchorage in the jaw. The odontoblasts in the tooth pulp produce dentine which is deposited on the walls on the tooth cavity. The layers can be correlated with regular events in the animal's life and their number is a guide to the ontogenetic age (Morris 1972; Grue 1979).

Shed and unshed antlers. The yearly antler cycle of elk, roe deer, red deer and reindeer offers a good seasonal indication.

On the site Star Carr the time of habitation was established on the basis of the development of antlers of the various species (fig. 89 in Clark 1954). Juvenile bones were, however, not taken into consideration. By applying this procedure only one period of habitation was recorded, namely winter time. Estimation of the age of the juvenile bones by me indicated a further habitation period during late summer and early autumn (Noe-Nygaard 1975 b). This time of habitation agrees well with the considerable number of skulls of roe-deer with unshed antlers that were figured but not taken into consideration by Clark (1954, fig. 31).

It can thus be concluded that a relatively safe estimate of the period of habitation of a settlement can be reached through the combined use a number of different techniques. In fig. 6 the period of habitation of the Mesolithic settlement Præstelyngen is estimated by combining several of the methods mentioned.

The locus of death

The place where an animal dies is considered a thanatic factor (fig. 2). The various sedimentary environments have different preservation potentials. Important factors are sedimentation rate, pH, and the degree of oxygenation. Thus the locus of death greatly influences the possibilities of an animal body passing into a fossil assemblage from the death assemblage (defined by Clark *et al.* (1967) as the total sum of corpses present on the surface of a sedimentary unit ready for burial). Aquatic organisms and those living near water are more prone to rapid burial. Consequently they constitute the greater part of the fossil record. This includes in particular those organisms that live in the sea, but also those in or near streams, lakes and swamps.

In this paper only calcareous, eutrophic lake and bog deposits are dealt with in further detail, whereas shellheaps and dry-land deposits are only briefly mentioned for comparative reasons. Some other types of depositional environments not influenced by man are listed below.

Dry land deposits. Most land-mammals die on dry land, but the preservation potential in this environment is very low due to the exposure to weathering and scavengers. The possibilities of rapid anoxic burial are few. Among dry land burial agents earth slides and wind blown sand may be mentioned, but even after burial the sediments are commonly well oxygenated thus allowing biological decomposition. Rapidly moving pore waters may cause chemical solution of bones. Terrestrial animals may in cases of drought gather around water holes resulting in concentration of bones (Conybear & Haynes 1984).

Bog deposits. Few larger mammals actually die in bogs, but the preservation potential may be very high. The animals will often have died by accident. Stagnant eutrophic water and a relatively high sedimentation rate will normally result in very good preservation. Oligotrophic acid bogs offer good preservation conditions for skin, hide and horn, whereas bone and woody material are commonly well preserved in more eutrophic, basic and neutral bog types.

Material from Danish bogs is described below.

Lake deposits. The number of larger mammals that die in lakes is limited, although hunted, wounded and old animals often seek the water, as may be the case with the aurochs from Vig (Noe-Nygaard 1973, 1974; Aaris-Sørensen 1984). Accidents constitute the major reason for accumulation of larger mammals in lakes. Thin ice cover is for example responsible for the death of many deer. The preservation potential is rather high, but variable due to the microbiological activity in the lake.

River deposits. Animals down in rivers because of flooding, thin ice, carelessness when drinking or during crossing. The preservation potential is variable and most of the material will be subjected to transport. The bone deposits commonly accumulate as lags in channel floor deposits of sand or gravel and may form bone beds.

Near-shore marine deposits. The preservation potential is variable depending on the rate with which the dead body is covered by water, sand or mud. If the dead animal is fat it may float in the waters for weeks aided by development of gas within the putrifying corpse. It will slowly disintegrate and the bones drop to the bottom one by one. Lean animals sink to the bottom more rapidly and thus have a higher chance for rapid burial, and thus a higher preservation potential (Schäfer 1972). Transport and redeposition are important taphonomic agents in high-energy environments.

Cave deposits. Many species of mammals are found in cave deposits where the preservation potential may be high. The faunal assemblages accumulated in caves represent a broad spectrum of the existing fauna often mixed with bone debris left by man. Stalagmitic limestone serves as the preservation medium. However, in some caves nothing is preserved or preservation is by mumification.

TAPHONOMIC FACTORS

Taphonomic factors, which can be described under the disciplines biostratinomy and fossil diagenesis, are those operating during the transition of a death assemblage into a total fossil assemblage until the moment of collection. The total fossil assemblage is defined by Clark *et al.* (1967, p. 155) as the sum total of fossil specimens entombed within any particular sedimentary unit in the area in question.

The first step from death assemblage to fossil assemblage involves taphonomic factors such as climate, degree of exposure, sedimentation rate, time intervals between episodes of sedimentation, lithology and grain-size, thickness of sediment cover, compaction, post-depositional action of roots and burrowing animals, permeability, and pH of permeating solutions.

The effect of some of these factors is described below, and special emphasis is placed on man as a taphonomic factor.

Climate and exposure

Climate and degree of exposure are of importance for the preservation potential of animal bones (Behrensmeyer 1978). Variable climatic conditions lead to selective destruction of bone and teeth owing to differences in resistance to weathering. It is well known that different bones of the mammalian body are preserved with different frequency in fossil and subfossil deposits (Voorhies 1969; Binford 1983). The various parts of the vertebrate skeleton have different functions and correspondingly have different structure and shape. Consequently there is a great variety of possible post mortem processes which affect the bones before burial. Knowledge of these processes and their results may be of considerable value in reconstructing aspects of the environments in which vertebrates were buried.

Experiments and observations of the weathering of bones under variable conditions have been carried out by Brain (1967), Behrensmeyer (1978), and Larsen & Noe-Nygaard (unpublished data on modern musk ox from East Greenland). Brain (1967) placed bones in sand and under leaves under arid and humid conditions. Bones exposed to weathering on a sandy substrate were bleached and developed a soft chalky surface. The bones were abraded by the action of cattle, and wind blown sand removed the soft surface by abrasion, resulting in the exposure of new surfaces of hard bone. Bones deposited covered by leaves in humid climate under well drained conditions revealed the same type of weathering. The bones found in kitchen-midden deposits from the Danish Mesolithic period is a good example of removal of the organic membranes exposing the inorganic bone material to both physical and chemical weathering. The sculpture of the bone surface, such as muscle attachment processes, is obliterated and the dimensions of the bones are altered due to the continuous removal of superficial bone material (fig. 8 c). Small fragments subjected to these conditions probably disappear completely. Teeth from medium sized mammals like red deer and roe deer exposed to weathering under semi-arid conditions crack and splinter very rapidly (Clark *et al.* 1967), whereas in bog deposits they normally comprise the most resistant and better preserved elements of the skeleton (Noe-Nygaard 1969). The high frequency of well preserved mandibulae containing teeth from subaquatic refuse heaps may indicate that only a short time elapsed between removal of the jaw from the body and its final deposition in the lake close to the site of habitation.

If the animal is subaerially or subaquatically exposed for some time after death, disintegration and scattering of the skeleton will start. Weathering, scavenging, current action and bacterial activity are important factors. The disintegration may be completed within weeks in a warm humid climate. In the arctic environment of East Greenland the disintegration of unburied skeletons of musk ox may last several hundred up to thousand years due to the cold, dry conditions (Larsen & Noe-Nygaard, in prep.).

Müller (1951, p. 40) summarized the course of disarticulation for marine mammals. The lower jaw is disarticulated first at an early state, followed by disarticulation of the phalanges. The other limb bones and the rest of the articulated elements are later stage disarticulations.

Experiments of skeletal disarticulation were carried out under semi-arid and desert conditions by Toots (1965). Five stages in disarticulation were recognized. The first step was the disconnection of the skull and some of the limbs. Then ribs became loosened from the front part. Limbs then started to disarticulate into smaller segments. The vertebral column then began to disarticulate. Finally weathering and disintegration of the individual bones commenced.

Some parts of the body contain a large amount of easily decomposed tissue. Where there is little flesh, ligament and hide tend to persist for long time and thus protect the bones. Metapodial bones are held together

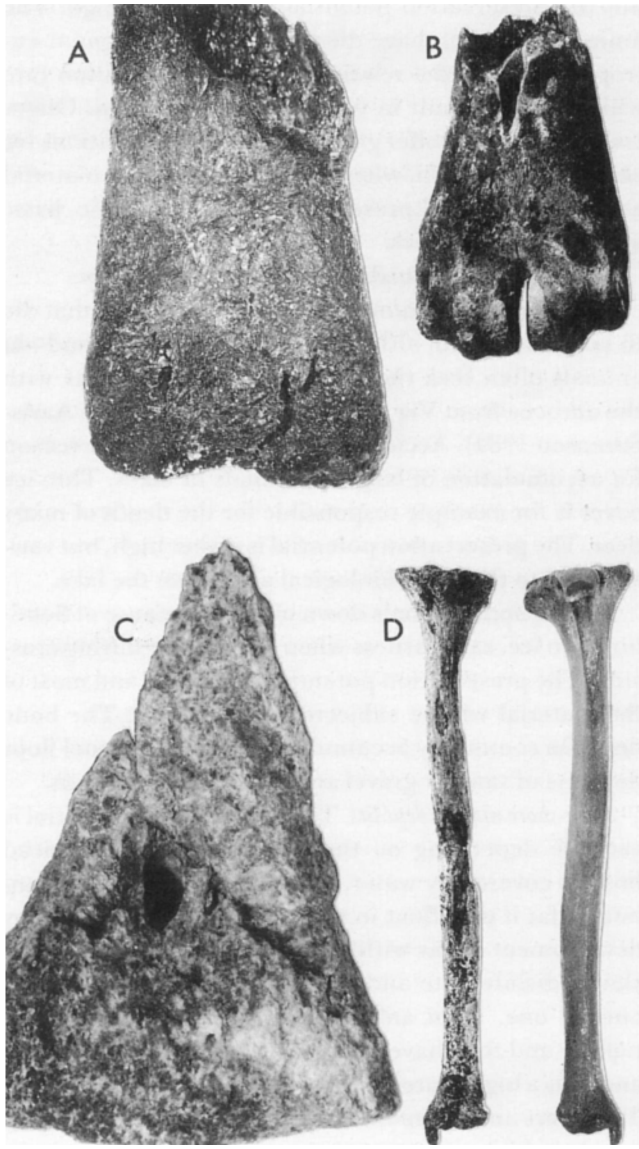


Fig. 8. A, C: Diagenetic decalcification of a metapodial bone of red deer from Star Carr. The bone fragment shown in A cannot be safely identified due to nearly complete decalcification in acid bog deposits, compare with B, a modern metapodium. Note the collagen fibres in the black bone on A. C is a metapodial bone from red deer from Brovst. The organic tissue has been removed by oxydation leaving the inorganic part unprotected. D: Two tibiae of dog from Præstelyngen, the left one deposited in peat, the other in gyttja (lime-rich organic mud). The dimensions of the bones indicate that they derive from animals of the same size – probably the same individual. Note the deformation and decalcified nature of the bone to the left; the weight of this bone is only 60% that of the bone to the right. Size: A × ⅔; B × ¾; C × 2; D × ½.

by remains of tissue after much of the skeleton has been disarticulated.

The time necessary to cause complete disarticulation and disintegration of the various bones during transport in running water was estimated in a series of experiments by Dodson (1973). In his experiment dead bodies of mice and frogs were used. It took 77 days to disintegrate a mouse and 45 to disintegrate a frog. Tendons were far more durable than muscles. It also emerged that a small stream with weak currents was only able to remove the small bones, while the larger remained behind as a lag deposit. The light bones of birds and of small mammals were selectively removed by current action. The various bones of a skeleton have different hydrodynamic properties. With the lowest velocity vertebrae start to roll along the bottom, the thoracic ones being most easily rolled. Humerus, femur and tibia move next, whereas much stronger currents are required to move mandibulae and skulls. The buoyancy of a bone is also of importance to its susceptibility to transport. Bones which have been lying on dry land for some time and then later transferred to water are able to float over a long period. Dried specimens of radius, ulna, femur and tibia of a frog were able to float for a month. See also Behrensmeyer (1975).

On the basis of our knowledge of how the various bones act to current transport it is possible to estimate whether a bone deposit has been exposed to transport or whether certain types of bones have been selectively removed.

Experience with early Pliocene bone material shows that the degree of mechanical fragmentation of the various bones differs (Voorhies 1969). Metacarpus, metatarsus and radius have a low fragmentation potential, whereas tibia and femur have a medium, and the fragile humerus a high fragmentation potential. Cranial and metapodial bones occurred with a high frequency in this deposit, whereas femur and humerus together with scapula, atlas and ulna were poorly represented (Voorhies 1969, plate 3). The studied difference in relative frequency of the various bones may not alone be due to different degrees of fragmentation and sorting by current of the various bones. Activity of predators may also account for a considerable part of the biasing factors working upon a bone deposit. The disarticulation sequence of vertebrate skeletons can be estimated on the basis of the relative numbers of different intact joints in a bone assemblage. Hill (1979) demonstrated that the disarticulation pattern is very consistent. However, the disarticulation sequence is different on dry land and in environments influenced by the presence of water.

Predation

During feeding, predators and scavengers most often concentrate on the eyes, the thigh-bone, the upper part of the shin-bone, and the upper part of the upper arm. Carrion feeders show a great preference for the spongy bone tissue, probably because of its content of iron and fat.

In archaeological deposits the lower ends of tibia and humerus are often found to be over-represented relative to the upper ends of the same bones (figs. 9, 10). This may be due to several factors such as selective destruction, selective removal by man, or dog scavenging.

Lyon (1970) suggested that dogs had an influence on archaeological bone deposits on the basis of an investigation of the activity of dogs in a modern village in Peru. In the village the dogs were of medium size and in some cases they totally devoured the bones of small animals such as fish, birds and small mammals and destroyed identifiable portions of the bones of the medium sized animals leaving only the remains of large animals in an identifiable condition. Domesticated dogs may not only account for the differential representation of skeletal parts but they may also totally destroy the remains of certain species so that the archaeological picture may be highly distorted.

On the upper arm bones of an elk from Star Carr, England, and from an aurochs from Grænge Mose, Denmark, the upper joint had been removed (fig. 11). Tooth marks on the bones of the aurochs indicate that the upper ends were removed by scavengers. Such marks were not seen on the bone from Star Carr, but a find of a skull of a dog at the site shows that dog was present (Clark 1972).

It is well known that scavenging birds are selective in their choice of where to peck. I have observed peck marks of birds on the upper end of humerus of a modern roe-deer.

According to Shotwell (1955) the relative state of preservation of a bone assemblage in a given deposit, can be estimated on the basis of calculations of the ratio of the amount of fragments and the minimum number of individuals, assuming that this calculation is made for several species. This relationship has been widely dis-

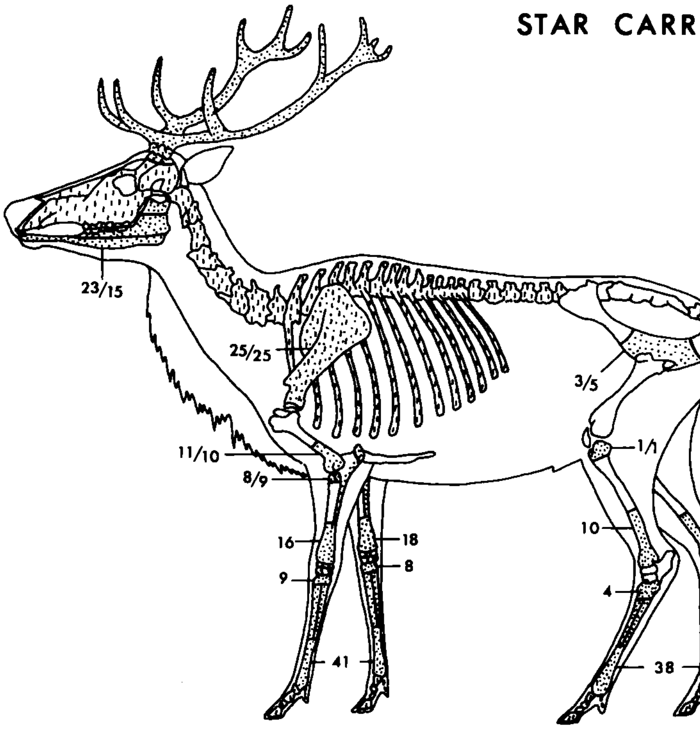


Fig. 9. Skeleton of red deer showing the type and amount of bones found at the Star Carr site. The bones subjected to systematic fragmentation are emphasized. Note the lack of certain bones and the differences in number of the various bones. Antlers are plentiful indicating October to January killing of the animals.

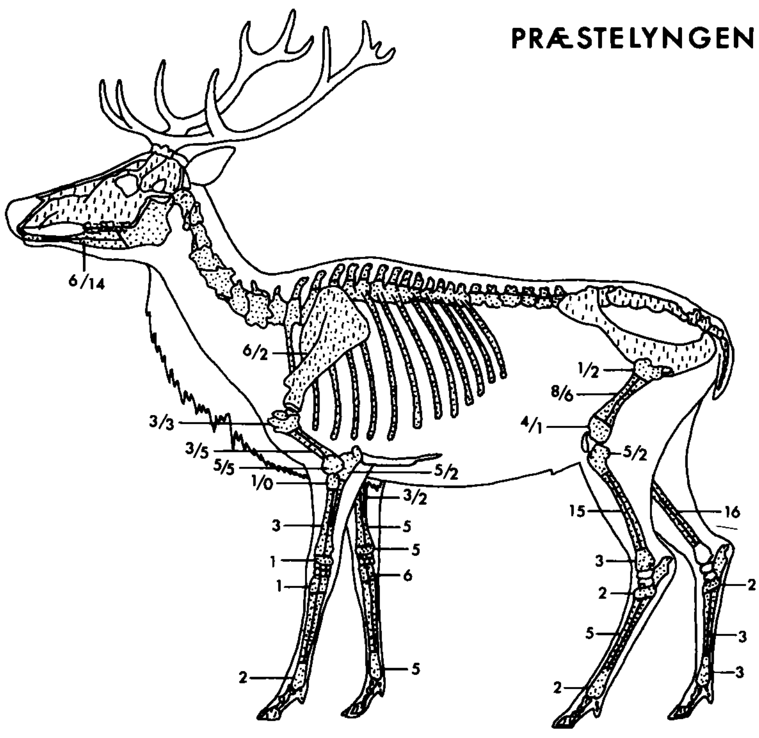


Fig. 10. Skeleton of red deer showing the amount of bones found at the Præstelyngen site. The bones subjected to systematic fragmentation are emphasized. Note the uniformity in numbers of the various bones and the absence of antlers. Lack of antlers may indicate inhabitation of the site within the period February to September.

cussed (*e.g.* Grayson 1978) and may be misleading depending on how prone the different types of bone are to fragmentation and current transport. In archaeological deposits the differences in fragmentation pattern for the various species (see below) will further hamper the possibilities of using this method alone for estimation of the relative degree of preservation. Shotwell (1955) further assumed that the skeletons of animals which lived closest to the site of deposition were better represented in the bone assemblage than skeletons from animals which lived further away from that site.

Sedimentary parameters

Post-burial alterations of chemical or mechanical nature can be ascribed to factors such as sediment permeability, changes in pH of the permeating water, and lowering of the ground-water level resulting from changes in drainage conditions.

Sediment permeability has a marked influence on the fossilization processes and on decomposition of the fossils. Sand and shell heaps present highly permeable media. Silt, clay and organic mud have very low permeabilities and offer protection for the organic remains which stand a better chance of final preservation.

Deformed bones have been shown by experiments to result from decalcification (Noe-Nygaard 1975 b). Examples of sub-fossil decalcified bones from the acid bog deposits of the Preboreal Star Carr Site are illustrated on fig. 8. The bones show various stages of shrinkage and deformation; some bones are so deformed as to preclude identification. On the surface of the bone the texture of the collagen fibres has been brought out.

In north and east Denmark the pH of the ground water has changed during the Mesolithic period, due to the outwash of $CaCO_3$ from the moraine soils. The early Mesolithic lake sediments were organic mud with a considerable content of $CaCO_3$. This is the case for the Aamose basin where the site Præstelyngen is situated (fig. 4). Towards the Neolithic period the pH was generally lowered in the depositional environments. Bones found in the more acid peat deposits are in a rather poor state of preservation. Two tibiae of dog were found at the site Præstelyngen, one in organic mud with a high $CaCO_3$ content, the other in $CaCO_3$-free peat (fig. 8). There is a marked difference in the outline, surface texture and weight of the two bones which probably belonged to the same animal. The differences are best explained by differences in pH values in the two types of sediment. Changes in chemistry of the percolating water during time may result in a downwards migration of the acid zone whereby bones originally deposited under conditions favourable for preservation are etched. Disintegration of the collagen fibres of bones reduces the preservation possibilities. Percolation of alkaline water in highly permeable sediments like sand and shell heaps will lead to this type of destruction. The $CaCO_3$ components of the bones dissolve and pass into solution. The sculpture of the bone, such as joints and muscle attachments, become smoothed and hinder proper identification. Smaller fragments may disappear completely. In some cases iron in solution is precipitated as iron oxides around the bone and within its porous structure, resulting in better preservation (Voorhies 1969).

Overgrowing of lakes together with modern agricultural drainage have lead to destruction of organic material in former water-logged sediment. Bones exposed to repeated moisturing and desiccation crumple and peel

Fig. 11. Right humerus of aurochs, single find from Grænge Mose. The proximal epiphysis is lacking. The tooth marks on 1 indicate that predators chewed away the blood-filled spongy tissue of the upper epiphysis. Size: × ⅙.

off like onions, resulting in total destruction of the bones within a short time. In Denmark many of the former bog areas have been turned into farm land of doubtful value, resulting in disappearance of the bones of numerous Mesolithic sites. The destruction is almost total, but at many sites the desiccation has only influenced the upper part of the deposit, destroying an unknown part of it and thus rendering a statistical treatment of the material impossible.

The taphonomic factors are manyfold and it is important to evaluate the effect of each factor especially in comparison of different achaeological deposits. In the next chapter a few of the taphonomic factors acting on Danish bog deposits are analysed.

TAPHONOMY OF SOME DANISH LAKE AND BOG DEPOSITS

Single bog finds and land mammals

The fossilised fauna from the deposits of Danish lakes, bogs or overgrown lakes stem from a variety of sources: 1) Skeletons of the animals which inhabited the lake bottom or water are embedded in the lake sediments. 2) Part of the natural population inhabiting the biotopes immediately around the lake and the near neighbourhood may accidentally fall into the lake, and in this way contribute to the bog sediments. 3) A human population may also contribute in several ways to the lake deposits. Animals may be driven into the lake during hunts, escaping their pursuers, but drowning; wounded animals seek the lake as a refuge; and animals may have been sacrificed and ceremoniously lowered into the lake to honour deities. Finally, refuse from lake side human settlements, including remains left over from meals, is also thrown into the water.

Natural death. It is in many cases impossible to separate fossil material representing the natural death of the animal population from material representing man's sample of this population. However, the isolated finds of complete skeletons most likely represent the accidental death of an individual belonging to the natural population provided that no weapons or unhealed injuries are to be seen, and that no observable sacrificial arrangements of the bones is recorded. Some complete skeletons have, however, been interpreted as representing a sacrificial arrangement e.g. Sørbylille, Åmosen (*e.g.* Troels-Smith, pers. comm. 1975). Isolated bog finds from Denmark number more than 10,000, but detailed information is unfortunately very rarely available. Only about a hundred finds are dated either by pollen analysis or ^{14}C analysis. The isolated bog finds consist of relatively large animals such as red deer, elk, aurochs. Commonly only the skull and a few bones are recorded, but complete skeletons are occasionally retrieved. Such a sample of the natural fauna is biased in many ways. Animals that have gone through the ice or have floundered in a quagmire are likely to be the heavier ones, and accidents of this type are likely to have happened more often to species living near a lake such as ox, elk, deer, and wild boar. These animals are heavy and having once broken through ice, they continuously will break the ice edge in their attempts to regain the ice surface. Their efforts to reach safe ground may result in their being buried quite rapidly in the soft lake sediment. Nevertheless, Collet (1912, p. 481) mentions that roe-deer often risk a thin ice cover and may drown or get stuck with their thin legs through the ice and starve to death. These animals will often be the target of predators such as wolf, fox and dog, and roe-deer is rarely recorded as single bog finds.

Another factor to be considered is a strong collection bias. Most of the finds from the bog deposits are recovered by non-scientists, giving the larger and more impressive finds a preference. Thus the number of finds of males of aurochs, roe-deer, and wild boar exceeds that of females by several times; this hardly proves that more males than females drowned in the lakes but that the horns, antlers and canine teeth respectively render the male skull more conspicuous than the female. Similarly, bird and fish remains occur abundantly in bog deposits; however, there are practically no records of single bog finds of birds and only a few complete skeletons of fish have been recorded at for example the Muldbjerg site. Most records of fish and birds are connected with archaeological excavations. Among birds, water fowl such as the various species of duck are the most common, but birds with other habitat requirements are also found. Nearly all the bird species recorded are only represented by a few bones, because of the light bone structure, fat and feathers, which keeps a carcase of a fowl floating for months leading to a scattering of the bones (Schäfer 1962, 1972).

Animals killed by man. Where isolated finds occur with flint embedded in the bones or with unhealed injuries it is obvious that the death of the animal was caused by man. In several finds such as the wild boar from Aldersro, the complete skeleton bears injuries and contains flint implements (Steenstrup 1889). The aurochs from Vig has several injuries, some healed and some unhealed (Hartz & Winge 1906). The unhealed injuries of this skeleton indicate that the animal did not live long after the last hunt, and the fact that it was found as a complete skeleton may be taken to indicate that the hunters never caught the deadly wounded animal (Noe-Nygaard 1973, 1974). An aurochs from Prejlerup found under similar circumstances was described by Aaris-Sørensen (1984).

Fragments retrieved from excavations may include bones of sacrificed animals, but these will in most cases be indistinguishable from the fragments derived from meals. There are, however, exceptions to this general principle. In rare cases it is possible to distinguish an offering from the rest of the deposited bone fragments. For example, in the Hamburgian Culture from Stellmoor several complete, non-transported skeletons of reindeer were found, weighed down by stones placed inside the rib-cage suggesting that the animals represent a sacrifice (Rust 1937, 1943). In other cases where only parts of the animals were sacrificed, a correct interpretation is more difficult. If, however, bones are broken following a certain pattern and if the fragments are collected at one place it is reasonable to class them with offering finds. A possible example is known from the early Neolithic settlement Store Lyng VI where four complete skulls of sheep/goat with similar fractures were found. One had a lesion in the frontal bone, and three had lesions in the back head (Troels-Smith, pers. comm. 1975). Møhl (1978) described six individuals of elk from the pre-boreal Skottemarke locality who appear to have been ritually killed.

The setting of the bones of the sacrificed animals from the Hamburgian Culture shows that if the carcase of an animal is buried in an articulated condition and is rapidly covered with sediment, all of the bones stand a good chance of preservation.

The place of sacrifice may, however, also be on dry land either at the living site or separated from it. The remains from such a place will be extremely difficult to distinguish from remains of meals and will in many cases never reach a lake.

Animals probably killed by man. It is difficult to prove the connection between barbed points or other projectiles and complete skeletons recovered from the same site, when the arrows are not embedded in the bones but just occur adjacent to the skeleton. A causal relationship between such an association between flint or bone implement and a skeleton have been suggested by several authors. As examples can be mentioned an elk from Taaderup dated to the pollen zone VI (Ødum 1920) and an elk from High Furlong dated to the Allerød period, pollen zone II (Hallam *et al.* 1973). In both cases there is no direct proof of a close causal connection between the skeletons and barbed points found nearby. The elk from Taaderup was found together with the basal part of a barbed point and no injuries were recorded on the skeleton. In this case the barbed point could very well have been deposited many years before or after the death of the animal, and no known dating method would be able to distinguish the difference in time. The object will be recorded as contemporaneous, and the obvious conclusion will then be that the elk was hunted and perhaps killed with the barbed point. Several damages of the skeleton were recorded on the elk from High Furlong but these are most likely of modern date (Noe-Nygaard 1975). Here again no real proof exists of contemporaneity between the barbed point found adjacent to the skeleton and the skeleton itself. The points could have been used as fish spears and dropped on a later occasion. The barbed points from High Furlong were very light and slender, much more suited as a leister or a fish spear than for elk hunting.

Deposits of mixed origin, Præstelyngen – a case study

The numerous fish remains recorded from archaeological sites commonly offer serious problems concerning their origin.

The fish bones found during an excavation are normally thought to represent meals left over by the inhabitants of the site. Most of the well preserved material stems, however, from that part of the refuse that was deposited in the water. The refuse from the site will thus run a risk of being mixed up with the carcasses from the natural population of fish in the lake.

The fish remains excavated from the Mesolithic site Præstelyngen in Denmark (fig. 4) are discussed in order to throw light on the questions if the fish remains represent left overs from meals, or carcasses of the naturally died animals, or both. Noe-Nygaard (1983) demonstrated by a combined population and seasonality study that it was possible to distinguish between the two main types of origin.

Accumulations of fish bones are in most cases interpreted to indicate that the culture was a fishing culture, while similarly, lack of fish bones at a site is taken to indicate that the inhabitants have not touched a fish (Brøndsted 1957).

Approximately 5000 fish bones were retrieved from the site of Præstelyngen (3280 ± 100 bc, K2049) (Noe-Nygaard 1983). Around 4000 were determinable and 78% of these belong to *Esox lucius*, the pike. The rest are distributed between the following species: tech *Tinca tinca*, perch *Perca fluviatilis*, crusian carp *Carassius carassius*, bream *Abramis brama*, roach *Rutilus rutilus*, rudd *Scardinius erythropthalmus*, spurdog *Squalus acanthias*, and catfish *Silurus glanis*.

The fish bones found on dry land around the site probably derive only from meals prepared by Mesolithic man, whilst the in-shore lake deposits may very well be composed of both refuse from the site and accumulations of fish which died naturally in the lake. A rim up to 5 m wide of dead floating fish with up-turned, air-filled bellies can commonly be observed in modern lakes. Such mass mortalities may have several reasons including lack of food, or more commonly suffocation beneath a thick late winter ice cover, or lack of oxygen, caused by biological overproduction and decay in warm summers.

At Præstelyngen it is clear, both from the large number of fragments and from the estimated minimum number of individuals (250) that pike was the dominant fish. Pike is a predator at the apex of the food pyramid whilst perch and the other fish species constitude its potential prey. Consequently, the ratio of the two groups does not reflect the composition of the natural fauna of fish in the lake. Several attempts have been made by poisoning a lake to retrieve the total population (Malin & Enros 1956; Berzins 1958; Larsen 1961). For comparative reasons the fish fauna of a modern lake poisoned by rotenone is pertinent to the problem presented here (Larsen 1961). The modern lake is comparable to the Aamose lake with regard to size, depth, pH and surroundings. Larsen counted 16,692 fishes from the lake, distributed as follows: roach, 13,731, perch 1,522, rudd 1,263, pike 111, tech 69, crucian carp 1, eel 5. The abundance of the various species is in accordance with a normal abundance of prey animals and predators. Larsen pointed out that probably not all the fish were caught and counted, but the number of missing fish would not markedly change the ratio between the two groups. It thus seems clear that the dominance of pike in the Aamose deposits does not reflect the composition of the natural fauna. The obvious explanation of the pike dominance is that it was the preferred fish for consumption by man, possibly because of a combination of flavour, ease of catching and type of fishing equipment. Pike is relatively easy to catch during spring and early summer when it inhabits the shallow, warm water zone near the lake shore, where the mating dance takes place. There are, however, other possible explanations for the large numbers of pike. Pike bones have a conspicuous shiny black surface which may lead to a collecting bias in black bog deposits. But the very careful excavation technique applied at Præstelyngen diminish collecting bias to a minimum. Few fragments will escape the excavator who is helped by the difference in colour between sediment and all preserved bone material. Furthermore, pike bones may be more resistant to scavengers, weathering, and diagenesis than bones of other fish. Finally, the dominance of pike may reflect an unstable monospecific fauna developed under abnormal conditions such as in isolated water-filled marl pits with no inlet or outlet. Individuals living under such conditions are commonly "Kummer Formen", that have large heads and may be cannibalistic. In the case of the Aamose Basin such conditions did not prevail. The faunal remains and the pollen spectrum from this period indicate an open lake with vegetation along the shore. Also the present day river Halleby Å ran through the area, as it does today. The lake thus had a fresh water inlet and outlet permitting immigration of fish.

In order to evaluate the influence of man on the deposition of fish in the Præstelyngen site in the Aamosen, it was compared with a Cromer interglacial age lake deposit, situated near Voigtstedt in the German Democratic Republic (Deckert, in Kahlke 1965). The possibility of human interference at Voigtstedt is negligible. Thousands of bones from various species of vertebrates were retrieved from the site. Apparently the shallow-water lake had a few deeper pools and had a small stream running through it. Among the bone remains there were about 550 identified fish bones distributed amongst eight species (fig. 12). More than half of the fragments were of pike. It is striking that pike is the dominant fish in the deposits of Voigtstedt and Præstelyn-

	% OF NUMBER OF FRAGMENTS		INDIVIDUALS%
	PRÆSTELYNGEN n = 2228	VOIGTSTEDT n = 550	MODERN POISEND LAKE n = 16693
Pike	75,80	52,6	0,7
Tench	1,88	29,1	0,4
Perch	21,70	6,4	9,1
Crusion Carp	0,20	3,8	0,1
Bream	0,18	0,4	—
Roach	0,20	0,8	82,2
Rudd	0,05	6,2	7,6
Spur dog	0,05	—	—
Spine loach	—	3,0	—
Wels	0,13	—	—
Eel	—	—	0,1

Fig. 12. Percentages of freshwater fish species found at Præstelyngen and Voigstedt compared to a modern poisoned lake.

gen. Furthermore, the distribution of the fragments of the various skeletal elements is very similar, at least for the five most common elements. The difference between the two deposits is that at Voigtstedt very few body skeletal remains were retrieved. This lack of the smaller and lighter part of the skeleton may be due to sampling bias or the small parts may have been removed by current action. Deckert (in Kahlke 1965) interpreted the distribution of bone fragments for the various species of fish as a response to differing resistance to mechanical wear.

The quantitative composition of the various species of the subfossil faunas in the Cromer lake and the Mesolithic lake are thus closely similar, whereas they differ markedly from the quantitative composition of the species in the modern lake described by Larsen (1961). This suggests that the distribution of the various species cannot simply be ascribed to a human factor, but may just as well be the result of mechanical and chemical biasing factors (cf. Deckert, in Kahlke 1965).

Thus, it is necessary to investigate other lines of evidence in order to directly associate fish bones at Præstelyngen with human activities at the site. This was attempted in two ways: 1) The population structure of the Præstelyngen pike was reconstructed. 2) The yearly season at which they had died was analysed by year-ring analysis.

The relation between distal height of the dental bone and the total length of 14 animals has been analysed in a material of 100 modern pikes (fig. 13). The correlation coefficient is very highly significant (r = 0.900). The size distribution of the pikes from Præstelyngen was calculated on the basis of the equation of the regression line (fig. 13) and the measurements of the distal height of the dental bone.

The size structure of the Præstelyngen population clearly differs from that of the modern poisoned lake (fig. 14). The dominance of individuals of a very limited size range between 30 and 70 cm suggests selective killing of fish and strongly implies that the accumulation of fish bone was due to human activity. The narrow size range of the selected fish may be a result of the method of killing. Several finds of Ertebølle fish spears, hooks and traps have been made from the lake area (Troels-Smith 1953). The use of fish spear strongly biases the catch in favour of the larger fishes, as they are easier to hit. Pike is approximately 2 years old before it matures, at which time it has reached a length of about 27–48 cm for males and 31–49 cm for females (Frost & Kipling 1967). The very large pike may have been too cunning to catch, or they may have inhabited less easily accessible parts of the lake. The pikes caught at Præstelyngen most likely represent mature individuals which

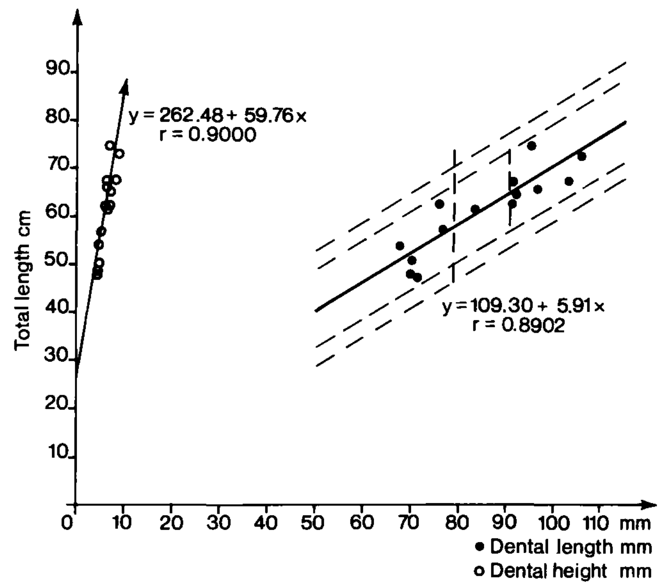


Fig. 13. Correlation lines between dental length and total length of modern pike (*Esox lucius*) (N=14), and between dental height and total length of modern pike (N=14).

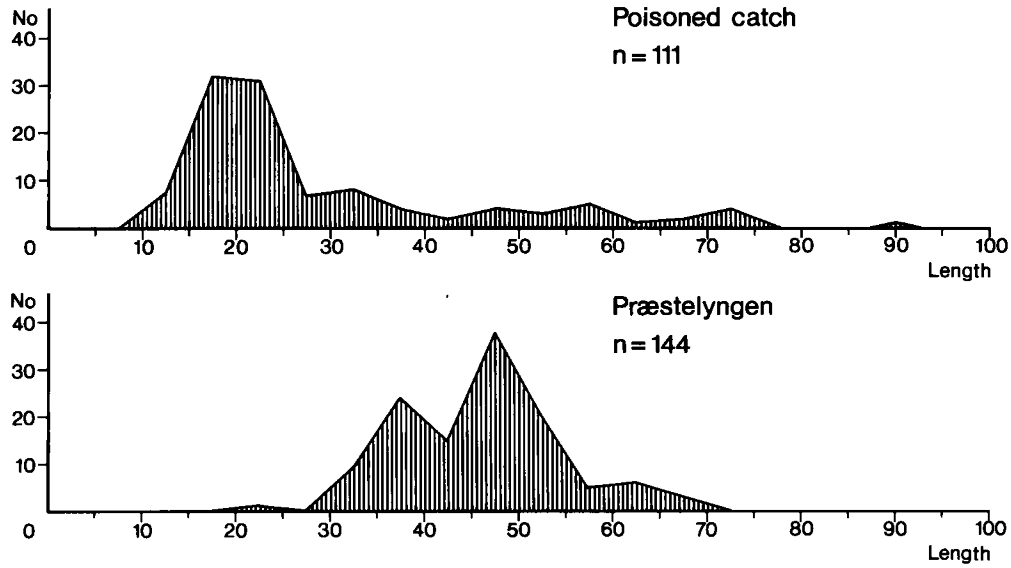


Fig. 14. Comparison between the population structure of pike catch from a modern lake, and the assemblage collected at Præstelyngen. Note the very narrow size range at Præstelyngen.

could easily be obtained at their spawning grounds at shallow water near the rim of the lake.

The size composition of pike at Præstelyngen might, however, be a result of a catastrophic mass mortality of specific age groups. This may have been brought about by anoxic conditions below winter ice or by biogenic over-production in the lake during warm stable summer conditions which would cause lack of oxygen or biogenic toxication (Noe-Nygaard *et al.* 1987).

In order to eliminate some of these natural factors, the season of death of the fossil pike was estimated by year-ring analysis of 79 well preserved vertebrae, following the method of Casteel (1976) and Voorhies (1969).

It is noteworthy that from about 3,000 pike bone fragments only some 120 vertebrae and very few other body skeletal elements were preserved. This may be due to the fact that more than about 90% of the bone material from the site was recovered from a human dump from the near shore lake deposits and thus may contain only the unwanted parts of the fish. A pike head is unattractive, has very little meat on it and has sharp teeth. The many bones from the pike head may thus represent the remains of the semi-product of the fish. This interpretation of immediate decapitation of the pike at the lake margin is supported by two points. The number of paired cranial bones is almost the same for the various skeletal elements indicating that the whole head was dumped at one time. Further, at a coastal site, Ølbylyng, of approximately the same age as Præstelyngen, the cranial bones only represent 1–2% of the total number of fish bones (Møhl 1970). The coastal people probably never brought the fish heads to the site itself, as they were dumped at the place where the fish were landed.

In order to estimate the season of death of the pike from Præstelyngen a sample of 100 modern pike was collected throughout one year. The development of the outermost annual increment on the atlas, on a praecaudal vertebra and the tenth caudal vertebra from behind was compared with the preceding fully developed annual layer of the same type. The white "summer" growth layer was divided into three segments. The annual increment of cleitrum and basihyale was tested as well for comparative reasons (fig. 15). The data on the fossil pike indicate that the major part of the fish were killed well within their season of growth. By direct comparison between fossil and modern pike it is apparent that the majority of the fossil vertebrae was derived from fish killed in the summer season, predominantly May, June, July, and August (fig. 16). From Williams (1955), Frost & Kipling (1967) and Casteel (1976) it is clear that the time of growth of pike depends largely on ontogenetic age, on the general condition of the individual and on the abundance of food available. Considering the possibility of false annulae, and a variation in the time of development of summer layers the only thing which is clear is that the fish were killed at a time within their main growth season. This season is in agreement with the season for habitation of the Præstelyngen site, deduced from other seasonal indicators (fig. 6).

The limited size range of the pike and their season of death suggest that human beings were responsible for their death, and also possibly for the death of the other species of fish. Consequently, fish constituted a major part of the food economy at the site.

From the faunal analysis of the seasonal occupation of the Mesolithic inland sites in the Aamose area it has been demonstrated that during the time of occupation all the available resources were exploited. But which resources the inland people utilized throughout the year is still unanswered. On one hand it has long been argued that the inland settlements were the summer hunting stations of migratory coastal people, and on the other that the inland people were an autonomous migratory group who did not permanently inhabit any one site (Andersen 1981; Mathiassen 1943; Noe-Nygaard 1971).

The pike bone assemblage consists almost entirely of skull bones. Annual ring analyses of vertebrae indicate pike mortality from May to August. This is in agreement with other seasonal evidence indicating the season when the Præstelyngen site was inhabited (fig. 6). The very narrow size distribution of the pike assemblage suggests that they were subject to a selective kill, probably by human beings.

These three lines of evidence indicate that the majority of pike bones and other fish dumped in the lake close to the Præstelyngen site represent the remains of catches made by people on the site. They decapitated the prey immediately, at the edge of the lake.

In addition to the important exploitation of fish at Præstelyngen the inland people also collected a great number of fresh-water mussels (Noe-Nygaard 1983).

The inference from the major role of fresh-water fish and mussels in the diet of inland Mesolithic people as part of the overall non-marine food intake is that two groups of Mesolithic people were in existence in Sjælland at the same time. One group exploited the whole range of prey species available along the coast, including marine fish, birds, mammals, and mussels, see *e.g.* Aaris-Sørensen (1980 b) and Enghoff (1983). This was supplemented with whatever non-marine birds and terrestrial mammals they could obtain. The inland people exploited the whole habitat around the larger lake areas

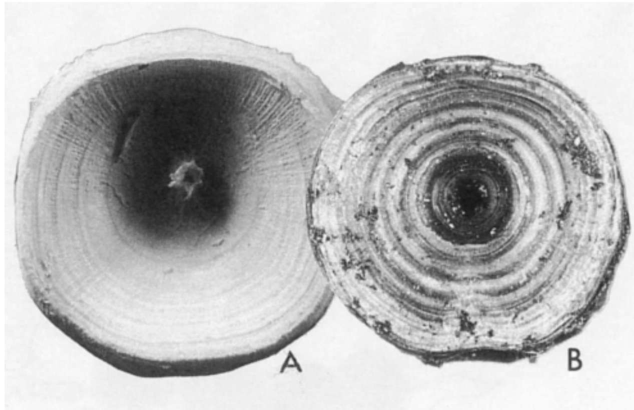


Fig. 15. Pike-vertebrae with clear year-rings which are useful as a seasonal indicator. A: modern pike; B: pike from Præstelyngen. Size: × 2.

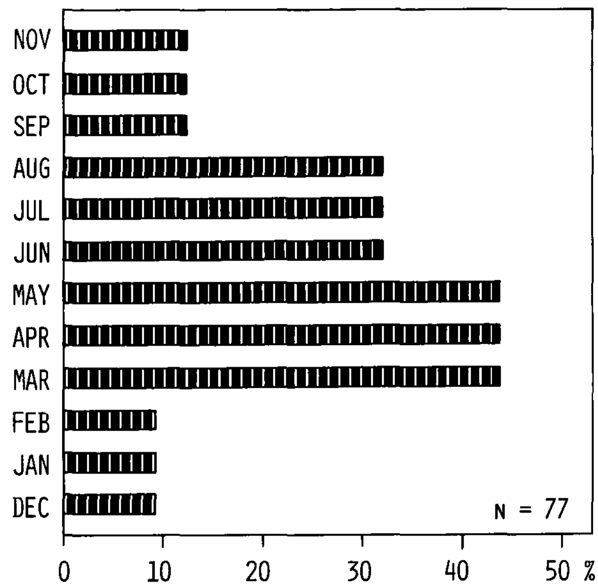


Fig. 16. Seasonal occupation of the site Præstelyngen deducted from year-ring analysis of pike vertebrae. Inset in the lower right shows a more detailed version of the quadrant in question based on direct comparison with year rings from monthly caught modern material.

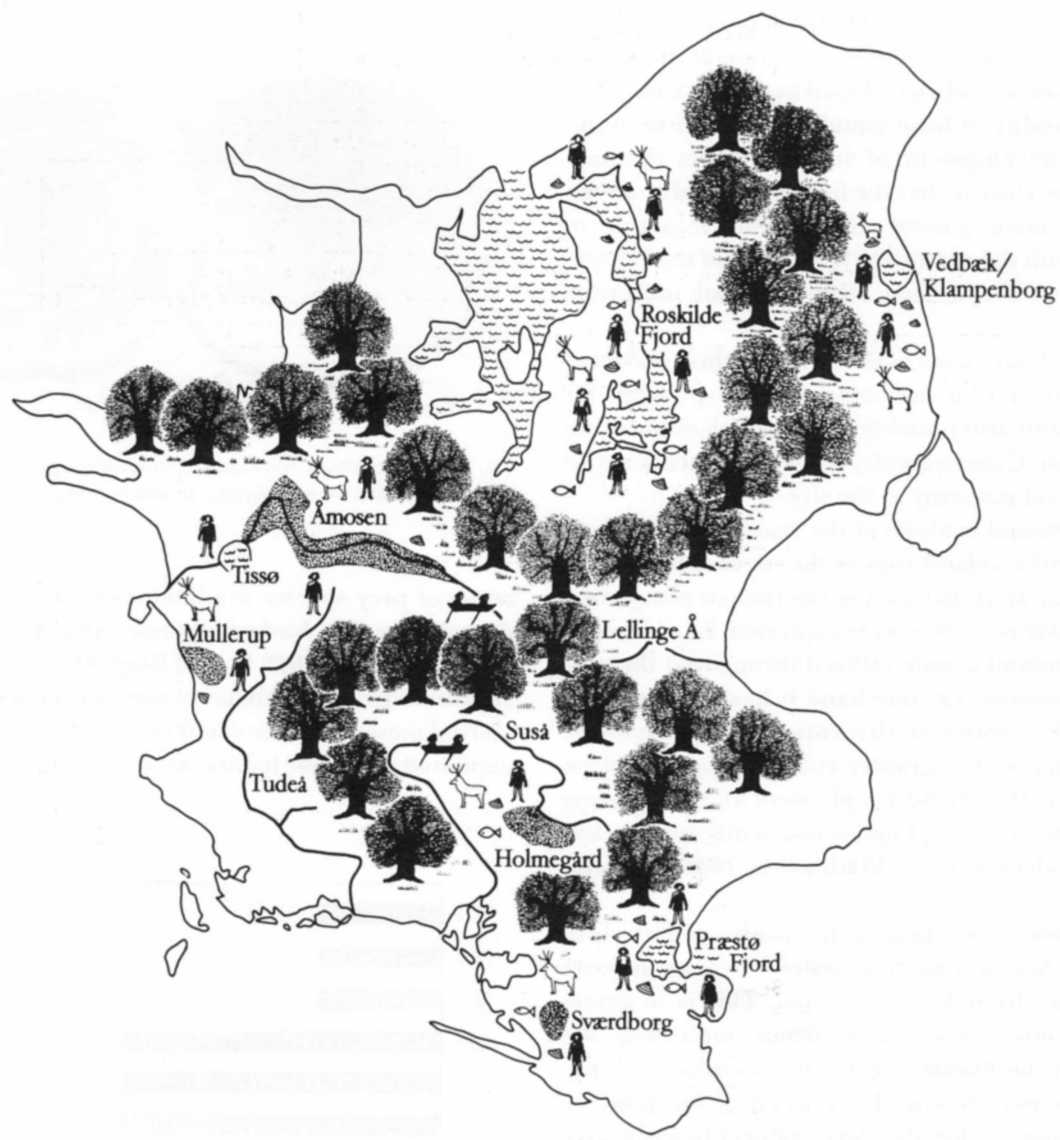


Fig. 17. Schematic map showing the main biotopes on the island of Sjælland during Mesolithic times.

which supported populations of mammals, birds, fish, and mussels. As both summer (e.g. Præstelyngen) and winter (e.g. Kongemosen) sites are known, the inland people seem to have exploited the whole habitat all year round. These two groups of people probably had some communication (Noe-Nygaard 1971), but were otherwise subsisting totally within their specific habitat (fig. 17).

This more stationary way of life in the late Ertebølle period might have facilitated the adaptation of the agricultural way of living in the early Neolithic.

Deposits of human refuse

Material embedded in bog deposits as a result of human activity is in some cases easy to recognize. The human habit of marrow fragmenting the long bones and breaking up the remainder renders identification of human

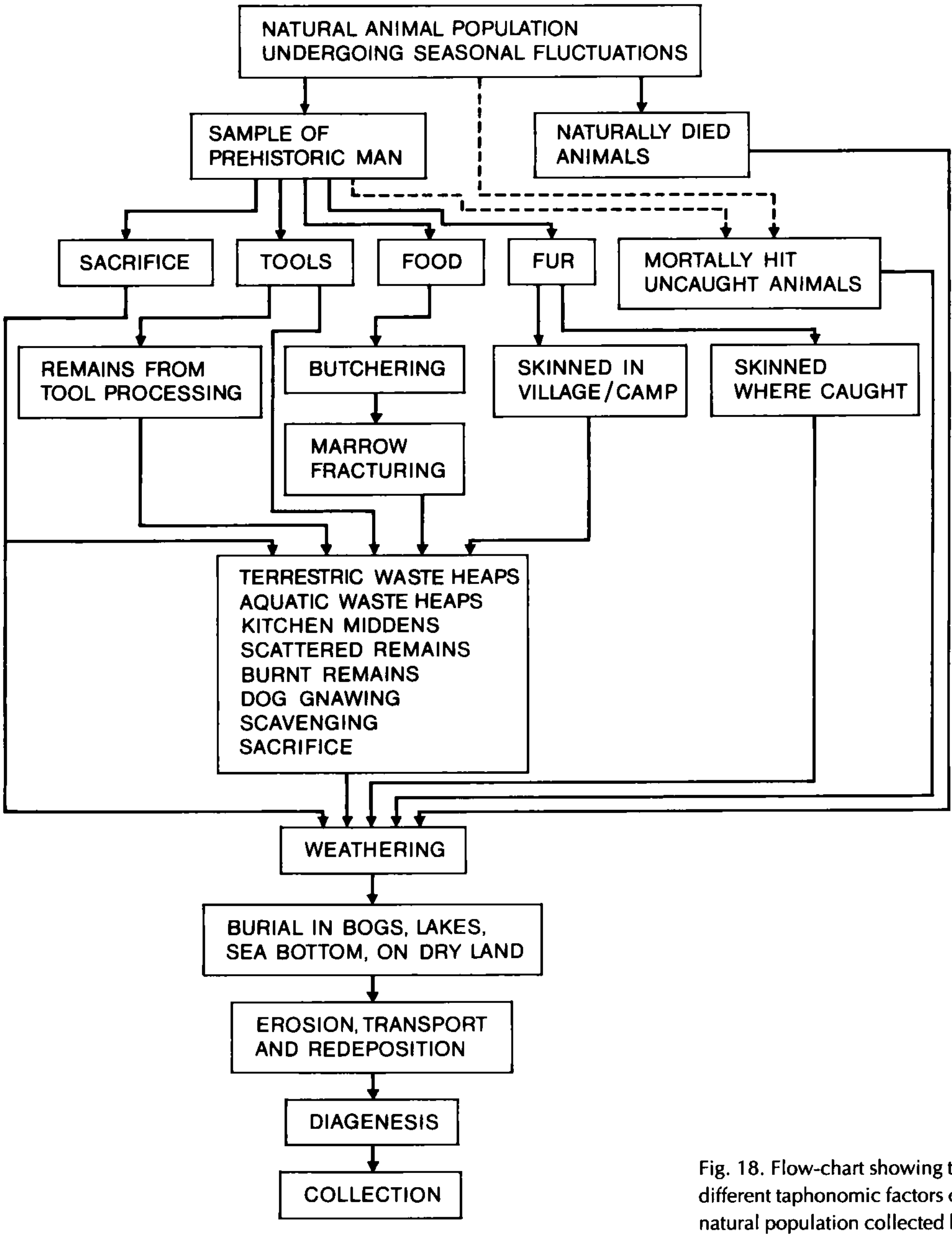


Fig. 18. Flow-chart showing the effects of the different taphonomic factors on a sample of the natural population collected by pre-historic man.

refuse possible. This fragmentation is an indicator of the use of the animals to man. Also the repeated patterns of the numerous cut, scrape and sawing marks are strong arguments for human activity (Noe-Nygaard 1969). The repeated pattern of the position of the cut-marks also diminish the obliteraty effect of *e.g.* trampling which in other cases may change or blurr clear cut marks (Behrensmeyer *et al.* 1986). Fig. 18 lists the taphonomic factors acting on a death assemblage the composition of which is determined by man. Food, tools and clothing are major purposes of killing the animals. In the following the results of the various procedures to which a killed animal may be subjected are analysed.

Food. When the butchering of a prey animal has taken place the odd pieces will probably be given to the dogs or just left where the animal was butchered as refuse. The rest of it, intended for consumption, would have to be prepared and eaten within a short time if it was not dried or smoked for later consumption. The bones from prepared food in most cases were exposed to marrow splitting before they were thrown away. This refuse may be deposited at several places (fig. 18). Firstly, in accumulations at a terrestric refuse heap, like the kitchen middens well known from Denmark (Madsen *et al.* 1900). Secondly, the refuse may be dumped in the neighbouring lake. Thirdly, the bones may be scattered around the site close to where they were eaten. Fourthly, the bones may have been thrown into the fire, where most of them would be totally destroyed. Only very few fire affected fragments are found on the sites. Burned bones are very fragile and porous and are easily destroyed. A considerable number is available only from burned bone tombs due to the immediate covering of the bones. If the bones are left either on a terrestric refuse heap or scattered around the site, scavengers like dogs, foxes and birds will have the opportunity of removing and destroying a greater part of the refuse. The refuse accessible but no longer attractive to scavengers and just lying around the site will be exposed to destruction by both mechanical and chemical weathering. Laboratory experiments showed that exfoliation was the first result of decalcification (Noe-Nygaard 1975 b).

The conclusion is that only the left-overs after meals that immediately are embedded in the lake sediments stand a chance of preservation. If the bones are uncovered for a period only a minor part of the fragments has a chance to reach the lake and the final embedding necessary for preservation for the benefit of the palaeobiologist.

Food and tools. The prey animals often serve multiple purposes to the stone age hunter. Raw material for tool processing is one of them. Antlers, metapodial bones, ribs and tibiae are the preferred bones for raw material. These parts will be removed from the rest of the animal either immediately after its death, i.e. the antlers, or after the meat has been eaten. The fragments resulting from tool processing consist of the finished implement, the waste products (Andersen 1971) and the unsuccessful attempts. The two last mentioned types of fragments would be exposed to the same destructive agents as the food remains mentioned above, while several alternative fates await the tool itself in addition to the above mentioned. It may be removed by its owner to a completely different place owing to his nomadic migrations or it could be used as a gift. The tool may be lost in a hunt or elsewhere; or it may be worn down and the stump thrown away. It is thus clear that the waste products and the discarded unsuccessful pieces stand a better chance of preservation at the site than the tool itself. Furthermore, the additional fragmentation owing to implement processing is likely to diminish the preservation potential making identification difficult or impossible.

In spite of the additional fragmentation it has been possible to retrieve and recognize waste products from

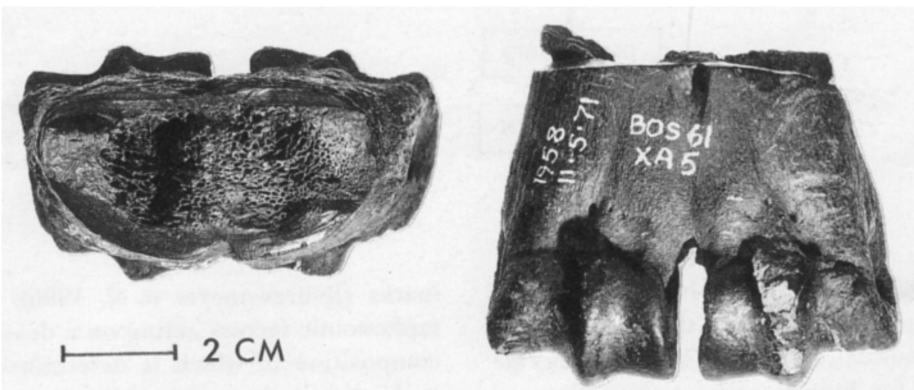


Fig. 19. Fragmentation pattern of metacarpus of aurochs from Star Carr. The view perpendicular to the long axis of the diaphysis of metacarpus shows the sawing marks made by Mesolithic man during the careful removal of the lower epiphysis. Note also the difference in outline of the fragments resulting from normal marrow fragmentation (figs. 21 and 24) and the outline of fragments resulting from tool processing.

the deposits. A good example is the fragments resulting from worked antlers described by Andersen (1971) and the often found lower joint neatly cut from the diaphyses of the metapodial bone (fig. 19). These types of fragments are found e.g. at Star Carr. The treatment of the various bones depends on the rôle they play for human beings. In cultures like the Hamburgian Culture where antlers are the only raw-material for implement processing, the treatment of the metapodial bones as well as the other bones will be very uniform. The fragmentation pattern of reindeer differs from that of the other deer (Møhl 1972). The special way of treating bones of reindeer is due to the very thin walls of the long bones which render them unsuitable as raw-materials for tools. The epiphyses are removed near the joint and the diaphysis remains as a tube from which the marrow is pushed or soaked out. In cultures where red deer, roe-deer and elk are the important game, the metapodial bones are treated in two ways depending on their use either as food or raw-material. When treated as food the bones are either broken rather carelessly as in Star Carr and Kongemosen (see below) or the joints are more carefully removed and the diaphyses are divided into two by series of laterally placed blows as is the case in Præstelyngen and Muldbjerg I (figs. 20 & 21). If the bones are treated as raw-material for tool processing the joints are removed and the diaphyses are parted carefully by groove cutting.

The various treatments give a variable number of fragments and increased possibilities for interpretations. From the Hamburgian Culture fragmentation produces three recognizable pieces and a few splinters. At the Kongemose and Star Carr sites fragmentation produces two recognizable fragments and a lot of splinters. In the Præstelyngen and Muldbjerg sites four recognizable pieces result from the fragmentation. If a bone such as metacarpus had been used for tool processing the recognizable fragments including the finished tool itself would be the same for all four sites, namely four.

Food and furs. Obviously fur and skin have been used for many purposes such as clothing, sleeping blankets and tent production. Skin has probably been used from both food animals and carnivores. It is difficult to prove this use of red deer, roe-deer, elk and aurochs because their remains always will have an overprint resulting from their main purpose as a food source. Bones of carnivores seldom show traces that can be interpreted as

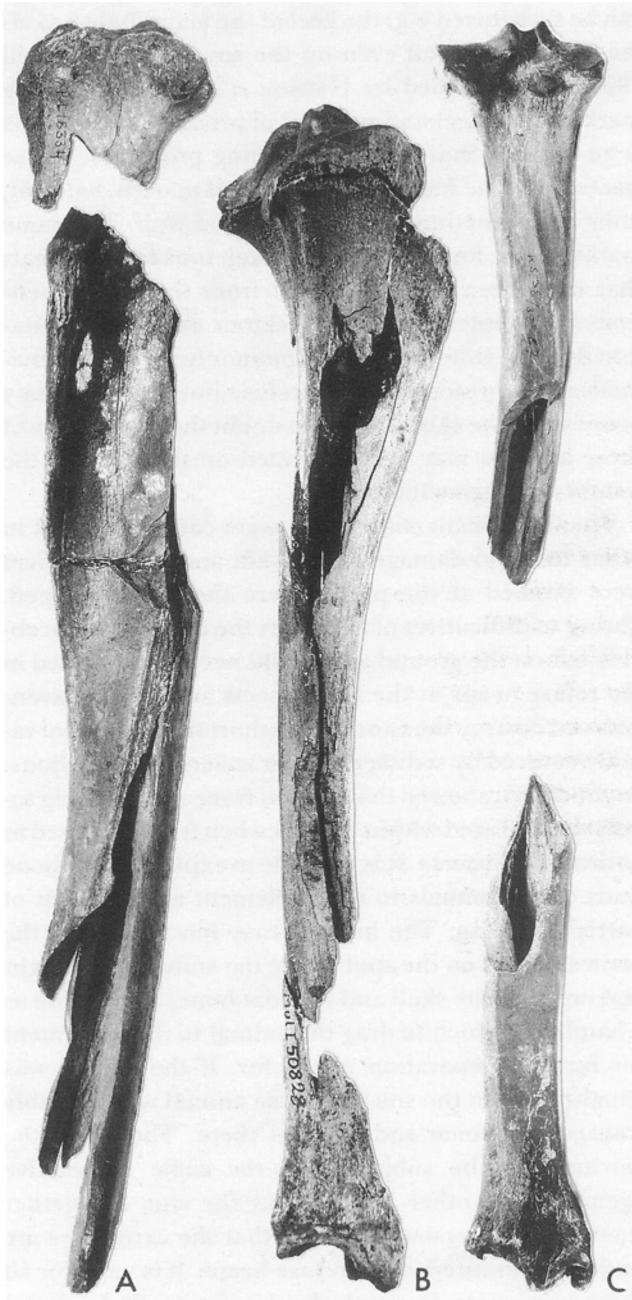


Fig. 20. Tibia from red deer from A: Præstelyngen; B: Muldbjerg; C: Kongemosen. Note the similarity in fragmentation pattern and resulting fragments in A and B as opposed to the fragmentation pattern in C. Size: A and B × ½, C × ⅔.

eating traces such as marrow fragmentation. However there are cases where repeated fragmentation pattern can be recognized e.g. the keel of the mandibula has often been broken off even on the small marten (Møhl 1972). As described by Hatting *et al.* (1973), cutting marks on the keel and removal of processus articularis is an obvious indication of skinning processes. These traces are to be found on craniums of marten, wild cat, otter and sometimes also on dog and wolf. The same marks can be found on modern skeletons from animals that have been skinned. Apart from the above mentioned examples carnivores seldom show fragmentation done by stone age man. Commonly very few individuals are represented in the refuse but often by many bones or by the skull alone. No doubt the importance of these animals may be underrated on the basis of the number of fragments alone.

The fur animals most likely were caught in traps in order to avoid damage to the skin and many of them were skinned at the place where they were trapped. Owing to difficulties of transport the carcase was probably left on the ground and would never be recorded in the refuse heaps at the site. Insects and other scavengers can destroy the carcase in a short time if it is not rapidly covered by sediment under anaerobic conditions. Payne (1965) showed that carrion from a juvenile pig totally disappeared within 24 days when freely exposed to both air and insects. It is possible to explain single bone finds of fur animals in the settlement as the result of partial skinning. The hunters may have removed the main skeleton on the spot where the animal was caught and only left the skull and the foot bones in the hide as a handle by which to drag the animal to the settlement for further preparation of the fur. If the animal was caught close to the site the whole animal was probably transported home and skinned there. Thereafter the carcase may be subjected to the same destructive agents as the other left-overs at the site. Altogether there is good reason to believe that the carnivores are under-represented in the refuse heaps. It is valid for all three categories 1) purely food animals, 2) food and implements processing, and 3) food and skinning, that the only part of the remains standing a good chance of preservation is the material that enters the lake without delay. If the bones are left around the site on dry land the chances for preservation are very greatly reduced. It is unlikely that the remains from the different activities were evenly scattered around the site; different places

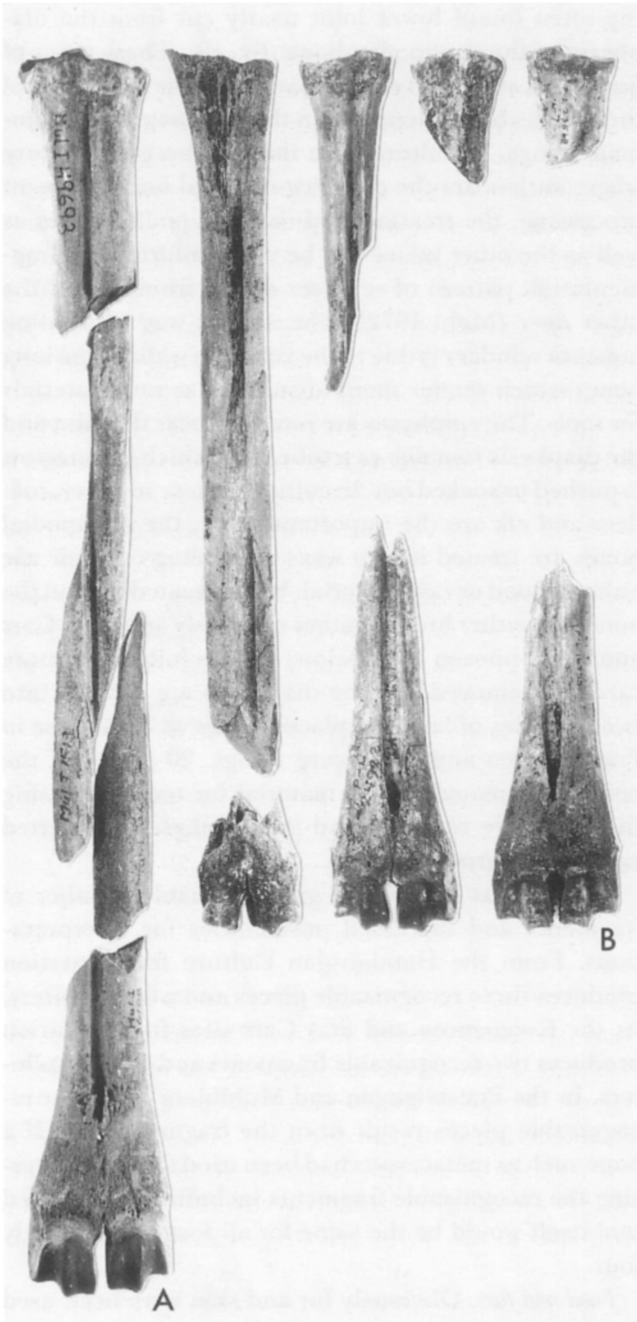


Fig. 21. Fragmentation pattern of metatarsus of red deer at Muldbjerg; A: Compare with the fragmentation pattern shown on fig. 24 and Præstelyngen; B: Compare also with the experimentally fragmented metapodium of roe deer (fig. 29). Size: × ½.

were probably used for different types of refuse. This seems to be the case of a number of settlements, *e.g.* Brovst.

When it has been killed, the common game animal is exposed to several different processes, two of which are butchering and marrow fracturing. First the prey is butchered, and later the bones are subjected to marrow fracturing, together with other destructive processes such as gnawing by dogs and burning. The refuse from the butchering probably went either directly into a lake or perhaps to the dogs. The nature of the applied marrow fracturing techniques and the relative importance of the processes are major factors in the preburial taphonomical history of the skeleton.

An analysis of marrow fracturing from various Mesolithic settlements from different periods is presented in the following section. Furthermore an evaluation is made of the taphonomic significance of different types of butchering and marrow fracturing techniques used by different cultures. This is particularly relevant since several authors (e.g. Uerpmann 1971, 1973; Clason 1967, 1972, 1974) have tried to estimate the original number of prey individuals on the basis of number of bone fragments without seriously taking the different butchering and marrow fracturing techniques into consideration. The various types of marrow fracturing found seem to belong to cultures at different technical levels. It would seem to be possible within a limited area such as northern Europe to establish a chronology using marrow fracturing type as an ecostratigraphic tool.

Before going any further it is necessary to define the three terms butchering, marrow fracturing and marrow splitting, as the last term especially has been applied to nearly all types of fragmentation.

Butchering is the cutting up of the animal while the meat is still attached to the bones, while marrow fracturing covers all the various processes by which the marrow is extracted, e.g. by cutting, beating, breaking, and crushing. Marrow splitting is a special case within the frame of marrow fracturing describing a process by which the bone is split longitudinally in two. The splitting is performed by a series of blows along the bone diaphysis after the meat has been scraped away. The term marrow fracturing carries no implication as to when the process took place in relation to the cooking of the meat.

The taphonomic model presented predicts that the number and kind of bones entering the burial stage at a site will depend on the butchering and marrow fracturing techniques applied by the inhabitant of the site. A further prediction is therefore that different cultures will produce different bone assemblages (Noe-Nygaard 1977).

MARROW FRACTURING IN THE MESOLITHIC

Material and methods

In the following account marrow fracturing techniques are compared from four Mesolithic bog deposits. These sites are: Star Carr (7500 ± 120 bc), Kongemosen (5600 ± 100 bc), Præstelyngen (3280 ± 100 bc), and Muldbjerg I (2900 ± 80 bc) (fig. 4), (Tauber 1970, 1972). The excavated material from the four sites was originally deposited in a lake close to the various habitations, embedded in gyttja (organic mud) with a minor content of calcium carbonate and drifted pieces of wood. The material is refuse from the settlements and was thrown into the lake which served as a dump. The bones do not seem to have lain scattered around the habitation for very long, since they bear little sign of physical destruction and wear. Gnawing marks occur on all four sites but few in quantity on the older sites. The bones seem have been thrown into the lake shortly after their use by humans ceased.

In the Danish material the state of preservation is extremely good, especially in the more calcareous layers of the bog deposits. Most of the bones are dark, hard and heavy and a large number of smaller fragments are preserved. However, where later postglacial humification has taken place, the bones have undergone some degree of decalcification and are very light and brittle and a light brown colour. In the Star Carr material many of the bones were in a very bad state due to decalcification and had to be impregnated with preservative simultaneously with excavation. In deposits where there has been decalcification, small fragments are almost lacking. The smaller the size of the fragments from the various marrow fragmentation processes the lesser the chance they stand of preservation in humified bog deposits. Their larger surface area exposed to dissolution leads to their more rapid dissolution. In Star Carr where the state of decalcification was most advanced very few small fragments were recorded. Also the

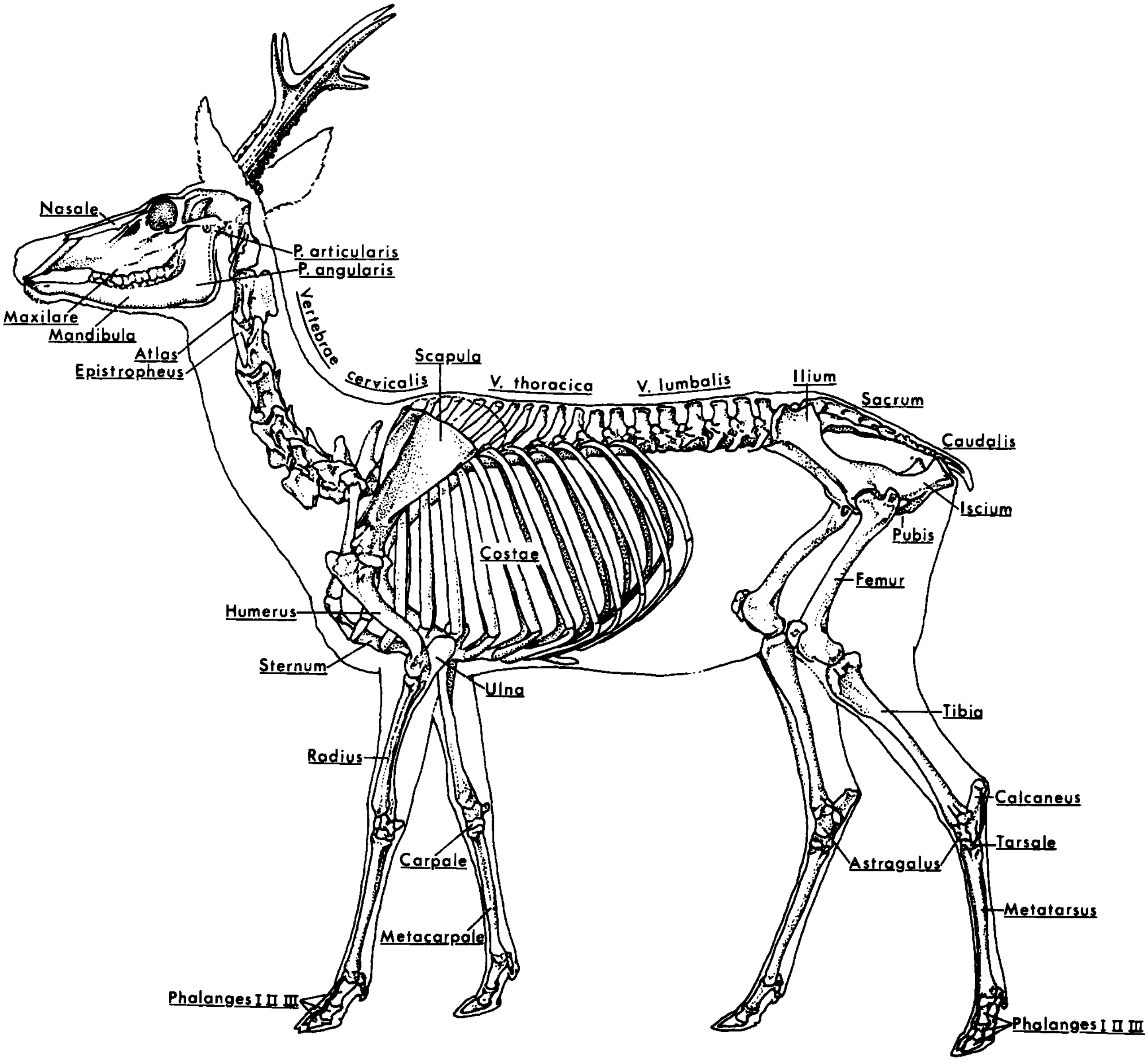


Fig. 22. Skeleton of roe deer with latin names on the various bone elements mentioned in the text.

possibility of overlooking small fragments is considerable, unless sieving techniques are used (Payne 1972). Even after the smaller fragments have been extracted, the possibility of identifying them to species and specific bone is limited and very time-consuming. Lyon (1970, p. 214) states that the destruction of bones by dogs on a site is the more complete the smaller the fragments. However, chewing marks are seen on the material from all four sites, so this can hardly be the only reason for the differences in number of small fragments recorded from the sites.

The fragments found in the refuse from the different sites are composed of a mixture of remains from meals, waste from implement production, and carcasses from skinned animals. The way in which the bones are reduced to fragments is determined by their use to man and to a certain extent by the structure of the bone. An example is illustrated by the material from the Palaeolithic Jaguar Cave (Idaho, USA) (Sadek-Kooros 1972, 1975). The outline of the illustrated bone fragments of metatarsus is very similar to that of the fragments found at both Star Carr and Kongemosen. In my opinion all of the fractures on the metatarsus described as primary from the Jaguar Cave (Sadek-Kooros 1975) and the similar fractures on the Kongemosen and Star Carr material were intentionally made in order to break the bone and get access to the marrow – in other words, were caused by marrow fracturing. The secondary fractures described by Sadek-Kooros (1975, p. 141), supposedly made to shape the primary fractures to some sort of an implement, do not alter the potential number of fragments per bone, nor do they unequivocally indicate the use of the fragment as a tool. A polish may be obtained in several ways, e.g. by serving as pavement on a floor.

Whether it is butchering, marrow fragmentation or implement production that determines the outline of the fragments is not so important, but fragmentation often seems to be uniform within a specific cultural group, and this may have wider implications.

The names of the various bones described below are shown in fig. 22.

Discussion and material of shed and unshed antlers from Starr Car has not been included in order to facilitate the comparison with Præstelyngen.

Bone material from Star Carr and Kongemosen

In the bone material from Star Carr (Clark 1954) which I had the opportunity to re-examine in 1974, the butchering technique and marrow fracturing was very uniform for the important game such as giant ox, elk, red deer, and roe-deer, whereas wild boar seemed to be butchered in a different way. The analysis of the technique used on the different bones will be exemplified by red deer.

Mandibles. – Forty-eight identified pieces, 23 from the right side, 15 from the left side, and from adult animals, plus two right fragments from juveniles. All of the mandibles were fragmented into 3–4 pieces (fig. 23). The fragment type most commonly found among the identified bones in the tooth-bearing part of the horizontal ramus, but several examples of the other fragment types occur among the unidentified bones.

Proceeding to the limb-bones, a characteristic pattern again emerges.

Humerus. – Twenty-three fragments including 2 which were decalcified and desiccated beyond further recognition, 10 dextral distal epiphyses, and 11 sinistral epiphyses. With very few exceptions (e.g. roe-deer), the humerus is represented by the distal part, the epiphyses, to-

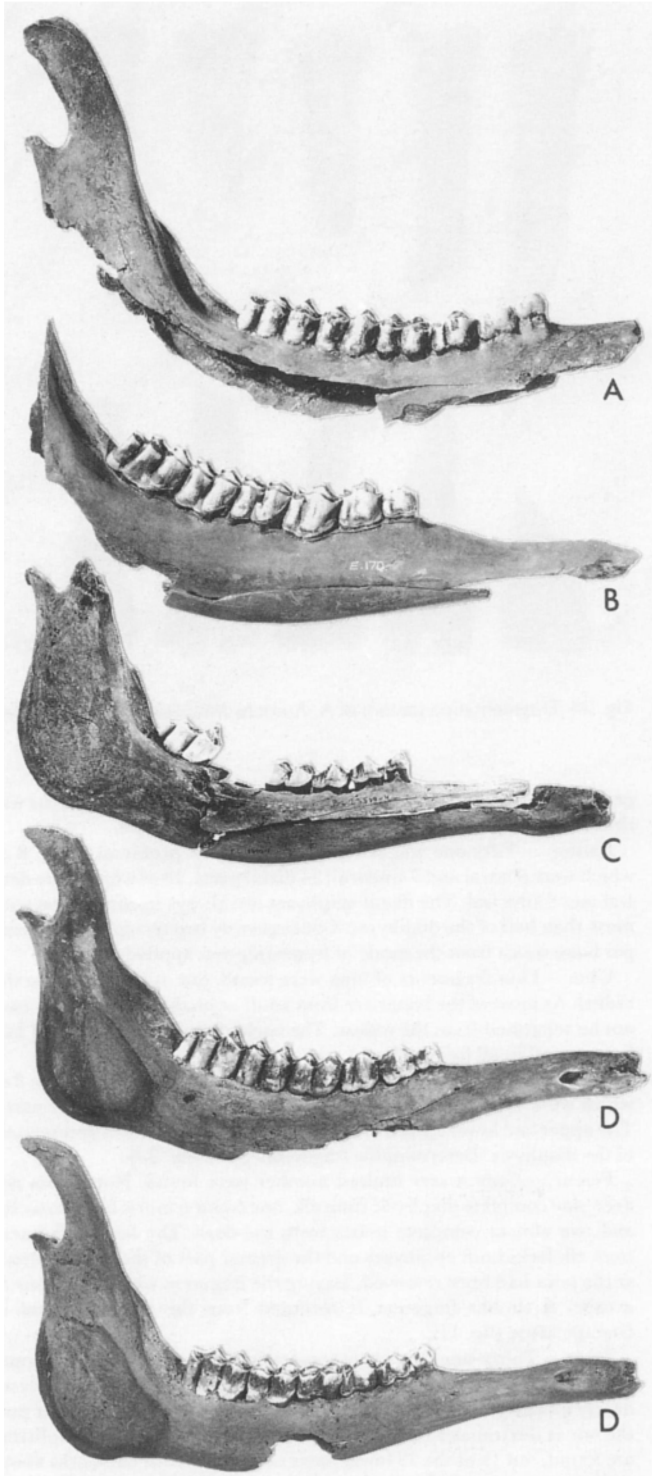


Fig. 23. Fragmentation pattern of the mandible of red deer from A: Kongemosen; B: Star Carr; C: Præstelyngen; D: Muldbjerg. For further explanation see the text. ⅓.

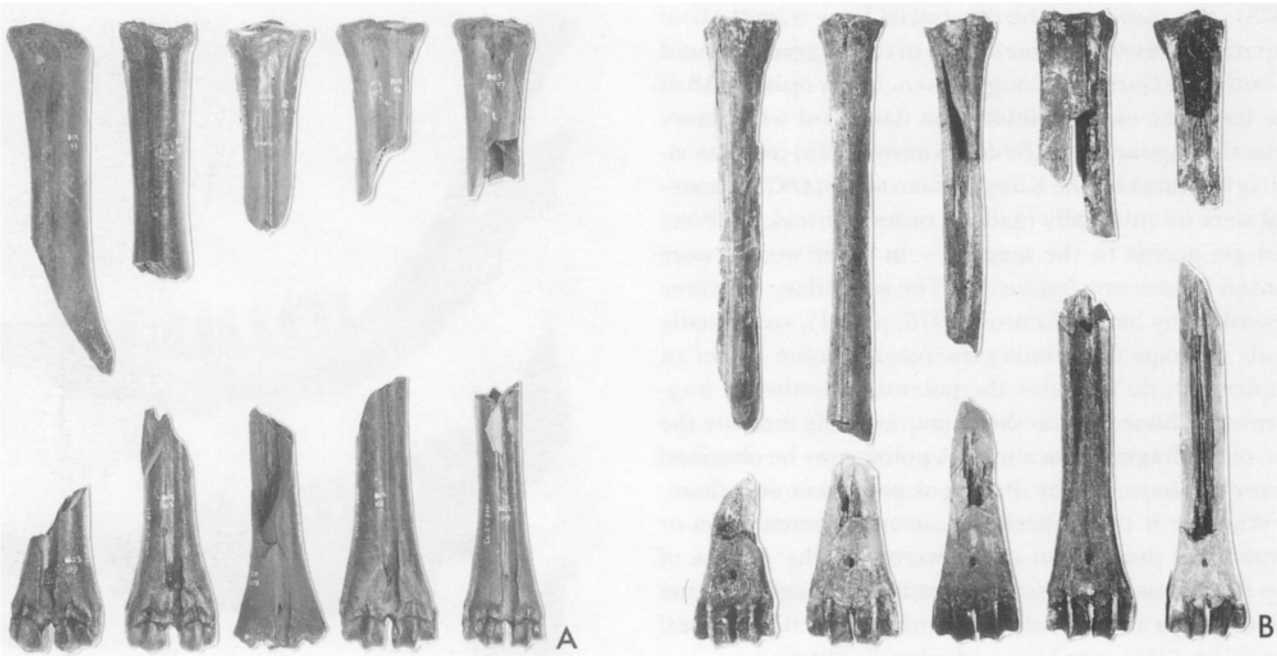


Fig. 24. Fragmentation pattern of A: Aurochs from Star Carr, and B: Red deer from Kongemosen. Size: A × ⅕–⅙, B × ¼.

gether with a greater or smaller part of the diaphysis. The humerus was thus divided into 2 to 3 recognizable fragments per bone.

Radius. – Fifty-one fragments comprising 17 proximal parts, 8 of which were dextral and 7 sinistral; 34 distal parts, 18 of which were dextral and 6 sinistral. The distal epiphyses are always in connection with more than half of the diaphyses. Consequently two recognizable pieces per bone result from the mode of fragmentation applied.

Ulna. – Four fragments of ulna were found, one still attached to the radius. As most of the bones are from adult animals, the diaphysis cannot be separated from the radius. The neck of the head of the ulna had been cut off in all four cases.

Metacarpus. – Fifty-eight fragments comprising 17 upper parts, 8 of which were dextral and 9 sinistral, and 9 sinistral, and 41 lower parts. The upper and lower epiphyses are always connected with a greater part of the diaphysis. Determinable fragments per bone: 2–3.

Femur. – Only a very limited number were found. None from red deer, one complete diaphysis from elk, one caput femoris from aurochs, and two almost complete bones from roe-deer. The femur fragment from elk lacks both epiphyses and the greater part of the spongy tissue at the joint had been removed, leaving the fragment with the outline of a tube. A similar fragment is recorded from the aurochs found in Grænge Mose (fig. 11).

Tibia. – Thirty-one fragments comprising 29 lower parts and 2 upper parts. The lower parts comprised 19 dextral and 10 sinistral epiphyses nearly all carrying a large part of the diaphysis. Of the two upper part the one is dextral and the other sinistral. No traces of marrow splitting are found, but 17 of the 29 lower parts carry numerous cut marks above the joint, probably deriving from cutting of the tendons in an attempt to separate the metatarsal bone from the tibial bone. There are two to three identifiable fragments per bone (fig. 20).

Metatarsus. – Fifty-seven pices, 38 of which are from the lower part and 13 from the upper parts (4 dextral and 9 sinistral). Six identifiable fragments of the diaphysis are recorded. Three of the lower parts belong to juveniles with loose epiphyses. All the upper or lower parts are connected with a greater part of the diaphysis. Maximum identifiable fragments are 2–3 per bone.

Rather few fragments of ribs and vertebrae are among the identified bones and no butchering or marrow fragmentation pattern is observed. The pelvic bones are all broken in the same way, and only the fragments around the acetabulum are found.

In the bone material from the early Atlantic settlement Kongemosen (5600 ± 100 bc), the butchering and the fragmentation technique employed was much the same as the one used at Star Carr (7500 ± 120 bc), compare fig. 24 and fig. 21. However, a few exceptions should be mentioned. The fracturing blow in the Star Carr material was placed on the lateral side of the diaphysis, while in the Kongemosen material the blow marks are most commonly situated on the front side or on the back side. The mandibles in the Star Carr material were fragmented in a basically uniform way (fig. 23), whereas the Kongemose mandibles were rarely fragmented, and when fragmentation occurred it was done in what looked as a casual manner. Later examinations revealed three types of repeated pattern of jaw fragmentation (Noe-Nygaard in press). The remains of the Star Carr wild boar are extremely fragmented and very few are identifiable: in total only 30 pieces, distributed over an estimated minimum number of five individuals. The only pattern observed is on the lower jaw bones where the incisional part of both left and right sides was cut off in the diastem between the canine teeth and the incisors. In the Kongemose material of wild boar the degree of fragmentation is much reduced compared with that of Star Carr. Furthermore, the modes of butchering and marrow fragmentation were the same for all of the game animals.

Bone material from Præstelyngen and Muldbjerg I

In the late Mesolithic (3280 ± 100 bc) site, Præstelyngen, the patterns of butchering and marrow fragmentation are different. The fragmentation technique employed on roe-deer follows that used on red deer, whereas the bones from the wild boar are extremely fragmented. In addition to the high degree of fragmentation of wild boar rather few fragments were retrieved; only 155 out of an estimated minimum number of 4 individuals. For comparison it should be mentioned that red deer is represented by 766 identified fragments with an estimated minimum number of 9 individuals. The most important game at Præstelyngen is red deer, roe-deer and wild boar. Red deer will again serve as an example.

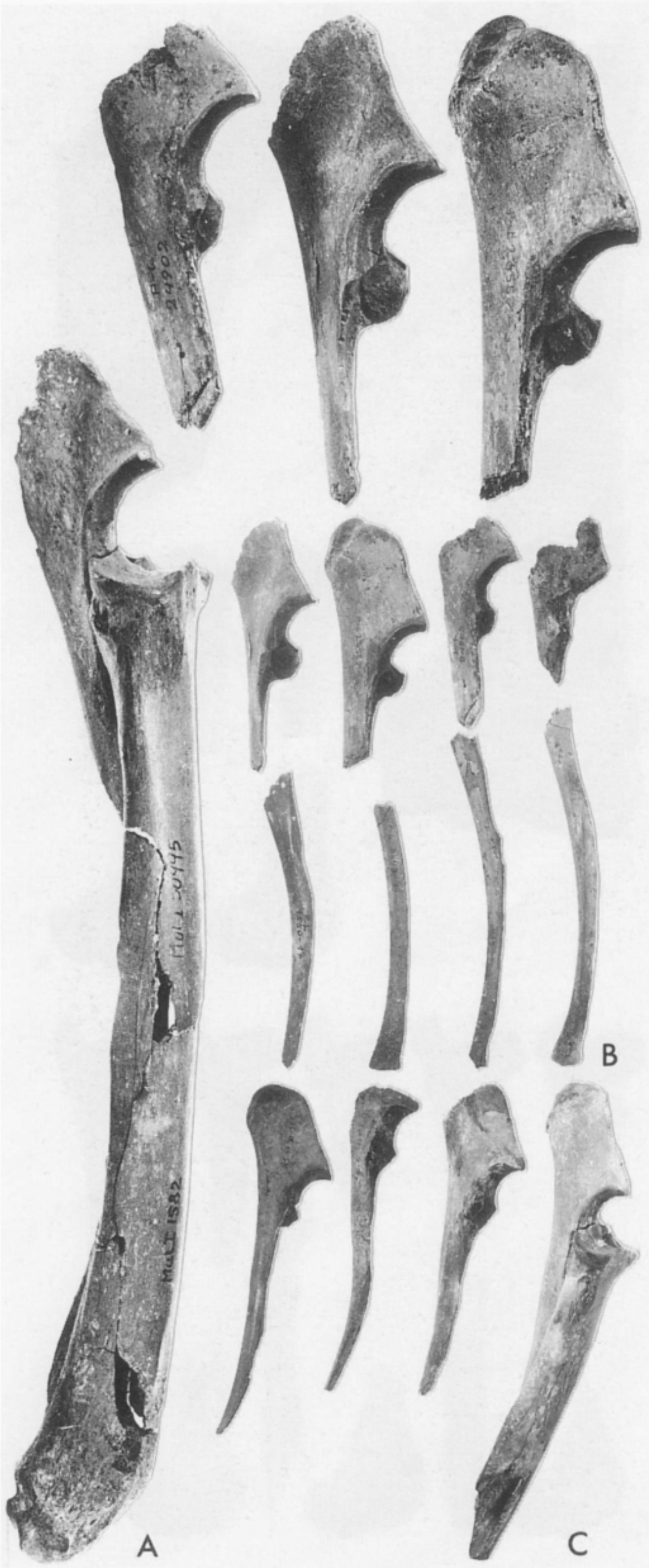
Mandibles. – Twenty-eight fragments, many of which should be reassembled, comprised dextral, 6 sinistral and 6 fragments which cannot be left/right identified. The mandibular bones were always broken into 3–4 pieces by a hard blow on the horizontal ramus just below the second and third molars. One typical fragment comprises the processus articularis together with the jaw containing the last two molars (fig. 23).

There is a second type in which the horizontal ramus is divided horizontally into two pieces and finally, in a few cases, the incisor region is broken off. Reassembling and gluing the fragments together leads to a better understanding of the mode of fragmentation. The jaw bones belong to animals ranging in age from 3 months to fully grown.

Humerus. – Twenty-seven fragments comprising 6 proximal ends (3 dextral and 3 sinistral), and 10 distal ends (5 dextral and 5 sinistral) together with 11 fragments of the diaphysis, 8 of which can be identified as to side (5 dextral and 3 sinistral). The number of determinable fragments per bone is 3–4. These had been produced by removal of the proximal and the distal epiphyses and division of the diaphysis laterally into two by blows along the shaft of the bone (fig. 25).

Radius. – Seventeen fragments comprising 6 distal parts (5 dextral and 1 sinistral) and 1 proximal part from the left side. From the diaphysis 10 fragments are identified, 8 of which comprise 3 dextral and 5

Fig. 25. Fragmentation pattern of humerus of red deer from A: Kongemosen; B: Præstelyngen. Note the difference in outline of the fragments. Size: The enlargement × ¾, A and B × ¼.



sinistral pieces, and two fragments which cannot be specifically assigned to a side. The radius was fragmented by removal of the proximal end and then splitting along the diaphysis which was still attached to the distal epiphysis. Traces of the splitting, which took place by means of a series of blows along the shaft of the bone, can still be seen on the fragmenting leaves us with 3 identifiable pieces.

Ulna. – Eleven fragments comprising 7 proximal ends (2 dextral and 5 sinistral) and 5 fragments of the diaphysis (2 dextral and 3 sinistral). The ulna is normally represented by two types of fragments, the head and the shaft. Juvenile ulnae are separated from radii whereas adult diaphyses remain fused with the radii (fig. 26).

Metacarpus. – Fifteen fragments comprising 7 proximal ends (6 dextral and 1 sinistral) and 7 distal ends with diaphyses (5 dextral and 2 sinistral) plus 1 fragment of the diaphysis. The normal number of fragments per bone is 2–3 and the fragmentation was carried out in the same way as in the material from Kongemosen; the distal epiphysis was removed and the diaphysis and proximal epiphysis were split. Clear striking marks are seen along the diaphysis.

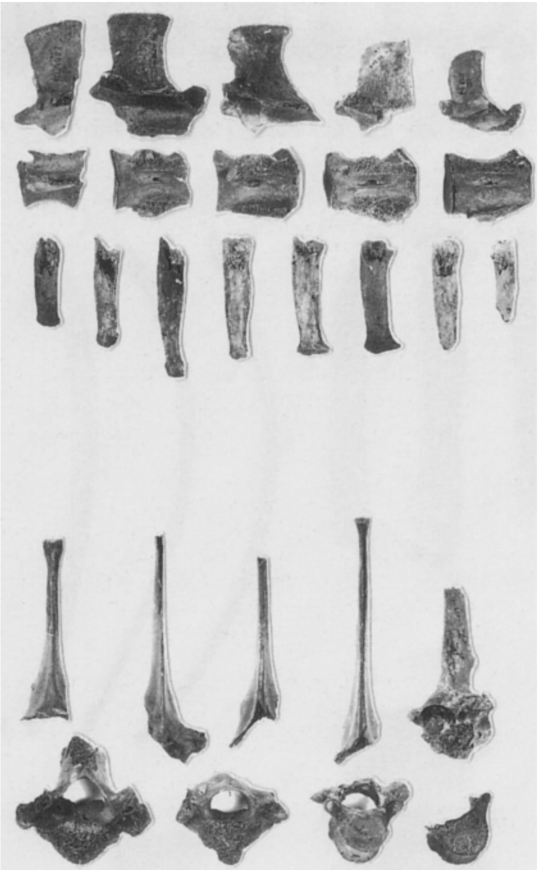
Femur. – Twenty-seven fragments comprises 3 proximal ends (1 dextral and 2 sinistral), 5 distal ends (4 dextral and 1 sinistral), and 14 fragments of the diaphyses (8 dextral and 6 sinistral) together with 5 pieces that cannot be classed with a specific side. The femur was parted into 4 identifiable fragments: a distal end, a proximal end, and two laterally split fragments of the diaphysis.

Tibia. – Fifty-one fragments comprising 7 proximal ends (5 dextral and 2 sinistral) and 5 distal ends (4 dextral and 1 sinistral). In addition 31 fragments of diaphyses (15 dextral and 16 sinistral) and 10 fragments of diaphyses, which cannot be assigned to any specific side, are recorded. The tibia was divided into 4 identifiable fragments: upper and lower ends and two longitudinally split fragments from the diaphysis (fig. 20).

Metatarsus. – Eighteen fragments comprising 4 proximal ends (2 dextral and 2 sinistral) and 5 distal ends (2 dextral and 3 sinistral). 9 diaphysial fragments, 5 from the dextral side and 3 from the sinistral side, with one not assignable to either side. The metatarsal bone was parted into 3–4 identifiable pieces as opposed to the metacarpal bone. In many cases both the upper and lower ends were cut off.

At the settlement Muldbjerg I, 200–300 years younger, which was inhabited in the period just at the Mesolithic/Neolithic transition, we find a pattern of butchering and marrow fragmentation which is very similar to the pattern found at Præstelyngen. The same pattern also applies to the skeletal part of the few fragments of domesticated animals found at Muldbjerg I. The similarity in butchering technique might indicate that no major change in food preparation took place at the Mesolithic/Neolithic transition and the people inhabiting the two sites may have belonged to the same ethnic group. However, the material is too limited to allow this conclusion before more dated settlements have been examined.

Fig. 26. Fragmentation patterns of ulna of red deer from A: Muldbjerg; B: Præstelyngen; C: Kongemosen. Note the completeness of the reconstructed radius and ulna from Muldbjerg. Size: A × 3/5, B and C × 1/2.



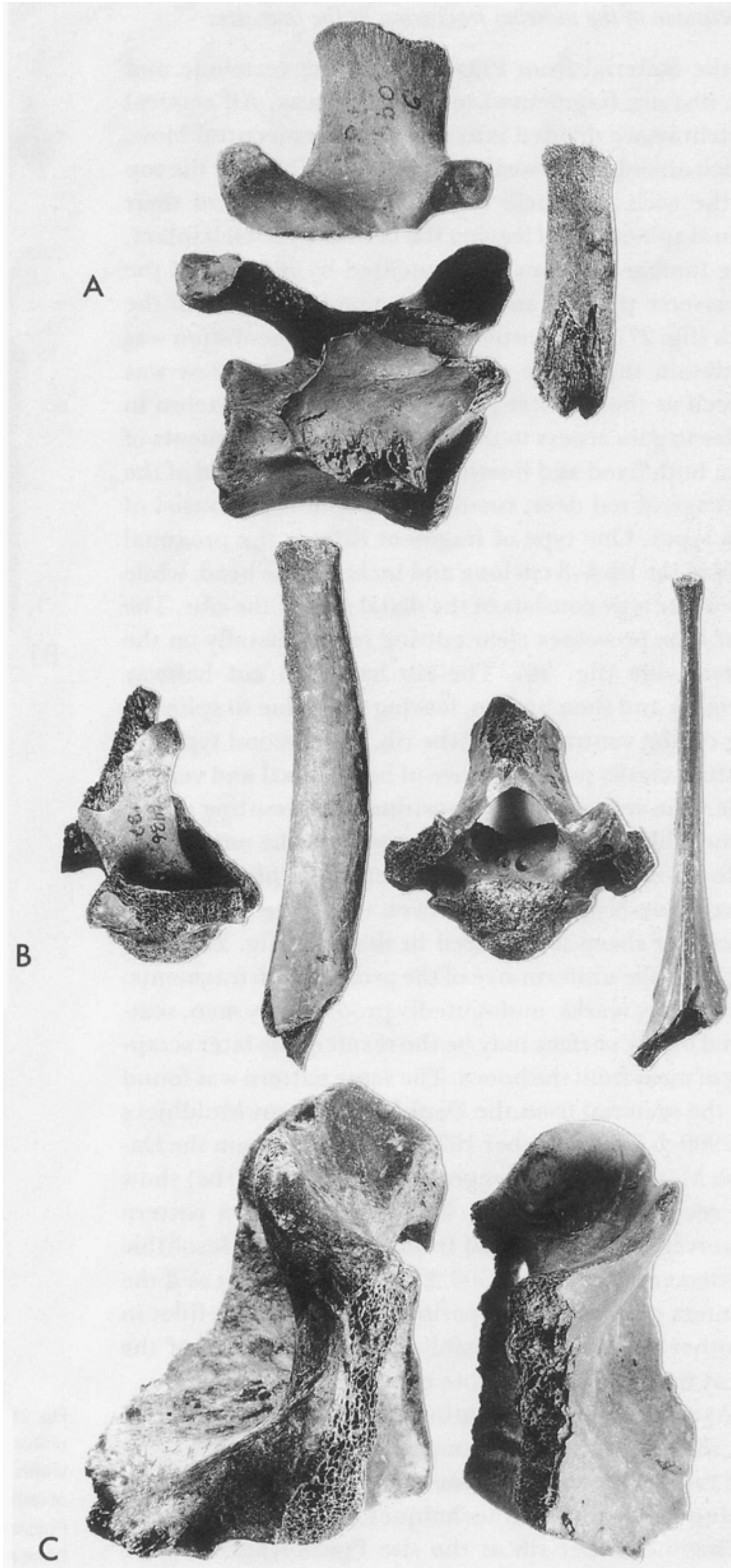


Fig. 27. C: Fragmentation pattern of vertebrae cervicalii of red deer from Præstelyngen. B: Fragmentation pattern of vertebrae thoracicae of red deer from Præstelyngen. C: Fragmentation pattern of vertebrae lumbalii of red deer from Præstelyngen. Size: C × 1.

Discussion of the marrow fracturing at the four sites

In the material from Præstelyngen the vertebrae and the ribs are fragmented in a specific way. All cervical vertebrae are divided into two by a dorsoventral blow, which aimed at the weakest point of the bone at the top of the arch. Thoracic vertebrae are relieved of their neural spines, often leaving the neural arch itself intact. The lumbar vertebra is fragmented by removal of the transverse process and neural spine together with the arch (fig. 27). The purpose of all this fragmentation was to obtain the edible medulla spinalis. The blow was placed at the weakest point of the specific vertebra in order to gain access to the spinal marrow. Fragments of ribs, both fixed and floating, from the caudal end of the rib cage of red deer, roe-deer and wild boar consist of two types. One type of fragment is from the proximal part of the rib 6–8 cm long and includes the head, while the other type consists of the distal part of the ribs. The first type prosesses clear cutting marks distally on the dorsal side (fig. 28). The rib has been cut halfway through and then broken, leaving scars due to splintering on the ventral side of the rib. The second type has cutting marks on the surface of both dorsal and ventral side. The very consistent position of the cutting marks is most likely due to the need to remove the unmanageable rib-ends just beyond the fillet before preparing the meat (Noe-Nygaard 1969). Even today the "back bone steak" of sheep is prepared in this way (fig. 28). This explains the uniform size of the proximal rib fragments; the cutting marks, undoubtedly produced by man, scattered on the surface may be the result of the later scraping of meat from the bones. The same pattern was found on the material from the Danish settlement Muldbjerg I (2900 ± 80 bc; Tauber 1970, 1972). Ribs from the Danish Mesolithic site Kongemosen (5600 ± 100 bc) show no recognizable pattern. Neither was such a pattern observed on the material from the English Mesolithic settlement Star Carr (7500 ± 120 bc). It seems as if the hunters of these earlier periods prepared their fillet in another way, which possibly involved removal of the meat from the bones before cooking.

As no actual fragmentation of the ribs has taken place, the fragments from Kongemosen and Præstelyngen are rather large and determinable to species. However, owing to the different techniques applied, the number of fragments per rib at the site Præstelyngen will be twice that at the site Kongemosen.

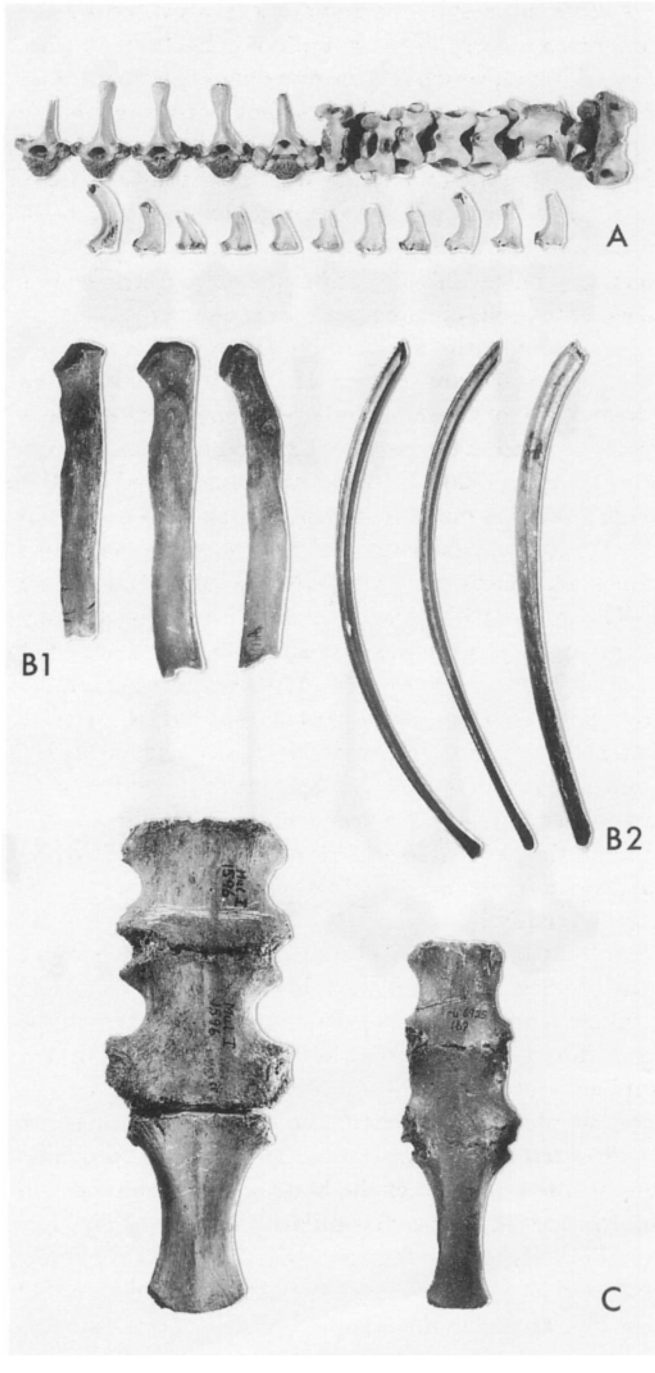


Fig. 28. A: Left over of meal year 1986 of sheep neck and back. Note the uniform length of the rib fragments. The length of the ribs indicate the width of the sirloin along the backbones. B: Fragmentation pattern of ribs of red deer from Præstelyngen. C: Sternum of red deer and roe deer from Præstelyngen. Note the uniform position of strong cut marks on both bone elements resulting from similar butchering techniques at the two sites. Size: $B_1 \times \frac{1}{2}$, $B_2 \times \frac{1}{4}$, $C \times \frac{1}{2}$.

A possible result of butchering is provided by the common recovery of the complete collections of phalangeal bones, which may be due not only to their more solid structure but also to the butchering technique applied; one of several possible explanations is that the distal ends of the limb bones were removed at an early stage of the cutting-up of the animal and were thrown away into the adjacent lake. The head had probably been cut off at an early state as well; cutting marks across the occipital condyles may indicate this.

To sum up, the marrow fracturing technique employed at Star Carr (7500 ± 120 bc) and Kongemosen (5600 ± 100 bc) is very similar while it differs in nearly all respects from the pattern found in the material from Præstelyngen (3200 ± 100 bc) and Muldbjerg I (2900 ± 80 bc). No real marrow splitting of the limb bones has taken place at Star Carr and Kongemosen. The long bones are nearly all represented by upper and lower ends together with greater parts of the diaphysis; fragments of diaphyses were recorded in only a very few cases. These fragments either were not produced by marrow fracturing, were lost during diagenesis, or escaped recovery because of small size. Nevertheless, even if all the fragments had been found, for example by use of the unusually detailed and meticulous excavation methods practised by Troels-Smith (1957) or by sieving methods, they would have been extremely difficult to identify.

At Præstelyngen and Muldbjerg I the limb bones are each divided into 3–4 identifiable parts, often as a result of marrow splitting: an upper, a lower, and at least two larger fragments of the diaphysis. In contrast to this dissimilarity of fragmentation of most bones, one exception should be mentioned: the metapodial bones are fragmented in a similar way at all four sites, probably due to the structure of the bone and its usefulness in tool processing. The dissimilarity between Star Carr and Præstelyngen in fragmentation of ulnae is merely a question of the ontogenetic age of the captured animal (fig. 26). Fusion of the ulna to the radius takes place after 36 months in red deer. The fact that the average age of the animals at Star Carr seems to be higher than the average age of the animals at Præstelyngen fits well with the supposed different targets of the people of the two settlements. Star Carr is considered to be primarily an autumn/winter settlement and/or hunting site where the hunters concentrated on antlers as raw material for tool processing and, of course, on a meat supply (Clark 1954, 1972; Noe-Nygaard 1975a), whereas Præstelyngen was a summer hunting and fishing settlement, which produced a number of juvenile red deer bones (Noe-Nygaard 1969, 1977).

Although the number of investigated sites is limited, it seems to be confirmed that 1) the number and kind of bones entering the burial stage at a site depends on the butchering and marrow fracturing technique applied, and that 2) the style of marrow fracturing and butchering do change between the different cultures whereas they are almost uniform within the same culture. Therefore, the patterns of marrow fracturing and butchering have considerable potential as ecostratigraphical tools. Binford (1981) suggested that the difference in marrow fracturing at the four sites exclusively was due to differences in the function of the sites.

Experimental marrow fracturing

In order to throw light on the differences and similarities in marrow fracturing at the four sites some experiments with modern material have been undertaken.

A roe-deer carcass was butchered and the limb bones were separated at the joints. The majority of the experiments were performed before any cooking took place and while most of the meat was still attached to the bones. The front limb bones were marrow fractured by blows inflicted with a stone having the shape of a *coup de point*. The hind limb bones were fractured by holding the bone by one end and beating it against a hard object of wood or stone using it as a club. It turned out to be difficult to place the blows on the stone accurately within a definite area owing to the protection of the meat and sinews and the elasticity of the fresh bone. The position of the break on the humerus was furthermore rather unpredictable. The radius and ulna were strongly fused along the diaphysis and only the proximal end of the ulna could be broken off. Later, when cooked and dried, marrow splitting of the radius was attempted by a series of blows along the diaphysis, but produced negative results. Similarly it was attempted to marrow-split the fresh metacarpal bone with a series of blows along the diaphysis, but it was found almost impossible to place the blows precisely on the bone as the stone slipped on the bone membrane. When the bone finally broke, the position of the fracture was unpredictable. The femur was fractured by striking the bone on a hard object. In this case the position of the fractures was easier to determine and the break was predictable (fig. 29). The tibia was broken in a similar way, placing the impact of the blow just below the attachment of the larger muscles. The fracturing resulted in two fragments, an upper end and a lower end in connection with a larger part of the diaphysis and a few minor fragments (fig. 29). The metatarsal bone was broken in a similar way (fig. 29). Many of the metapodial bones at the four above-mentioned sites were split along the diaphysis and included splitting of the upper epiphysis. Splitting of modern metapodials of roe-deer and sheep was therefore attempted by means of a blow placed on the surface of the upper joint. This resulted in a splitting of the bone into two fragments with an outline similar to the fossil fragments.

The experiments led to the following conclusions. The actual splitting of the bone of the diaphysis as found at Præstelyngen and Muldbjerg I most likely took place after the removal of the meat, for this would have been necessary to get access to the diaphysis in order to divide the bone along its full length. The habit of splitting the diaphysis might then indicate that the meat was cooked before dividing the bone. When cooked, the membrane surrounding the marrow tends to adhere to the inner side of the bone wall. To split the bone would therefore be a reasonable way to gain access to the marrow of the diaphysis in order to scrape it out. When reindeer bones are fractured, the large diameter of the marrow cavity renders it unnecessary to break the diaphysis as the marrow can be pushed out of the tube (Ulrik Møhl, pers. comm. 1972). The fragments from Star Carr and Kongemosen show no sign of splitting and are composed of lower ends and upper ends with larger parts of the diaphysis much like the fragments derived from the experiment. They could have resulted from removal of part of the bone before cooking. Breaking of the bone before cooking has two advantages, firstly the raw marrow is easy to pull out and secondly the steaks will be of a more manageable size without the lower, sparsely meat-covered end.

Assuming that the above hypothesis for the genesis of the fragments produced at the four sites is acceptable, it would then be interesting to know if differences in the marrow fracturing were consistent within an ethnic group and different from that of other ethnic groups. In this connection it is of great importance that both cases of assumed pre-cooking fracturing belong to cultures with no recorded ceramics. In contrast the assumed post-cooking fracturing was found in cultures possessing ceramics. In cultures without ceramics, roasting of meat has probably been the more common way of food preparation although the small number of burnt fragments including epiphysial parts of the bones from the excavations might indicate application of other methods in food-processing, such as boiling, drying and smoking. Cooking could have taken place by heating stones and dropping them into water held in a skin bag or a wooden container. The insignificant number of burnt bones at the sites might be due to other reasons: they are less resistant to weathering and in some cases they might have burnt away completely. Therefore, lack of burnt bone material does not necessarily indicate boiling as a food preparation method, but roasting is not likely to have been the only method employed at the sites Star Carr and Kongemosen.

If we assume that boiling has been one way of cooking in the aceramic periods, and if boiling has taken place by use of hot stones, the size of the steak will have a certain importance. Firstly, the size of the container in which the cooking takes place determines the size of the meat to be boiled, and secondly, it is easier to heat water in small containers. A reasonable way to reduce the size of a steak containing a bone such as a tibia, femur or humerus would be to remove before cooking the part of the bone which is sparsely covered with meat. The resulting fragments from such a procedure would correspond to many of the fragments found at Star Carr and Kongemosen. A number of the fragments will even have the outline of fragments resulting from modern butchering.

I conclude that the main pattern of marrow fracturing at Star Carr and Kongemosen was determined by pre-cooking marrow fracturing to reduce the size of the steak suitable for cooking. A superficial examination of the bone material from Ulkestrup Lyng – a Danish bog site from the Maglemosian culture dated to 6100 bc (fig.

Fig. 29. A: Femur, tibia and metatarsus of a modern roe deer fragmented by striking it on a hard table. Note the type and number of possible identifiable fragments. B: Humerus, metacarpus, ulna and radius of a modern roe deer fragmented by a chisel-pointed stone. Note the number and outline of identifiable fragments. Size: × ½.


A
B

4) – seems to fit well with this conclusion. Apart from the general pattern common at Star Carr, Kongemosen, and Ulkestrup Lyng, distinct minor differences are also recorded. These might be due to smaller differences in cultural tradition.

DIFFERENCES IN MARROW FRACTURING AS A TAPHONOMIC FACTOR

Four hypotheses are proposed to explain the interdependence between number of retrieved bones, estimated minimum number of individuals, and butchering and marrow fragmentation techniques.

1. The number of fragments per individual of a species depends on the butchering and the marrow fracturing techniques employed.
2. Differences in butchering and marrow fracturing of different species on a site result in differences in the proportion between number of fragments and estimated minimum number of individuals.
3. The degree of retrieval of different species on a site depends therefore on the butchering and marrow fracturing employed.
4. Differences in the proportion of fragments to estimated minimum number of individuals of a species at different sites express the degree of the taphonomic overprint, other things being equal. If the proportion is small the overprint is strong, and vice versa.

The type of marrow fracturing of the bones at the site Præstelyngen gives means of calculating the theoretical number of bone fragments of an animal. Thus red deer would be broken into at least 263 more or less determinable pieces, where the 263 fragments are an estimated minimum presumably well below the actual number of fragments. The type of fracturing known at Star Carr gives an estimated minimum number of determinable fragments of about 146 (fig. 30). The estimated number of individuals is, however, not likely to be affected much by the different butchering methods as the estimate most often is based on the more solid parts of the skeleton, such as epiphyses and the tooth-bearing portion of the jaw bones. These parts are rarely directly affected by the fracturing. The minimum number of individuals is more likely to be affected by seasonal factors, such as differences in age of the animals. Bones from young animals are more easily decomposed than the bones from adults. In this case it is thus a question of analyzing the effect of the seasonal variation.

A comparison of faunal remains from different sites on the basis of fragments, if at all permissible, necessitates at least an analysis of the marrow fracturing technique applied at the sites. Pronounced differences in the relative amount of fragments of a species from one site to another might be due solely to differences in fracturing.

The various weighting methods (*e.g.* Kubasiewicz 1956; Uerpmann 1971, 1973; Clason 1971) which attempt to quantify the number of animals butchered at a site are all based on the fragments retrieved as the primary material. Consequently, all the methods are affected by the butchering and marrow fracturing methods employed, as these are responsible for the number of fragments. Furthermore, the weighting methods are also dependent on uniform conditions within the deposit containing the bones. The influence of this sedimentary factor of the weight of bones can be illustrated with an example from the site Præstelyngen. Skeleton elements from a dog have been recovered from the site. Parts of the skeleton were situated in the gyttja (organic mud), and parts of it in the peat (fig. 8). One tibia from each type of sediment was measured and weighed. The bones had exactly the same length, but whereas the one found in the gyttja weighed 18.05 g, the one found in the peat weighed 11.30 g. A loss in weight of 83% is thus a result of variation in the local chemistry within a small area at a site. This type of pitfall together with other factors such as variation in bone weight according to sex and age imply that this method must be considered unreliable in spite of new calculation methods and arguments introduced by Clason (1974). Especially where the method is used in comparing faunal remains from different sites, the assumptions that have to be made in order to simplify the calculations, together with the above mentioned problem, lead to the conclusion that this methodological approach ought to be abandoned.

It should be emphasized that the bone material of one species from a bog site will have another weight than the bone material of the same species found at a kitchen midden. This can be demonstrated by a comparison of bone weights from the site Brovst with those at the site Præstelyngen. The site Brovst is composed of two shell deposits. One dating from the Kongemose culture and one from early Ertebølle culture (Andersen

	No.	Præstelyngen	Star Carr
Calvarium	1	1 x 10 = 10	1 x 10 = 10
Mandibula	2	2 x 4 = 8	2 x 1 = 2 (8)
Vertebrae	24	3 x 12 + 2 x 12 = 60	24 x 1 = 24
Costae	28	2 x 28 = 56	1 x 28 = 28
Femur	2	2 x 4 = 8	2 x 2 = 4
Tibia	2	2 x 4 = 8	2 x 2 = 4
Humerus	2	2 x 4 = 8	2 x 2 = 4
Radius	2	2 x 3 (4)= 6-8	2 x 2 = 4
Ulna	2	2 x 2 = 4	2 x 2 = 4
Fibula	2	2 x 1 = 2	2 x 1 = 2
Acetabulum	2	2 x 3 = 6	2 x 1 = 2 (6)
Sternum	1	1 x 1 = 1	1 x 1 = 1
Scapula	2	2 x 1 = 2	2 x 1 = 2
Sacrum	1	1 x 2 = 2	1 x 1 = 1
Metacarpus	2	2 x 3 = 6	2 x 3 = 6
Metatarsus	2	2 x 4 = 8	2 x 3 (2)= 4-6
Tarsal	5	5 x 2 = 10	5 x 2 = 10
Carpal	5	5 x 2 = 10	5 x 2 = 10
Phalanges	12	12 x 4 = 48	12 x 2 = 24
Total		263	146

Fig. 30. The calculated number of fragments of each type of bone of a *Cervus elaphus*, at Præstelyngen and at Star Carr. The difference in number of fragments at the two sites is due to the difference in marrow fracturing technique used at the two settlements.

1971). The bones from Brovst are about half as heavy as the bones found in gyttja at Præstelyngen and Kongemosen whereas the bones found in the peat at Kongemosen have more or less the same low weight as those from the shell deposit at Brovst. At the Brovst site the organic collagen fibers have been removed, and in spite of the calcium rich milieu, the inorganic calcium hydroxyl apatite is decomposed by transport of material and mechanical weathering. The exchange of material and transport of $CaCO_3$ in solution is a well-known process causing problems when shells are used for ^{14}C dating. In that case, removal of up to 50% of the outer part of the shells is necessary to minimize contamination with modern CO_2. The surface of the bones becomes porous and chalky and the characteristic features like muscle attachments and joints are obliterated, rendering identification difficult.

However, in cases of careful excavation or where the sieving method is applied, it might be of interest to know the weight of the identified bones as opposed to the weight of unidentified bones. The percentage weight of unidentified bones to identified bones gives a better impression of their relative importance than does their number. The tiny, mostly unidentified fragments retrieved by the sieving method will constitute in terms of number of fragments a considerable percentage of the total number of identified fragments. The figures from Præstelyngen will serve as an example. The total number of identified fragments from mammals is 1,185, and the number of unidentified fragments is 357, amounting to 30.1% of the total number of fragments – a rather high proportion. Using the weight of bones, the percentage is very different. The total weight of fragments of identified mammal bones is 11,368 g while the weight of unidentified bones is 540 g. The percentage of unidentified bones is 4.5%. The two percentages show that the unidentified fragments are very small, but that they occur in great numbers. Both percentages ought to be given in order to present a full picture of the excavated material.

At the two sites – Star Carr and Præstelyngen – the degree of fragmentation of the wild boar bones was much higher than that of cervid bones. At Præstelyngen the proportion of NF (number of fragments) to EMNI (estimated minimum number of individuals) for wild boar is 39 (NF 155: EMNI 4) as opposed to 85 (NF 766: EMNI 9) for red deer (fig. 32). At the Muldbjerg I site this proportion for red deer of the same age is 81 (NF 243: EMNI 13), whereas only one pig bone has been recorded so far. Turning to Star Carr the proportion for red deer amounts to 23 (NF 588: EMNI 25), and only six for wild boar (NF 30: EMNI 5). As the depositional environments were much the same at Præstelyngen and Star Carr, and as the bone structures of wild boar and red deer do not differ very much, the small number of wild boar bone fragments at both sites cannot be ascribed to diagenetic factors. No obvious explanation can be given, but a few hypotheses will be discussed.

The relatively short, curved diaphysis of the limb bones of the wild boar does not make them suitable for implement processing; this could have resulted in a more careless fragmentation of the bones. Furthermore, the bones are at least as solid as the bones of red deer and being shorter than those of red deer they are more difficult to break. This might have led to a more violent fracturing of the bone, resulting in smaller fragments. The bones might have been smashed up for fat extraction by boiling. If we assume that wild boar bones really were more strongly fragmented than bones from other animals, the loss of bone material might be greater owing to the easier decalcification of the smaller fragments. Finally, the cartilaginous parts of wild boar bones comprise more of the total bone as compared to cervid bones. These soft part of the bone in particular were subjected to chewing by dogs, just as may be observed in modern cases where dogs often eat almost the whole of a pig bone, leaving only small parts of the diaphysis.

Another explanation worthy of consideration is selective meat storage for later consumption. This might lead to removal of meat from the site. But often the excavated fragments are so few in number that no indication of selective meat removal can be found. In addition, it should be emphasized that decomposition is accelerated by fat. The boar is a fat animal as opposed to red deer and roe-deer (Rolfe & Brett 1969). The absence of brittleness of bones in and around adipose tissue in preserved fossils has been explained by decalcification brought about by the fatty acids (Rolfe & Brett 1969). Thus, deficiency of wild boar bones and the small fragments in which they are found might be the result of accelerated decomposition owing to fatty tissue around and within them. Often there is a total lack of ribs and vertebrae, except for the first cervical ones, and very few parts of diaphyses of the femur and humerus.

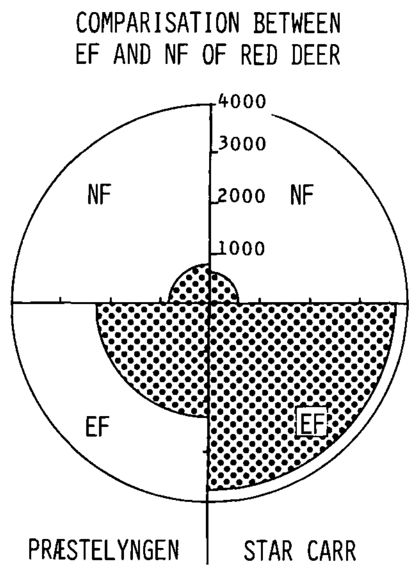


Fig. 31. Comparison of the sites Star Carr and Præstelyngen on the basis of the estimated number of fragments (EF) of red deer and the number of fragments (NF) of red deer actually found at the site. The estimated number of fragments (EF) is based on an estimation of the amount of fragments derived from one red deer subjected to a specific marrow fracturing pattern. The estimated number of fragments per animal (EF) were calculated to 146 at Star Carr and 263 at Præstelyngen.

The number of fragments per estimated minimum number of individuals (EMNI) is one way of indicating taphonomic overprint (fig. 31). It is obvious that Præstelyngen with 85 fragments per EMNI of red deer has a higher degree of retrieval than Star Carr with only 24 fragments per EMNI if the expected number of fragments per individual is the same at both sites (calculated on the basis of the fracturing technique). As an example the estimated production of fragments of a red deer at Star Carr (146) is only 5/9 of the estimated amount of Præstelyngen (263). For comparative reasons the number of bones at Star Carr therefore ought to be multiplied by 5/9, which results in a comparable number of 45 fragments per EMNI. Still, the degree of retrieval at Præstelyngen is less than twice as large as that of Star Carr, but nowhere near four times as high as indicated by the first uncorrected number.

Another way of illustrating the taphonomic overprint would be by a comparison of the total number of fragments of a species calculated from the estimated minimum number of individuals and the expected number of fragments indicated by the fracturing technique, and the actual number of fragments retrieved from the site. Fig. 31 shows, as expected, that the taphonomic loss in Star Carr is higher than at Præstelyngen.

A good indication of material having suffered taphonomic interference is differences in number of left and right side bones and upper and lower ends of the same bone (fig. 9). Compared with fig. 10 lower and upper ends show a more even distribution than left and right side.

CONCLUSIONS

The reconstruction of the palaeoecology of early man is one of the major aims of the analysis of archaeological deposits. Faunal remains especially yield valuable information in such reconstructions, and taphonomic considerations are a prerequisite in palaeoecological studies.

The aim of the present paper is to illustrate some of the numerous pathways leading from the subfossil death assemblage to the sample of the palaeobiologist. Meaningful reconstructions of ancient communities can only be made on the basis of well preserved and untransported fossil assemblages representing death assemblages uninfluenced by man. These death assemblages should again be the result of normal death rate of a stable population. Any fossil assemblage that has undergone selective destruction or transport is of limited value in any kind of population or community analysis. Nevertheless, seasonality, marrow fracturing techniques, ontogenetic variations and changes in growth have proved to be of outstanding importance in the evaluation of how, where, and why our ancient predecessors selected their prey.

Thus a thorough study of the taphonomic history and population characteristics of a fossil assemblage may offer substantial information on the subsistence economy of pre-historic man.

Marrow fracturing is here considered to be an important taphonomic factor. Great similarity is observed in the applied marrow fracturing techniques as found at Star Carr and Kongemosen in the one case and the younger Præstelyngen and Muldbjerg I in the other.

Differences in marrow fracturing technique between

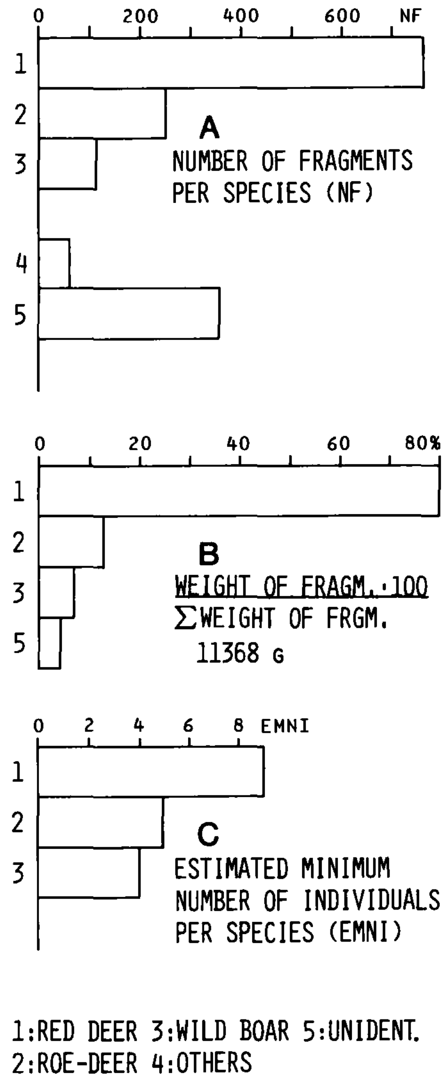


Fig. 32. Number of fragments of the three most important prey animals at the Mesolithic site Præstelyngen. The figures show the pronounced differences in relative abundances when calculated on the basis of different fragment parameters.

various cultures may reflect different methods of preparing food and may therefore reflect differences in cultural level, such as aceramic as opposed to ceramic cultures. It may thus be possible to use the character of bone splitting as an ecostratigraphical tool.

Different marrow fracturing techniques result in different numbers of fragments in a given type of bone. This has a considerable influence on the hypothetical total number of fragments at a site calculated by extrapolation from the excavated material. The number of fragments retrieved from a site as a fraction of the number of fragments calculated from the estimated minimum number of individuals, taking the marrow fracturing technique into consideration, may give an indication of the degree of taphonomic loss. Comparisons of the faunal composition and number of individuals from different sites can only take place after consideration of a number of taphonomic factors, of which one of the more important is the marrow fracturing technique.

The degree of fragmentation of bones in a deposit uninfluenced by man expresses the resistance of the various bones to mechanical destruction. The degree of fragmentation where human factors are predominant expresses, in addition, the activities of man as a taphonomic factor. In both cases the degree of fragmentation may be used as an indicator of the taphonomic overprint.

The study of marrow fracturing is therefore a fundamental part of the taphonomic analysis of an archaeological deposit. Furthermore it gives valuable information about many aspects of the daily life of early man; and finally may prove to be a potential ecostratigraphical tool within limited areas.

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A Maglemosian Hut at Lavringe Mose, Zealand

by SØREN A. SØRENSEN

In the spring and summer of 1986 Roskilde Museum investigated a mesolithic settlement in the bog known as Lavringe Mose in the interior of the island of Zealand (fig. 1). (Danish *mose* = bog).

The settlement had been discovered as early as 1943, and registered as mesolithic without any specific cultural affiliation.[1]

No major investigation of the site was carried out at that time. This fact should be seen in the context of the enormous amount of work taking place in the Zealand bogs at the time. The intensive peat cutting of the 1940's revealed very many rich mesolithic sites, which had to be investigated quickly before they were destroyed. For several years archaeological efforts were thus limited to these rescue excavations, in bogs such as Åmosen and Holmegård.

Between the initial discovery of the settlement in Lavringe Mose in 1943 and the time when attention was again directed to it, there was a period when the bog lay uncultivated. Then in the early 1970's large sections of the bog were taken into cultivation, and drainage and agricultural activity once again directed interest towards the settlement.

During the 1970's and early 1980's surface collecting on the settlement produced a large assemblage. The National Museum gave permission for a small trial excavation in the period 1971–73, carried out by a student.[2] This excavation covered only 25 m^2 and yielded a small assemblage. The finds from both the excavation and the surface collections revealed that the settlement was mainly occupied in the late Ertebølle period. However, the material collected from the surface also included a couple of microliths, showing that the site had also been visited during the Maglemose period. It was against this background, and because bones had been ploughed up around the settlement, that the Roskilde Museum wished to investigate the settlement thoroughly in 1986.

TOPOGRAPHY

Lavringe Mose is a relatively small basin, lying between the towns of Osted and Rorup in central Zealand. The Lavringe River runs through the bog, and on via the Kattinge lakes to reach the sea at Roskilde Fjord about 10 km north of the bog. Across the bog runs a glacial end moraine, visible in the landscape as a low gravel hill (Milthers 1935, 21). This gravel hill has been partly eroded away in the middle of the basin, and appears now chiefly as two promontories projecting into the bog from north and south. Between these two promontories the water level has never been very high, as the eroded gravel hill forms a line of transition running across the basin. This is of interest when we compare the topography of Lavringe Mose with the positioning of the large settlement concentrations in Åmosen. In Åmosen, K. Andersen has demonstrated that a large proportion of the settlements indeed lie close to these so-called lines of transition running across the Åmosen basin (K. Andersen 1982, 177 ff). I will not discuss further the

Fig. 1. The position of Lavringe Mose is marked with a dot on the map of Zealand.

question of the topographic positioning of settlements in this article; suffice it to say that these lines of transition may be a topographic indicator of general relevance for the placing of inland settlements.[3] The settlement described here lies on the end of the promontory projecting into the bog from the south.

STRATIGRAPHY

The stratigraphy of the settlement was relatively straightforward. At the top was the ploughsoil, some 20–30 cm deep, which had disturbed the Ertebølle settlement's occupation and midden layers in several places. Off the settlement, where the former lakebed ran evenly down towards the present river, the midden layer was overlayn by a sterile peat horizon in several places. Under the midden layer south of the boundary hedge was a layer of gyttja resting directly on the basal gravel.

North of the boundary hedge the stratigraphy was somewhat different, in that the Ertebølle midden layer here was partially redeposited, and rested on a thick layer of broken shell material devoid of cultural remains. This shelly layer contained increasing numbers of fragments of wood and bark down towards the bottom, and on this basis could be divided into two layers. Under the layers of shell material was a layer of peat, which contained artifacts and a wooden structure dating from the Maglemose period. It is this wooden structure that is the subject of this article.

The stratigraphy near the structure is shown in fig. 2, the floor layer of the structure being in layer 5. Above the wooden structure the layers of shelly material form a sterile wedge between the Ertebølle midden layer and the Maglemose activity layer. Only a few metres south of the wooden structure the inwashed shell material is completely absent, so that it is thus of a local nature. The shelly layers were presumably washed in and deposited by powerful wave action.

THE MAGLEMOSE LAYER

The Ertebølle settlement will not be described further in this article (see Sørensen 1987). The following will concentrate on presenting the finds from the Maglemose period.

Several stakes were found hammered down in the peat under the thick shelly layers; these had stood either vertically or at a slight angle. Scattered between these were many fragments of broken and fallen stakes, and many small pieces of bark.

Analysis of a total of 17 pieces of wood, charcoal and bark from this layer gives the following result: 16 were of Scots Pine (*Pinus sylvestris*), and one of birch (*Betula* sp.).[4] Besides these species, hazel (*Corylus avellana*) was represented by 4–5 nutshells.

The standing stakes were 5–10 cm in diameter. The fallen and broken pieces were similar, except for two rather thicker ones which were around 15–20 cm in diameter. None of the standing stakes had been sharpened in any way at their lower ends. To achieve the same effect as a sharpening, in several cases the stakes were placed with their thinnest end downwards. Whether this was the case for all of them could not be determined due to their variable states of preservation.

The standing stakes were best preserved, with lengths of up to 53 cm, towards the east, where the peat and gyttja layers were thickest. Preservation was significantly worse further west, probably because the stakes here were placed almost directly into the basal gravel. In the northwestern corner of the excavated area a number of fragments of wood lay horizontally. These were clearly parts of the structure that had been washed together here.

A few of the stakes were charred at the top, and thus show that the structure was on dry land when it was in use. Scattered between the stakes and fragments were a few charred fragments and a quantity of charcoal.

The distribution of wood in the excavated area was quite limited. To the east, where the contemporary lake shore lay, only a few pieces were found apart from the eastern end of the structure's row of stakes. To the west was more of a scatter, because as mentioned a quantity of wood was washed together and deposited at the end of the gravel hill. This washing together must have taken place when the wooden structure was flooded shortly after the site was abandoned. Considering the thickness of the stakes, one must assume that they would have been completely destroyed if exposed to the air, had they not been submerged and incorporated into the shelly layer relatively quickly. It must thus be presumed that the wooden structure was submerged quite soon after it was abandoned. This flooding can therefore not be explained in terms of the climate causing an

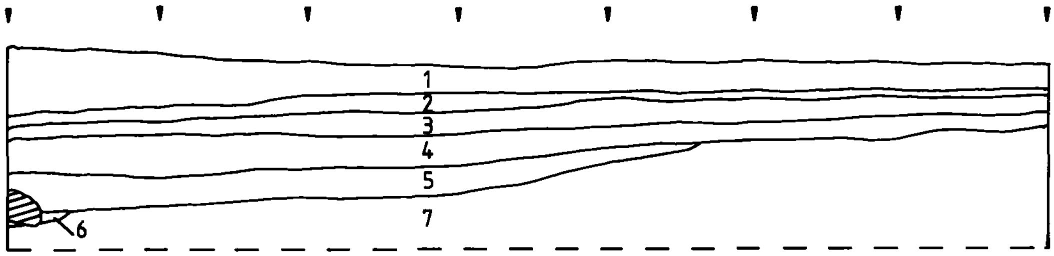

Fig. 2. The drawing shows part of the main section running east-west. The layers are as follows: Layer 1: modified peat. Layer 2: dark gravel (redeposited Ertebølle occupation layer). Layer 3: fragmented shells. Layer 4: fragmented shells containing wood, bark and peat. Layer 5: reddish brown peat (this was the layer in which was the stake structure). Layer 6: greyish green gyttja. Layer 7: basal gravel. Scale: 1:50.

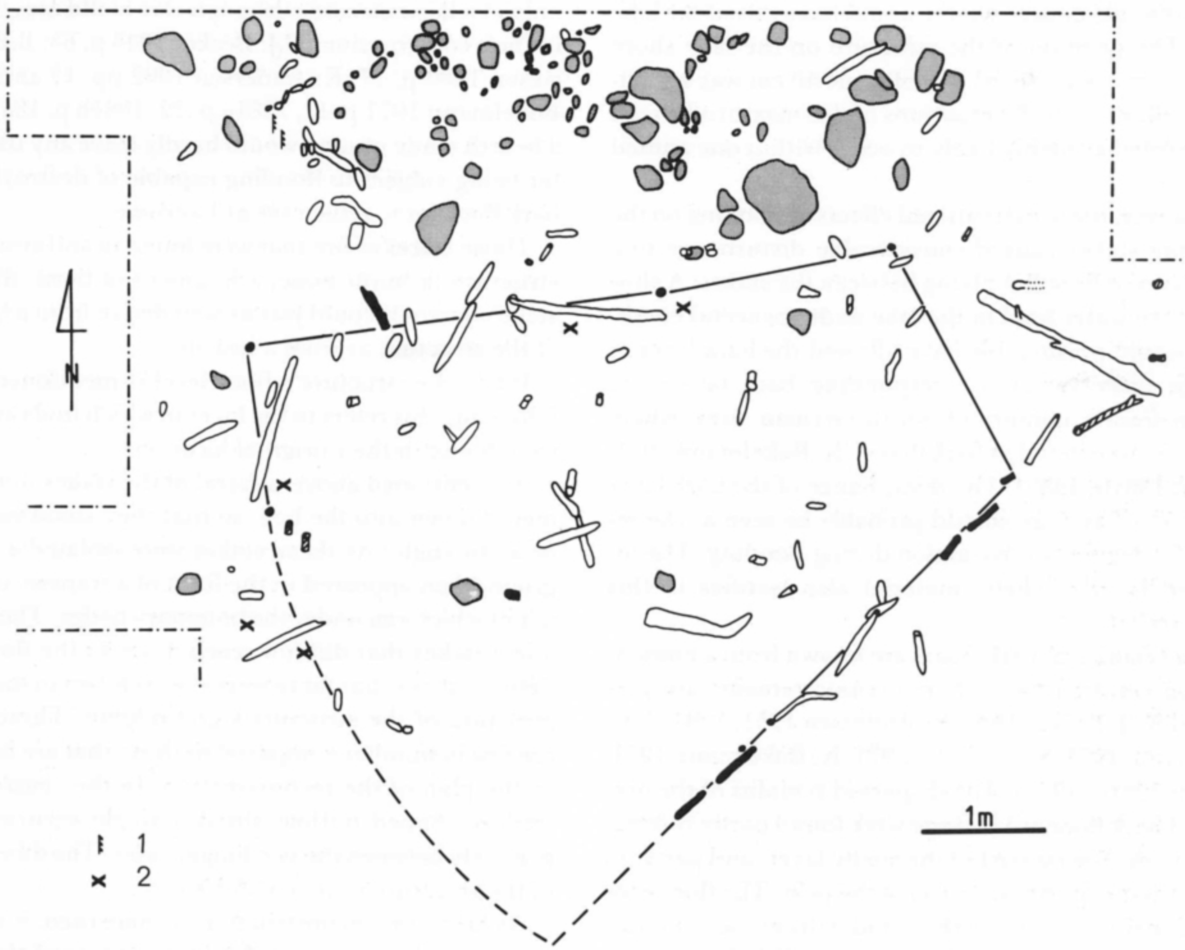

Fig. 3. Plan of the stake structure. All stones and pieces of wood in the excavation area are included. Stones are grey, wood is outlined. The vertically set stakes which form the basis of the reconstructed groundplan are black. Stakes possibly associated with the structure are hatched. The five complete microliths found in very close association with the stake structure and the two fine-toothed leister prongs are marked. 1: leister prongs. 2: microliths.

alteration in lake levels, but must be viewed within a much shorter time perspective. The explanation is thus probably to be sought in the seasonal fluctuations of the water level of the lake, taken together with the position of the structure immediately by the lake shore.

The location of Maglemosian settlements on lake shores is known from many other localities, and has been interpreted as evidence that the settlements were occupied in summer (C.J. Becker 1945, 63). A position on the surface of the bog so close to the lake edge would be uninhabitable at other times of the year due to damp and precipitation. The seasonal determination of these settlements is based not only upon their location, but is also considerably supported by the faunal and floral remains found on them. The explanation of the rapid flooding of the Lavringe structure could therefore be that it was built during the summer, when the water level in the lake was extraordinarily low. Increased rainfall in the subsequent winter would have raised the lake level. The position of the structure on the lake shore meant that a water level rise of some 40 cm was sufficient to submerge it. Fluctuations of this magnitude must be regarded as highly likely to occur within one annual cycle.

However, the preservational effects of flooding on the standing stakes caused considerable disturbance to a bark layer or bark floor lying between the stakes. A slow rise of the water level in the lake under peaceful conditions would presumably have allowed the bark layer to remain more intact. Corresponding bark layers are known from a number of North German sites, where they are interpreted as bark floors (K. Bokelmann 1971, 1981a, 1981b, 1985). The disturbance of the bark layer or floor at Lavringe should probably be seen as the result of a degree of wave action during flooding. The inwashed layer of shelly material also testifies to this wave action.

The remains of bark floors are known from a number of Maglemosian huts where organic remains are preserved (C.J. Becker 1945, K. Andersen 1951, 1982, A.D. Johansson 1971, S. Welinder 1971, K. Bokelmann 1971, 1981a, 1981b, 1985). The dispersed remains of the presumed bark floor at Lavringe were found partly redeposited in the lowest part of the shelly layer, and partly in their original position on top of the peat. The floor consisted mainly of pine bark, to judge from the available remains. A few quite small fragments of birch bark were however also found. It is difficult to decide whether the original proportions of pine and birch bark were so strongly weighted in favour of pine. The bark of pine is much thicker, and it consequently preserves much better than paper-thin birch bark. The largest bark fragments from Lavringe were about 10×20 cm, while at e.g. Ulkestrup the pieces of bark were up to several metres in length (K. Andersen 1982 p. 11). Several quite thin sticks were found to the southeast, along the best preserved row of stakes. These were possibly also remains of the floor. They could have formed a support layer beneath the bark floor. None of these sticks was unfortunately identified to species.

Hearths are nearly always found in association with the other wooden structures known from the Maglemose culture. No clear evidence of a hearth was found at Lavringe, but this is hardly surprising in view of the poor condition of the floor layer. As they are known elsewhere, Maglemose hearths consisted most often only of a layer of sand, although clay could also be used in their construction (C.J. Becker 1945 p. 63, B.B. Henriksen 1980 p. 57, K. Andersen 1982 pp. 12 and 19, K. Bokelmann 1971 p. 11, 1981a p. 22, 1981b p. 181). Such a hearth made of sand would hardly leave any traces after being subject to flooding capable of destroying the bark floor, as was the case at Lavringe.

Those traces of fire that were found in and around the structure (a burnt bone, a fragment of burnt flint and some charcoal) could just as well derive from a burning of the structure as from a hearth.

When the structure's floor level is mentioned in the following, this refers to the layer in which finds and bark were found in their original location.

As mentioned above, several of the stakes were hammered down into the bog, so that they stood vertically or at an angle. As these stakes were isolated a regular groundplan appeared in the form of a trapeze, one corner of which ran under the boundary hedge. There were a few stakes that did not reach down to the floor level defined above, but these were not included in the reconstruction of the structure's groundplan. These stakes are few in number compared to those that are included in the plan of the reconstruction. In the centre of the trapeze shaped outline stood a single vertical stake, precisely between the two longer sides. The dimensions of the structure were 5.5×5.5×2 m.

As far as the reconstruction is concerned, it must be emphasised that the southeastern corner of the structure was not examined during the excavation, as it ran under the above-mentioned boundary hedge. It is possible that an extension of the excavation under the boundary hedge would have yielded a couple more preserved stakes to complete the southeastern corner of the structure. This was not carried out, partly because the trees in the hedge had thick, deep roots, and partly because the peat and gyttja layer was not very deep in this corner. The chance of finding more preserved stakes in this area was thus minimal.

Another area where there may be a little uncertainty in the reconstruction of the groundplan is the long eastern side. This side could possibly have extended further to the northeast than the black signature on the drawing indicates (fig. 3). This is because two stakes were found beyond the end of the stake row (marked in black) and in line with it, but they did not reach down to the defined floor layer. One stake, however, did reach down to this layer; this was a little out of line with the stake row, so that it stood roughly on the centre line of the wooden structure. It could therefore very well be that this extension, marked with hatching on the drawing (fig. 3), had some function in connection with the rest of the stake structure. It would in fact be reasonable to suppose that the structure originally consisted of many more stakes than those that were hammered very deep. During flooding, most of the more loosely fixed stakes and the entire superstructure were simply washed away, together with part of the bark floor.

During flooding and the subsequent deterioration of the wooden structure, several of the vertically set stakes were put under such severe pressure that they broke close to the floor level. There were thus several broken stake segments which formed extensions of their original vertical bases. This showed that the vertically set stakes originally reached significantly above the floor level. The position of the broken pieces, forming extensions of the vertical sections from which they were broken, also suggests that the shelly layer covered the area shortly after the structure was abandoned.

THE FINDS

The quantity of finds in and around the structure in Lavringe Mose was in general very limited. It is thus questionable whether one can speak of a settlement in the traditional sense, in which the settlement is defined as an accumulation of implements and waste. I will return to this question later, in the section on the interpretation of the wooden structure.

At settlements with poorer conditions of organic preservation than Lavringe, attempts have often been made to reconstruct various activity areas and hut positions on the basis of find distributions (E. Brinch Petersen 1971, O. Grøn 1983, H.P. Blankholm 1985, J. Skaarup 1979). In these cases the presence of hearths could be demonstrated by means of the concentration of burnt flint. The quantity of finds at Lavringe Mose was however so small that this method could not have been used here. One would scarcely have recognized such a small assemblage as a functional unit had it not been for the well-preserved wooden structure. As far as struck flints are concerned, only 2–3 regular microblades and about 170 waste flakes were found.

Besides this, five intact asymmetrical triangular microliths were found. Three of these were found on the floor level along the edge of the stake structure, the other two just outside it. There were also a further five broken microliths or microlith roughouts. These were more spread out through the excavated area.

It is difficult to determine what type of microliths the fragments come from, but the five complete examples are of the type usually called »Sværdborg triangles« (E. Brinch Petersen 1971).

A waisted blade (fig. 4) was also found on the floor inside the stake structure. It was somewhat thinner than those known from Klosterlund, but was very similar to the examples from Flaadet (E. Brinch Petersen 1966 p. 118, J. Skaarup 1979 p. 80).

A few artifacts were found outside the structure to the east, where the waste deposits out in the lake began. Of flint objects, one core axe and one microlith roughout were found, as well as a few blades and waste flakes. Among bone tools there is one so-called bone mace, the function of which is however unknown (fig. 4). A very similar example is known from Lundby II, where it is called a "container" (B.B. Henriksen 1980 p. 76).

The mace from Lavringe was made from an aurochs metatarsal bone. The bone was smoothed at one end, so that the articulation was completely removed. The natural hole for a sinew in the smoothed end was bored out to make it somewhat larger. Finally, the end of the bone was hollowed out, so that it appeared as a depression. This depression however, was not hollowed out so deeply that it reached the bone's marrow canal, as was the case with the Lundby II example.

A little to the north of the stake structure, in the northwestern corner of the excavation area, two finetoothed leister prongs were found. One was completely intact, but the other was broken into three pieces which were all found within a metre of each other. These are leister prongs of the Duvensee type.

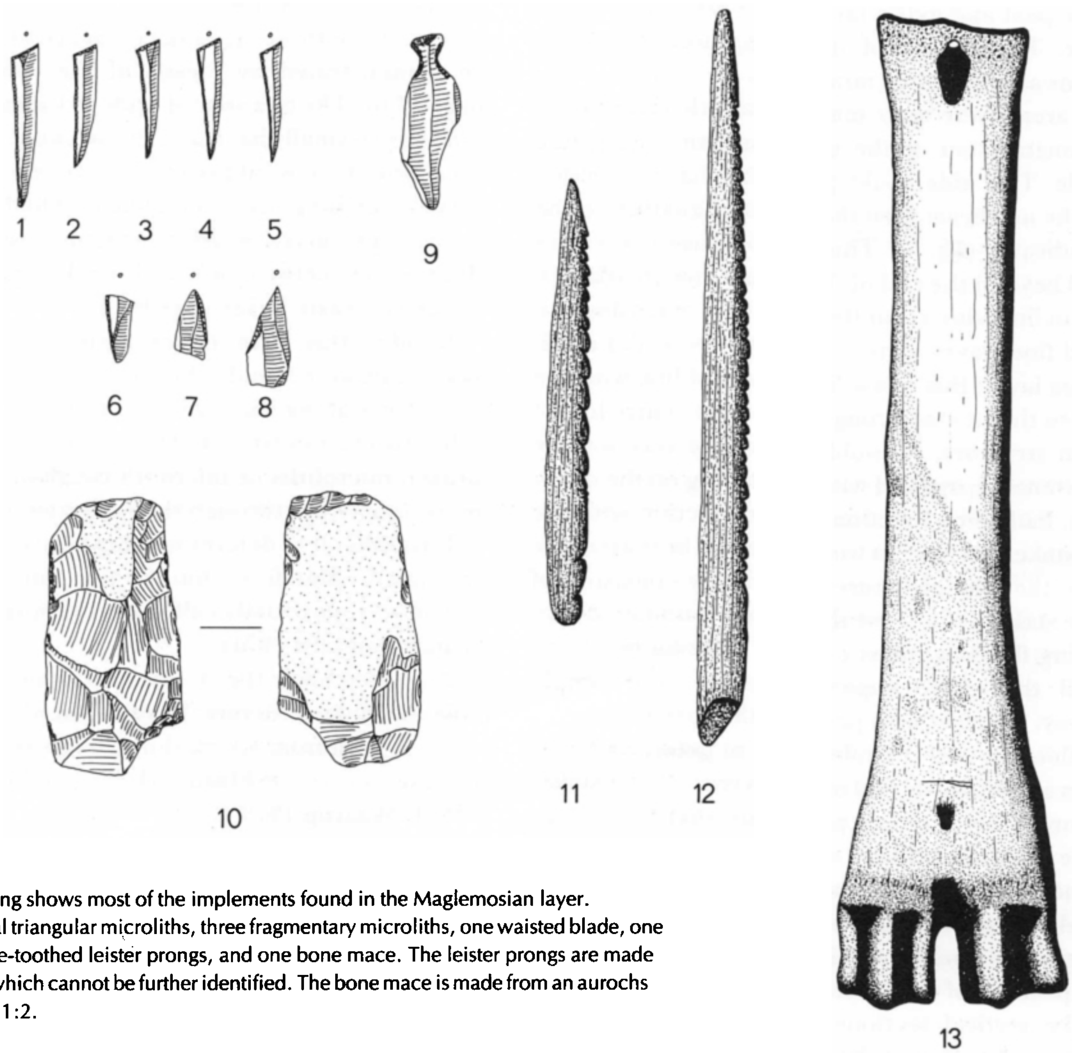

Fig. 4. The drawing shows most of the implements found in the Maglemosian layer. Five asymmetrical triangular microliths, three fragmentary microliths, one waisted blade, one core axe, two fine-toothed leister prongs, and one bone mace. The leister prongs are made from longbones which cannot be further identified. The bone mace is made from an aurochs metatarsal bone. 1:2.

THE DATE OF THE WOODEN STRUCTURE AND THE FINDS

All the artifacts and flint waste, as well as the stake structure itself, were found immediately under the shelly layer, in the uppermost couple of centimetres of the peat layer. Stratigraphically, no separate horizons of finds could therefore be discerned. The contemporaneity which the stratigraphic observations suggest is, however, contradicted by the date of the artifacts.

The two leister prongs of Duvensee type traditionally belong to the Preboreal and extend a little way into the early Boreal, which corresponds to M0/M1 in the archaeological phase division (C.J. Becker 1952 and 1953, E. Brinch Petersen 1973).

The waisted blade is a type known from several of our earliest Maglemosian settlements, such as Klosterlund and Flaadet (E. Brinch Petersen 1966 p. 118, J. Skaarup 1979 p. 80). These settlements belong in Maglemose phase M0, which means that there is close agreement between the chronological evidence from the leister prongs and the waisted blade.

The bone mace and the core axe cannot be used for the finer chronological determination of the find – but the microliths can.

The fragmentary microliths and the microlith roughout are of little assistance. The fragments could apparently all come from oblique triangular microliths, while the roughout could equally well be either a simple lanceolate type or an isosceles triangle. Both the last-named types would agree well with a date about the

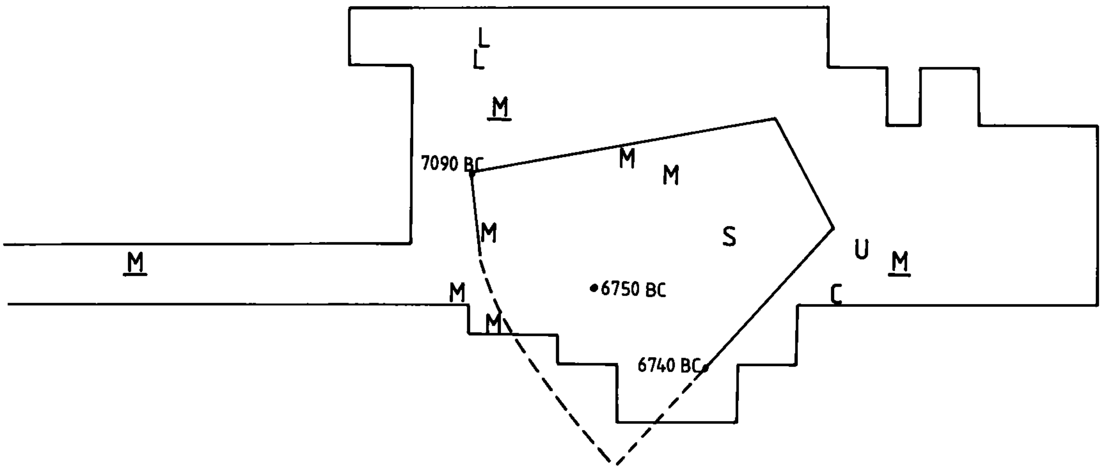

Fig. 6. Plan of the excavated area showing the position of the wooden structure and of the most important finds. The three stakes dated by radiocarbon are also marked. M = complete microlith, M = fragmentary microlith or roughout, L = leister prong, S = waisted blade, C = core axe, U = bone mace.

transition between phases M0 and M1, but because of the uncertainty regarding the actual types involved this microlithic material cannot be given any conclusive significance regarding the date.

The dating of the structure from the artifacts runs into a problem, however, when the asymetrical triangular microliths of Sværdborg type are considered. The five complete examples form the assemblage's only intact microlith form, but their chronological position is somewhat later than that of the rest of the assemblage, as they date to phase M3 (Brinch Petersen 1971). This means a difference in time of over 500 years.

As the last datable item we have the stake structure itself, which has been radiocarbon dated. Three stakes from the structure have been dated, with the following result:

Stake 9 (K-4800): 6740 ± 120 bc;
Stake 53 (K-4801): 7090 ± 125 bc;
Stake 75 (K-4802): 6750 ± 120 bc.

This dating of the structure places it at around M0/M1 in the phase divisions, which agrees with the evidence from the leister prongs and the waisted blade.

THE FAUNA

Despite the small number of bones that was found during the excavation, no fewer than 12 different species are represented. The species and fragment totals are as follows:

Pike, *Esox lucius*	24 fragments
Rudd, *Scardinius erythrophthalmus*	1
Frog, *Rana* sp.	1
European pond tortoise, *Emus orbicularis*	4
Mallard, *Anas platyrhynchos*	6
Wigeon, *Anas penelope*	1
Ground vole, *Arvicola terrestris*	10
Otter, *Lutra lutra*	1
Red deer, *Cervus elaphus*	7
Roe deer, *Capreolus capreolus*	5
Wild pig, *Sus scrofa*	7
Aurochs, *Bos primigenius*	3

The identifications were carried out by the zoologists Kim Aaaris-Sørensen and Knud Rosenlund, both of the Zoological Museum, Copenhagen.

CONTEMPORARY WOODEN STRUCTURES

For comparison with Lavringe, a series of contemporary finds are known which comprise bark floors and/or vertically set stakes. These wooden structures are all interpreted as the remains of huts with bark floors.

Within the area of the Maglemose culture several such hut finds are known, although some are in poor condition and disturbed. The majority of the huts compared to the Lavringe structure have earlier been published. An exception to this is *Holmegård IV*, which I will briefly describe.[5]

The excavation of Holmegård IV took place in July

SITE	FLOOR	VERTICALLY SET STAKES	HEARTH	DATING b.c.
Duvensee 8	Birch 2,5 × 2,5 m	÷	+	7690 – 7460 M0
Duvensee 2	Birch 5 × 5 m	÷	+	7470 – 7330 M0
Barmosen 1	Aspen 3 × 2 m	÷	+	7290 – 6380 M0
Duvensee 1	Birch 4,5 × 3,3 m	÷	+	7250 – 6810 M0
Duvensee 6	Birch 6 × 4 m	÷	+	7150 – 6890 M0
Bara Mosse 1	Pine 4,2 × 4,5 m	÷	+?	7100 – 6900 M0
Lundby II	Pine/Birch > 3 × 2 m	÷	+	M0
Lavringe mose	Pine/Birch 5,5 × 5,5 × 2 m	Pine	÷	7090 – 6740 M1
Duvensee 13	Pine 3 × 3,5 m	÷	+	6750 – 6710 M1
Ulkestrup 1	Pine/Birch/Alder 6 × 4,25 m	Hazel, Birch/Poplar	+	6420 – 6190 M2
Ulkestrup 2	Birch 6 × 4 m	Hazel	+	6230 – 6080 M3
Holmegård IV	Pine/Birch 6,5 × 3 m	+	+	M3

Fig. 5. The table lists a series of known wooden structures from the Maglemose culture, all interpreted as huts, for comparison with that from Lavringe.

1944, under conditions that were far from ideal from an archaeological point of view. The excavation had to fit in with the peat cutting taking place in the area of the settlement. Two, in some places three, occupation horizons could be distinguished. In the lowest two bark hut floors appeared.

Hut 1 was the best preserved, with a floor consisting of from one to two layers of bark sections, laid criss-cross. This floor formed an irregular rectangle measuring about 6.5 × 3.0 m. The peat cutting had unfortunately damaged the edges of the floor a little. Above the bark floor was a compact layer of hazel nut shells, sand and branches. A hearth had been placed near one of the long sides of the feature, and had clearly scorched the bark of the floor. The flint distribution on and around the floors was such that all the larger pieces were found outside the floors, with only a few small fragments on them. Opposite the hearth was a stone measuring about 20 × 30 cm, resting directly on the bark floor. According to the notes, the only implement found on the bark floor was a small thick flake scraper.

One vertically set stake is mentioned in connection with the bark floors; the excavator has also verbally communicated the fact that several such stakes were found during the excavation. He states, however, that no direct association could be definitely demonstrated between the bark floors and the vertically set stakes.

The floor in hut 2 was somewhat worse preserved than that in hut 1, but was of about the same shape and appearance. It lay a little deeper than floor 1, but also belonged to the lower layer. In connection with floor 2 several stakes 5–7 cm in diameter were found; they lay roughly parallel but at varying distances apart. These are believed to acted as supports for the bark floor.

Both a hearth and a stone "seat", very similar to those on floor 1, were found on floor 2. The concentration of flint was considerable outside the floor, but fell sharply at the transition to the floor.

It was established that both huts lay directly on the contemporary lake shore.

A survey of the other sites where organic parts of huts are preserved shows that most commonly only parts of the bark floors are preserved. Stakes from the walls are on the other hand found very rarely. Well-documented wall stakes are only known at *Ulkestrup Lyng*, and these do not form any system and cannot be used as the basis for a reconstruction of the huts' original ground plan (K. Andersen 1982 p. 10 ff). Both the bark floors and the huts reconstructed from flint scatters are most often interpreted as the remains of rectangular huts.

The sizes of the recorded hut floors vary between c. 2.5 × 2.5 m and c. 4 × 6 m, but the smallest measurements do not come from intact floors and the actual size of the huts was probably around 4 × 6 m. If one examines the bark used for the floors, there is much similarity between the huts, although with some chronological development from floors made only of birch bark to floors of birch and pine bark. *Barmose 1*, with its floor of aspen bark, is the only exception to this.

As can be seen from the table (fig. 5), all the structures except Lavringe have a hearth in close association to the wooden structure, either on the bark floor itself, or just outside it. At *Bara Mosse*, however, the presence of a hearth is a little uncertain, a fact connected with the early uncovering of the find (S. Welinder 1971 p. 185 ff).

There could well have been a hearth associated with the Lavringe find, but if it consisted of a layer of sand placed directly on the bark floor, the subsequent flooding removed all trace of it. As the concentration of flint associated with the Lavringe structure was so small, it is not possible to demonstrate the presence of a hearth by means of a concentration of burnt flint.

The distribution and concentration of flint associated with the wooden structures varies considerably, and two different patterns can in fact be distinguished. One, in which the greatest concentration of flint is found directly on the bark floor, is known from the huts at Ulkestrup Lyng (K. Andersen 1982). The other pattern, with a limited quantity of flint on the hut floor, is known from Holmegård IV, Lundby II and Lavringe (C.J. Becker 1945, B.B. Henriksen 1980 p. 57 ff).

INTERPRETATION OF THE WOODEN STRUCTURE AT LAVRINGE

The only structures contemporary with that at Lavringe are all interpreted as the remains of huts, or occupation platforms. It has been pointed out, however, that it is usually impossible to demonstrate whether there ever was a superstructure associated with the bark floors (K. Bokelmann in press). This argument cannot be refuted, but it applies to the majority of our prehistoric hut and house structures.

Even at the sites where vertically set stakes were not found associated with the bark floors, a light superstructure along the lines of a tent can easily be envisaged. For the remaining structures, with deeply fixed stakes, a more substantial superstructure can be imagined. Judged from the limited material presented in the table (fig. 5), it could seem that there is some chronological basis for the presence of vertically set stakes around the bark floors. The sample is however neither very large, nor excavated according to the same methods, so this conclusion should be treated with great caution.

As far as the interpretation of the wooden structure in Lavringe Mose is concerned, there are so many points of similarity between it and the other wooden structures in the table, that I feel the obvious interpretation of Lavringe is as the remains of a hut.

The floor of pine and/or birch bark, and the typical location close to a former lake shore, are some of the characteristics of the huts of the period. The vertically set stakes at Lavringe furthermore give an idea of the shape of the hut. It was clearly trapezoidal, and so diverges from the prevailing view of Maglemosian huts, which are normally interpreted as rectangular. The divergence need not however be significant for the interpretation of the feature, because intact bark floors clearly revealing the original groundplan have never been found. A damaged trapeze-shaped floor could thus easily be interpreted as the remnants of a rectangular hut. Finally, there is also the possibility that Maglemosian huts were of various shapes. The possible extension of the eastern long side can be interpreted as a windbreak connected with an entrance opening towards the lake. The presence of an entrance could not, however, be demonstrated during the excavation of the feature.

If the trapeze-shaped feature at Lavringe is regarded as a hut, then the interior stake, midway between the long sides, must be seen as a "roof support".

When the Lavringe settlement is compared not just to other settlements with huts but to other Maglemose sites in general, it is very poor in finds. An explanation of this may be found if we direct our attention to some of the ethnographic descriptions of hunter-gatherer societies. These descriptions distinguish between different types of settlement, each with their own function (Binford 1982). Settlements with large accumulations of artifacts and waste must be regarded as base camps. Smaller special purpose camps from which hunting was carried out will on the other hand not be characterised by large quantities of finds, but rather by a limited assemblage reflecting the activities carried out on the settlement. This could for example involve the curation of hunting equipment, implements used for the construction of a hut, and perhaps the hut itself.

Lavringe must be regarded as such a small hunting camp. This is a type of settlement which is usually archaeologically almost invisible, because of the small number of finds. The site cannot therefore be directly compared with the large, well-known settlements known from a series of large bogs.

Several quite small settlements are known in Sweden, which have produced a limited number of microliths and a few waste flakes and cores (M. Strömberg 1986). These are regarded as small, sunken hut sites, and are, along with Lavringe, perhaps the traces of short-term hunting expeditions.

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NOTES

1. National Museum, Parish Register no. 3, Osted parish.
2. The excavation was undertaken by the then stud. mag. Bent Larsen.
3. I have previously worked with a topographic model for the location of Ertebølle and Kongemose coastal settlements. This model is partially described in A. Fischer and S. Sørensen 1983.
4. C. Malmros of the National Museum's VIII section is thanked for these determinations.
5. The excavator of Holmegård IV, C.J. Becker, is thanked for his great kindness and help regarding access to previously unpublished information about this excavation; and for permission to use the material in this article.

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An Early Neolithic Pottery Deposition at Ellerødgård I, Southern Zealand

by HENNING NIELSEN

In April 1982, motorway construction occasioned the excavation of an Early Roman Iron Age settlement, during which Sydsjællands Museum investigated a structure which furnished important new information on pottery deposition in the Early Neolithic (1). The site was located near a major watershed about 10 km NE of Vordingborg on the upper slope of a south-facing hillside, about 47 m above sea-level. The subsoil consisted of stiff boulder clay covered by a sandier, water-bearing stratum, which meant that the water table was close to the surface, despite the elevation. The Neolithic structure was found in the NW part of an excavation area measuring 65 × 23 m, just north of the settlement.

After removal of the topsoil with earth-moving machinery, features were excavated segmentally, furnishing profile sections for study. The Neolithic structure, which was by far the largest, was excavated in quadrants, leaving a cruciform profile balk in the centre (fig. 2–3). From an archaeological point of view, the excavation was far from satisfactory, due to the unusually difficult working conditions (2). These shortcomings in the investigation technique brought uncertainty to observations and thus to interpretation of the find.

THE LARGE PIT COMPLEX, FEATURE CE

The pots were found in a complex of pits, CE, the westernmost part of which lay outside the excavation area. The structure cut through the easternmost part of a slight natural hollow sloping SW, which was filled by a 5–15 cm thick humus-containing layer devoid of culture remains. This hollow had the character of a natural drain for surface water from the hill, which is pointed by the fact that an artificial drain had been cut in the 1920s with its origin in the Neolithic complex and discharge to the SW.

Fig. 2 is a plan of the structure, which appeared as an elongate depression more than 8 m long and 5–6 m wide. It was oriented on a WNW-ESE axis and had an excrescence to the east, measuring 3 × 2.25 m, and only a few centimetres deep. A round-bottomed ditch, 4.75 m long, 0.50–0.75 m wide and about 0.50 m deep, extended SW from the SE part of the depression and gave the southern edge of the structure an irregular outline. 8 small post-holes and a 2 m long E-W oriented ditch up to 2 m further south are thought to be part of the structure, but do not permit further conclusions as to the original appearance.

Prior to excavation, the structure was manifest as a dark patch, disturbed by two post-holes along the northern edge, one post-hole between the depression and the long ditch, and a hole 0.80 × 0.65 m in area and 0.20 m deep in the centre of the eastern part. Although devoid of dating material, these features are probably coeval with the numerous features from the Early Roman Iron Age at the site.

The structure may be described as a flat-bottomed depression, only 0.40–0.50 m deep, but with at least 4 deeper, round-bottomed pits: IL, IM, IN and IP, 0.60–

Fig. 1. Map of Zealand showing the location of the site.

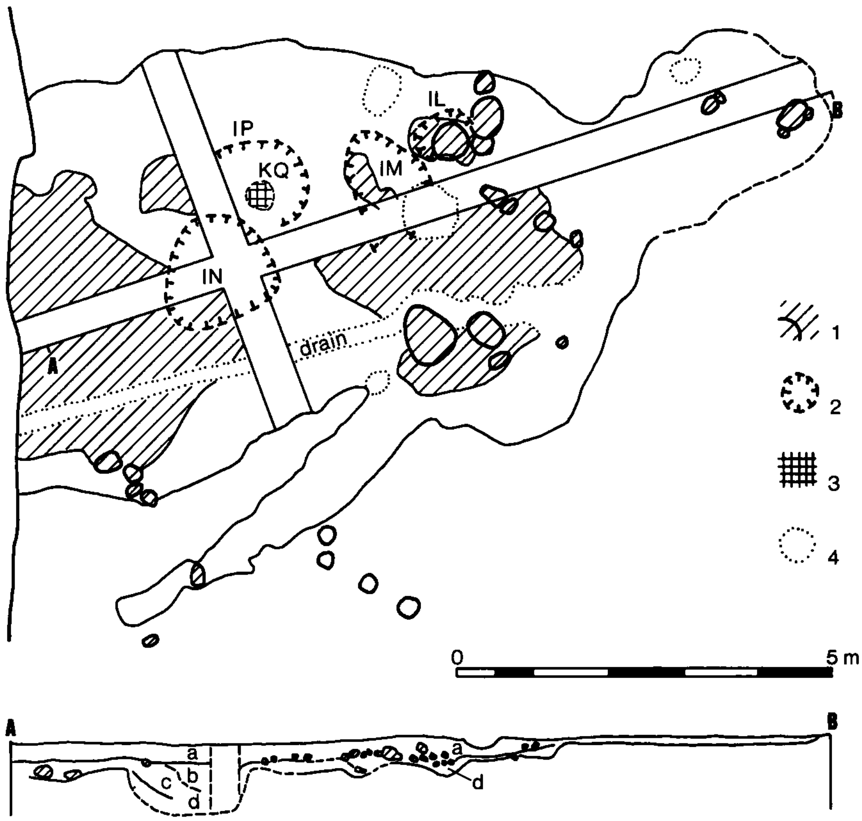

Fig. 2. Plan and profile section of Ellerødgård I, feature CE. 1: stones and groups of stones; 2: pits in the bottom of the depression; 3: potsherds; 4: secondary excavations.

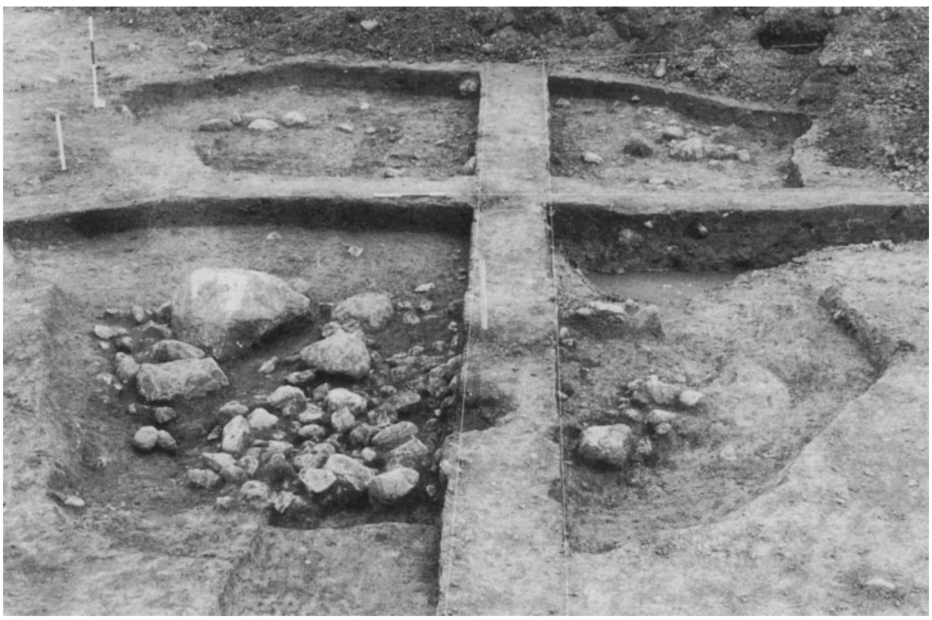

Fig. 3. Feature CE during excavation, viewed from the NE.

1.20 m in diameter and 0.12–0.70 m deeper than the rest of the structure. The largest and deepest of the pits, IN, was in the centre of the depression.

Longitudinal and transverse sections revealed uniform deposition circumstances for the whole pit complex. The layers were with one exception continuous, both in the main depression and in the deeper pits.

Stratigraphy (fig. 2)

a. Uppermost a brown argillaceous mould, 0.25–0.30 m thick.
b. An incoherent patch of stones measuring 0.10–0.25 m, which locally formed several layers and in surface view looked like patches of irregular paving up to 4 × 4 m in size. A few rocks of about 0.50 m extended above stratum *a* and were found mainly to the SE. A rock on the south side measuring 0.70 m had been displaced when the above-mentioned drainage ditch was dug. Between the stones and under them were flint implements and swarf, animal bones and potsherds. These objects were clearly concentrated in or near some of the deeper pits. It could be established that stone stratum *b* intruded down into these pits, apparently as a result of subsidence.
c. A layer of dark grey mould with charcoal, 0.20–0.40 m thick, was found only in pit IN between strata *b* and *d*. It was bounded below by a charcoal horizon a few mm thick.
d. A layer of greyish-yellow arenaceous clay had a thickness of 0.10–0.20 m in the main depression, but was up to 0.30 m thick at the bottom of the pits. This layer rested on yellow clay subsoil.

The four smaller pits at the bottom of the depression will be separately described in the following. Several smaller pits of the same kind may have existed in the NW and SE parts of the structure but have escaped notice.

SMALL PITS WITHIN FEATURE CE

Pit IL. Pit measuring 1 × 0.60 × 0.12 m. Between the stones over the base were sherds of two pots (KS and KÅ, fig. 10), a disc borer and a disc scraper, 9 flint chips and a couple of pieces of fire-brittle flint.
Pit IM. Pit measuring 1 × 1 × c. 0.17 m, practically triangular. No artefacts were found in association with this pit.
Pit IP. Pit c. 1.50 m in diameter, c. 0.50 m deep. Found during excavation of N-S profile section trench and cleared with a shovel. The stratigraphy of this pit accords with the description above. To the SW, the upper edge of pit IP must have been in contact with pit IN, although this went unnoticed during excavation. Under stone layer *b*, fragile pieces of a thick-walled, ribbed storage vessel (KQ, fig. 8) were found with fragments of animal bones and flint swarf.
Pit IN. This pit, which contained the bulk of the pottery, was concealed by the section balks and was not investigated until the last day of the excavation. Examination was hampered by the fact that the bottom of the pit was below the water table. Presumably a small part of the base of the pit to the NE has not been excavated. Due to lack of time, the lowest layers had to be removed in large shovelfuls with a view to later extraction of artefacts.

Pit IN had a practically triangular outline with rounded corners and base. The width above was about 1.50 m in each direction and about 1 m at the base. The sides were steep, but passed smoothly into the bottom. The depth was 0.70 m. Fill layers *a* and *b* had subsided into the pit so that stone layer *b* was deepest at the centre (fig. 2). Over and between the stones were flint swarf and scattered animal bones. The lowest stones seemed to form two parallel SW-NE oriented rows across the potsherds, about 1.25 m long and 25 cm apart. Above them was an entire mandible of domestic pig, besides bones of sheep and domestic ox. Under the stones, layers *c* and *d* contained pottery in the form of 14 originally entire vessels, which were best preserved to the west, but were compressed to the east in compact layers of sherds (fig. 4). With the sherds was found a bone chisel (fig. 12).

At the bottom of the pit, layer *d* was found. At the surface it contained, especially to the south and west, patches of red-burnt clay, and it was separated above from layer *c* by a thin charcoal horizon. Some of the sherds seem to have been pressed down into layer *d*. Several of them show traces of secondary burning. In the west of the pit, pots KA, KB and KD stood half overturned towards the edge of the pit, while pot KC in the east was overturned with its mouth towards the centre of the pit (fig. 4). The uppermost pieces of pot KC lay over a flat stone, whereas at a lower level pieces of the same vessel

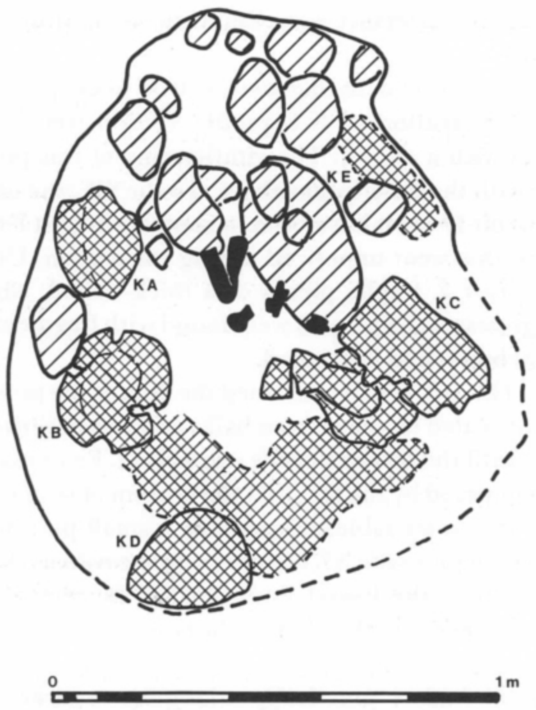

Fig. 4. Plan of pit IN, completed on the basis of excavation photographs. Oblique hatching indicates stones, cross-hatching potsherds, and black figures animal bones.

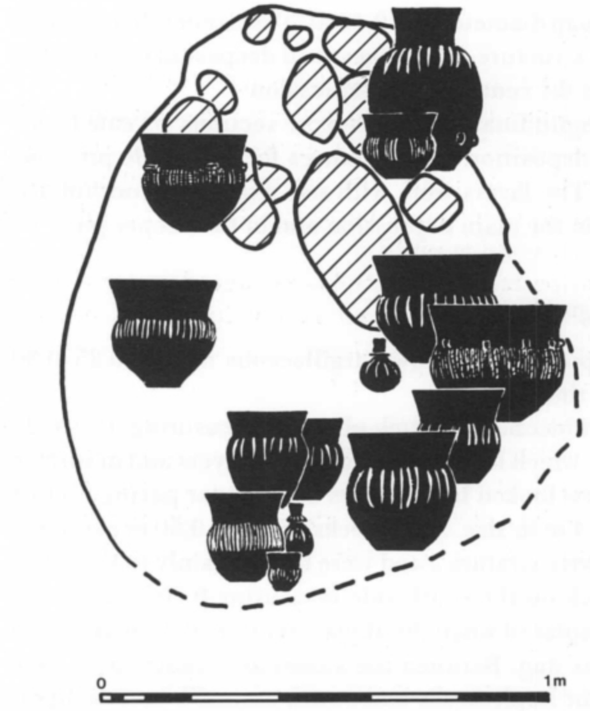

Fig. 5. Plan of pit IN with a reconstruction of the placement of the pots. Pot size slightly reduced in relation to the pit.

lay under the stone, which must thus have subsided or collapsed onto the pot. Right at the bottom, under the sherd patches, lay the collared flask KF upside down. No pot showed traces of original content.

Within feature CE, the contents of pit IN must constitute an integral find, where the pots were deposited on a single occasion prior to the placing of a cap of stones over both this and the other pits. It is unclear whether the animal bones were first introduced at the same time as this stone capping. It was first when the substrate for the stones was destroyed that they fell into the pit and damaged the pots, perhaps in connection with the fire of which traces could be observed in pit IN. To the NE, the lugged vessel KE lay in large fragmented pieces. Exactly half of this pot's belly is missing, which suggest that a small part of the NE edge of the pit was not completely excavated.

The uniform stratigraphy throughout feature CE suggests that the different pits and their content of pots must have been established at a single juncture, just as the cover of stones was presumably added on one occasion.

FINDS

Depression CE contained much pottery, flint and animal bones. The shallower part of the depression was, however, not completely investigated in the NW and SE quadrants. The same applies to pit IP, so the artefact material from these parts of the structure is incomplete. In contrast, the largest of the pits, IN, was more carefully excavated, and the material collected here must be considered almost complete. The fact that many of the pots from pit IN are nevertheless highly fragmentary is due to the wet conditions in the pit and the rude method of excavation, in conjunction with the disintegration of many of the sherds during the drying and cleaning prior to conservation.

As far as the circumstances of find for flint and animal bones are concerned, the same applies as for the pottery: the finds from pit IN are practically complete, whereas collection from the rest of the structure had a more random character.

Pottery

Excavation yielded sherds deriving from 31 pots. 14 of these pots were included in the integral find in pit IN. Sherds from 7 pots were taken up in the area west of pit IN, while east of the same pit sherds from 9 pots were found, 2 of which may be assigned to pit IL. Only 1 pot was remarked in pit IP.

The pottery comprises 4 large lugged beakers (one of which has been identified only by its ornament) and 1 small one, 20 funnel beakers, 1 cylinder-necked beaker, 2 collared flasks, 1 lugged jar and sherds from 2 unidentified pots.

Reconstruction of the poorly preserved pots is based on measurement of the preserved parts, related to the proportions of neck/belly and height/rim diameter and ornament zones in the best preserved of the vessels.

Pottery from pit IN (fig. 6–7)

KA. An ornamented lugged beaker. Height: 25 cm, rim diameter 27 cm, base 7.5 cm. Parts of the rim and a few belly sherds are missing. At the junction of neck and belly are 6 tubular, facetted lugs. Ornament: a zone at the top of the belly with groups of vertical whipcord impressions, interrupted by small smooth zones. One side of the vessel shows secondary burning marks.

KB. An ornamented funnel beaker. Height 26–28 cm, rim diameter 27 cm, base 7.6 cm. Small parts of the vessel wall are missing. Ornament: vertical sharp ridges on the upper part of the belly.

KC. 2 large pieces and 178 smaller loose sherds of a decorated lugged beaker. Reconstructed height c. 30 cm, rim diameter c. 37 cm, base missing. At the junction of neck and belly there have been 10 narrow band-like lugs, of which there are three preserved and traces of three more. Ornament: a zone in the upper part of the belly with vertical two-ply cord impressions turned over at the top. The vessel has been subjected to strong secondary burning.

KD. C. 325 small sherds of a decorated funnel beaker. Reconstructed height c. 21.5 cm, rim diameter c. 24 cm. Ornament: a zone on the upper part of the belly of vertical, thin, incised lines. The sherds are unstable and friable on account of secondary burning.

KE. 4 large pieces and 24 smaller sherds of a decorated lugged jar. Preserved height 31.6 cm, reconstructed height c. 42 cm, base c. 14 cm. At the base of the belly there have been 6 sturdy lugs, of which there are four preserved and traces of a fifth. Ornament: sturdy, vertical, sharp ridges at the top of the belly. Part of the vessel wall has been subjected to secondary burning. The entire neck and half of the belly are missing.

KF. The upper part of a decorated collared flask. The upper part of the neck is missing. Preserved height 7 cm, reconstructed height c. 15 cm. The collar is in the form of an applied cordon. Ornament: widely set slight ribs at the top of the belly. Slight secondary burning is seen on the belly.

KG. The upper part and 7 loose sherds of a decorated collared flask. Preserved height 10 cm, reconstructed height c. 15 cm, rim diameter 4.2 cm. The collar has been extruded from the inside in one piece with the neck. Ornament: sharp, close-set ridges at the top of the belly. At the junction of neck and collar there is an encircling row of oval stab-marks.

KH. C. 135 loose sherds of a decorated funnel beaker. Preserved height 15 cm, reconstructed height c. 24 cm, rim diameter c. 24 cm. Ornament: vertical but skew ribs on the upper part of the belly, sharp above, blunt below. Marked by secondary burning.

KI. A large piece and 34 smaller loose sherds of a decorated funnel beaker. The base is missing. Preserved height 17.6 cm, reconstructed height 21 cm, rim diameter 19.6 cm. Ornament: crude vertical ribs on the upper part of the belly. Marked by secondary burning.

KK. Wall and base and 60 loose sherds of a decorated funnel beaker. Height 26 cm, rim diameter 22.5 cm, base 9 cm. Ornament: short crudely applied ribs on the upper part of the belly.

KL. 4 large pieces and 17 smaller loose sherds from a decorated funnel beaker. Height 30 cm, rim diameter 27.6 cm, base 8 cm. Ornament: plastic ribs, crudely executed, on the upper part of the belly.

KM. Sherds of a large, decorated funnel beaker. Preserved height 14 cm, reconstructed height c. 30 cm. The rim diameter is put at c. 30 cm. The exact size and form cannot be given with certainty. Ornament: vertical sharp ridges on the upper part of the belly.

KN. 28 sherds of a decorated funnel beaker. Preserved height 14 cm, reconstructed height 17 cm, rim diameter 18 cm, base missing. Ornament: groups of scored vertical grooves on the upper part of the belly with 4–5 in each group, separated by 4–5 cm wide empty fields.

LD. A large piece of wall and base of a decorated funnel beaker. Preserved height 4.5 cm, reconstructed height c. 9–10 cm, base 2.7 cm. Ornament: close-set, incised grooves on the upper part of the belly. The sherd was found during conservation in a highly friable state during excavation of KD and is preserved as a mount in a lump of earth.

Pottery from pit IP (fig. 8)

KQ. 4 large pieces and 126 smaller loose sherds from a decorated funnel beaker. Preserved height 23 cm, reconstructed height c. 30 cm, rim diameter 31.5 cm, base c. 13 cm. Ornament: vertical flat ribs, crudely executed and up to 1 cm wide; about 1 cm below the rim there is a row of perforations about 2 cm apart and 6–7 mm in diameter. Funnel beaker KQ must in contrast to all the other pots from the structure be characterized as a storage vessel.

Pottery from the area west of group IN (fig. 9)

The pottery from that part of feature CE that lies west of IN was recovered without precise indication of provenance, although it was re-

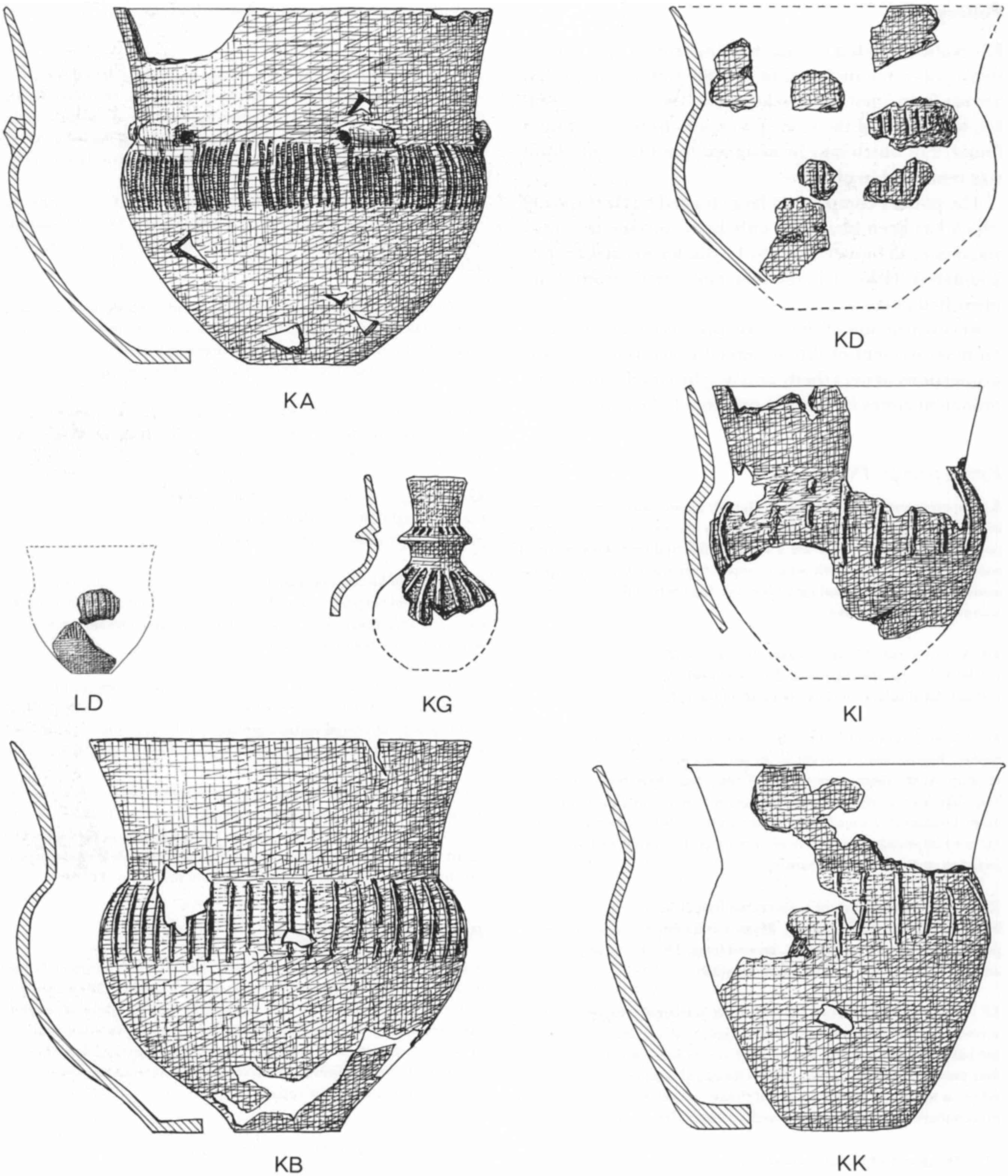

Fig. 6. Pottery from pit IN, western group. Measured by H. Nielsen and drawn by H. Ørsnes. 1:4.

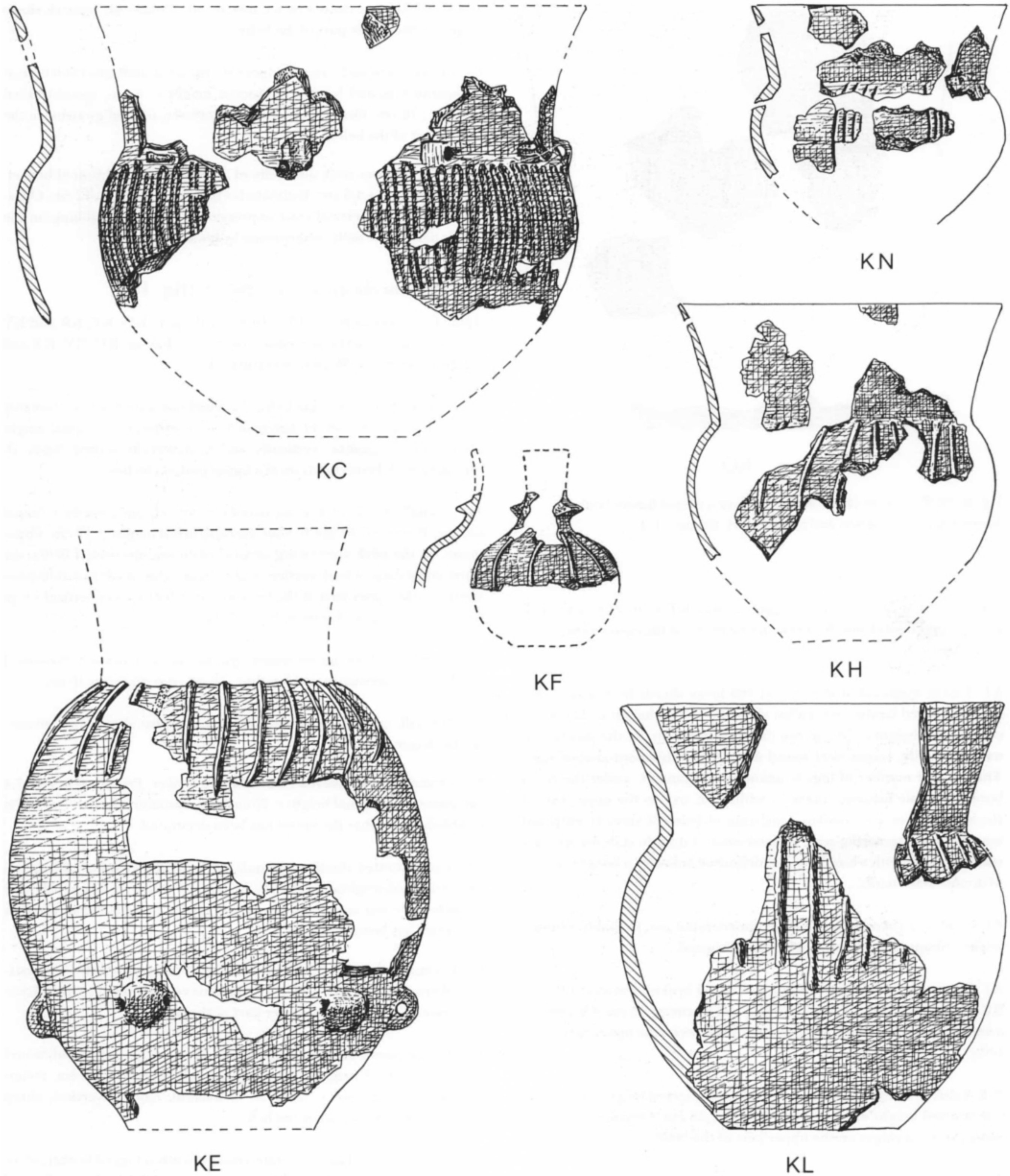

Fig. 7. Pottery from pit IN, eastern group. Measured by H. Nielsen and drawn by H. Ørsnes 1:4.

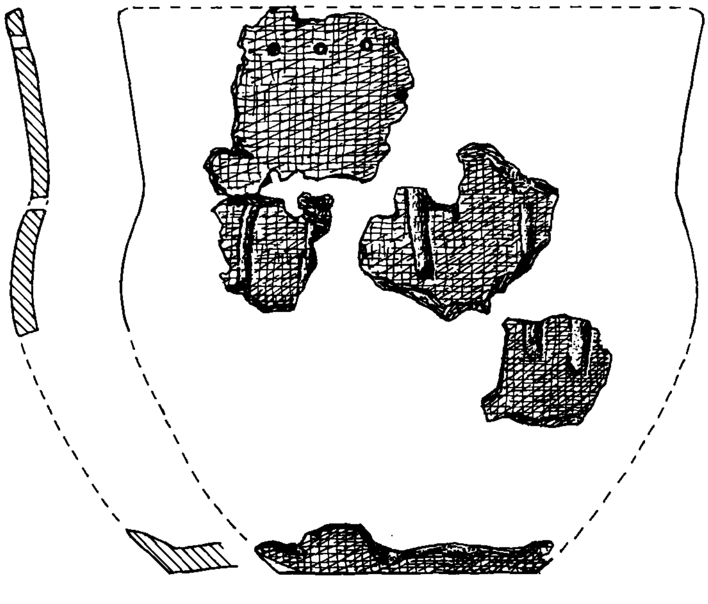

Fig. 8. Pit IP: storage vessel in the shape of a ribbed funnel beaker. Measured by H. Nielsen and drawn by H. Ørsnes. 1:4.

marked that the sherds from lugged beaker KT were very scattered, some of the sherds from this vessel being found at the eastern end of the structure.

KT. 3 large fragmented sherds and 160 loose sherds from a large decorated lugged beaker, somewhat skew. Preserved height c. 22 cm, reconstructed height c. 28 cm, rim diameter c. 37 cm. At the junction of neck and belly, traces were found of 2 presumably cord-shaped lugs. The original number of lugs is unknown. Ornament: under the rim a border of triple festoons, made by whipcord, and on the upper part of the belly a zone of ornament consisting of fields of vertical whipcord impressions alternating with vertical rows of double stab-marks, presumably made with a bird bone, all delimited below by a horizontal row of double stab-marks.

KY. C. 50 small sherds from a large undecorated pot, probably a funnel beaker. Shape and size cannot be reconstructed.

KZ. Large piece of a small decorated funnel beaker. Preserved height 9.2 cm, reconstructed height 12.5 cm, rim diameter 13 cm. Ornament: a zone of incised, narrow, close-set vertical lines on the upper part of the belly.

KÆ. 8 sherds of a decorated funnel beaker. Preserved height 10.2 cm, reconstructed height c. 16 cm, rim diameter 16 cm. Ornament: narrow, sharp, vertical ridges on the upper part of the belly.

KØ. 2 large sherds and 14 small sherds from the belly of a decorated vessel, presumably a funnel beaker. Preserved height 11 cm. The shape and size of the pot cannot be reconstructed. Ornament: vertical, sharp ridges on the upper part of the belly.

LA. 1 large sherd and 7 smaller loose sherds from underpart and base of a decorated funnel beaker. Preserved height c. 8 cm, reconstructed height c. 16 cm. Ornament: vertical, close-set, incised grooves on the upper part of the belly.

LC. 7 sherds from neck and belly of a small decorated funnel beaker. Preserved height 4.5 cm. Estimated original height c. 11–12 cm. Ornament: groups of vertical cord impressions or rows of stabbing on the upper part of the belly, interrupted by blank fields.

Pottery from the area east of pit IN (fig. 10)

Apart from vessels KS and KÅ from pit IL, pots KO, KP, KR and KV may be assigned to the immediate vicinity of that pit. KU, KV, KX and LB derive from the SE part of feature CE.

KS. 2 small sherds from the belly of a small decorated pot, presumably a funnel beaker. Preserved height 2.5 cm, presumptive original height 10–12 cm. Ornament: vertically and transversally scored fields alternating with blank fields on the upper part of the belly.

KÅ. 7 small sherds of a small decorated vessel, presumably a funnel beaker. Preserved height 6.5 cm, reconstructed height c. 10 cm. Ornament: on the neck alternating vertical plain and decorated fields, the latter consisting of both vertical and oblique rows of whipcord impressions; on the upper part of the belly are broader fields of vertical whipcord, alternating with narrow blank fields.

KO. 9 sherds of an undecorated cylinder-necked beaker. Preserved height 10 cm, reconstructed height c. 18 cm, rim diameter 10 cm.

KP. 26 small, undecorated sherds of a vessel whose shape and size cannot be determined.

KR. 15 undecorated sherds from a funnel beaker. Preserved height 7.4 cm, estimated original height c. 20 cm, rim diameter 23 cm. It cannot be established whether the vessel has been decorated.

KU. 4 undecorated sherds of a small lugged beaker. Preserved height 3 cm, estimated original height 16–20 cm, rim diameter 12 cm. About 1 cm below the rim are traces of a lug. It cannot be established whether the vessel has been decorated.

KV. 12 sherds of a decorated funnel beaker. Preserved height 7 cm, estimated original height c. 12 cm. Ornament: vertical striping with close-set incised grooves on the upper part of the belly.

KX. 2 large pieces and 194 smaller sherds of a large decorated funnel beaker. Preserved height 16 cm, reconstructed height c. 26 cm, reconstructed rim diameter c. 36.5 cm. Ornament: narrow, vertical, sharp ridges on the upper part of the belly.

LB. 2 sherds from a large decorated pot, possibly a lugged beaker, of indeterminate shape and size. Ornament: vertical fields of two-ply cord impressions, alternating with plain fields, on the upper part of the belly.

Size variation

Technically, the pots are generally of good quality. The tempering of the fabric is in most cases quite fine, and two-thirds of the vessels have a smooth and even surface.

The reconstructible beakers could be divided naturally according to size into four groups:

- Group I: large beakers more than 25 cm tall; comprises 4 lugged beakers and 10 funnel beakers.
- Group II: medium-sized beakers 20–25 cm tall; comprises 4 funnel beakers.
- Group III: smaller beakers, 15–20 cm tall; comprises 2 funnel beakers and 2 cylinder-necked beakers.
- Group IV: small beakers, less than 13 cm tall; comprises 5 funnel beakers and 1 cylinder-necked beaker.

We must assume that the varying size of the pots reflected practical daily functions, although naturally nothing precise can be said. Only the large funnel beaker KQ can reasonably be designated a storage vessel. The other large vessels have perhaps rather been used for the transport or serving of food. The small beakers in group IV can hardly be thought of as other than drinking vessels, which agrees well with their more varied appearance and decoration. If we accept this view, the function of the vessels seems, as mentioned below, to a certain degree to be reflected in the decoration.

Decoration

Of the 31 pots found, only one, the cylinder-necked beaker KO, cannot have been decorated. A further two vessels, KP and KY, are represented by so few sherds that the question of decoration cannot be decided.

All decorated vessels have vertical patterning of the upper part of the belly. Four vessels have additionally ornament on or near the neck, including collared flask KG, which has radial elongate stab impressions on the collar.

In the coarse storage vessel KQ, there is a row of perforations under the rim. It is uncertain whether these have had a decorative or a practical function, for instance for fastening a lid or winding of the rim. The large lugged beaker, KT, has triple festoons under the rim, executed in whipcord. A small, poorly preserved beaker, KÅ, has on the neck vertical fields of oblique whipcord impressions, vertical cord impressions and blank fields.

The belly ornament covers between two-fifths and one half of the belly in each case. Vertical plastic moulding or ribs is found in 13 of the decorated vessels or 42% of the entire vessel material from the find, disposed in 9 funnel beakers, 1 cylinder-necked beaker, 1 lugged jar and 2 collared flasks. These mouldings take the form of narrow sharp ridges to flat poorly defined ribs. Vertical striping, either as thin incised lines or narrow grooves, is found in 6 funnel beakers, or in 19% of the entire material. In a single small beaker there are vertical fields of crossing vertical or horizontal incised lines, alternating with blank fields.

Cord pattern occurs in three large lugged beakers and a little cylinder-necked beaker. It is difficult to relinquish the impression that this form of decoration, time-consuming as it must have been, was reserved for vessels with a particular function. It must therefore be permissible to assign the sherds of the large vessel LB, which is cord-decorated, to the group of lugged beakers, although the number of sherds is too small to allow its shape to be determined. Both two-ply cord (KC, LB) and whipcord (KA, KT) have been used. In lugged beaker KT, zones of whipcord are combined with zones of vertical rows of double stab-marks. In the little cylinder-necked beaker KÅ, vertical rows of whipcord occur in groups alternating with narrow blank fields, as in lugged beaker KA.

At the base of the neck of vessel LC are impressions which may derive from either cord or stabbing. When this vessel is excluded, the group of pots with cord impressions makes up 16% of the total number of vessels.

Dating

Both the shape repertory and the decoration with cord impressions link the Ellerødgård I find to the Early Neolithic C phase Virum style, as this has been described by Ebbesen and Mahler (1979: 152). It is, however, remarkable that the pots of the Ellerødgård I find mainly have plastic ribs and vertical striping, stylistic features which the authors accord only little attention in connection with the Virum style.

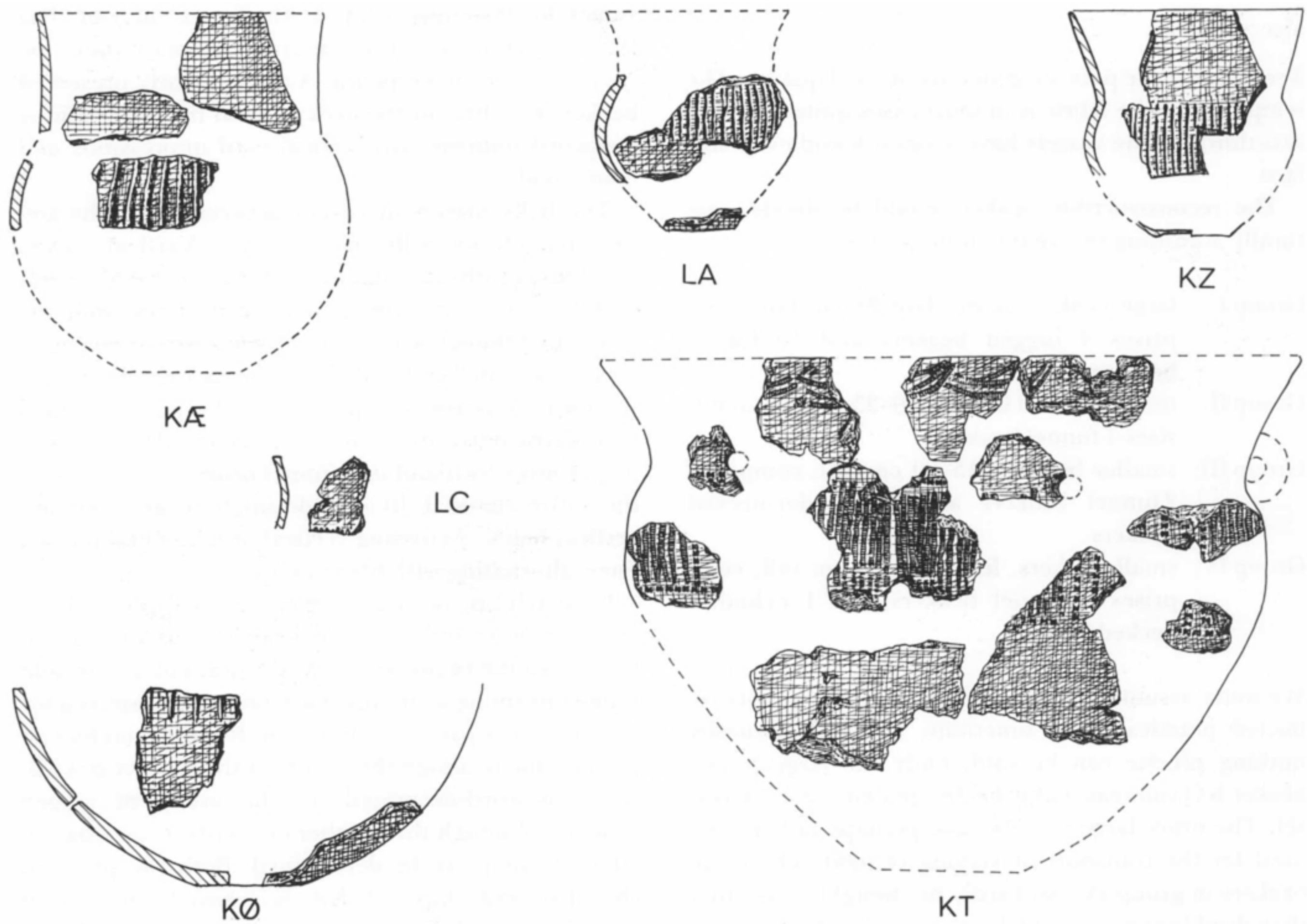

Fig. 9. Pottery from the area to the west of pit IN. Measured by H. Nielsen and drawn by H. Ørsnes. 1:4.

If the ornamental elements be correlated with the size classification, it is seen that vertical ribs appear in all funnel beakers of group I, in 2 funnel beakers of group II and in 1 cylinder-necked beaker of group III, but not in the small funnel beakers of group IV. Since there is room for them on the small collared flasks, this lack of ribs cannot be due to the small size of these vessels.

Vertical striping of the belly does not occur in group I, but twice in group II, once in group III and thrice in group IV.

Decoration with cord impressions occurs either in group I, where it occurs only in lugged beakers, or in a very fine execution on the beakers of group IV.

Examination of the pots of the Virum style, as they occur in the Ellerødgård I find, leaves the impression that the commonest types of vessels were large funnel beakers with ribs and smaller funnel beakers with striped belly. Next in order of frequency are large, fine lugged beakers with cord ornament and small, fine beakers, likewise with cord ornament, or with incised ornament zones. The group is supplemented by a smaller number of lugged jars and collared flasks whose ornament links them to that of the large funnel beakers.

An investigation of whether this tendency to functionally determined utilization of decoration elements seen in the Ellerødgård I material is general within the Early Neolithic pottery falls outside the scope of this article. The tendency to use cord ornament on lugged beakers and jars was established by Becker (1947: 152). Other examples may be seen in Ebbesen and Mahler's work (1979, i.a. fig. 23:3). Examples of the utilization of

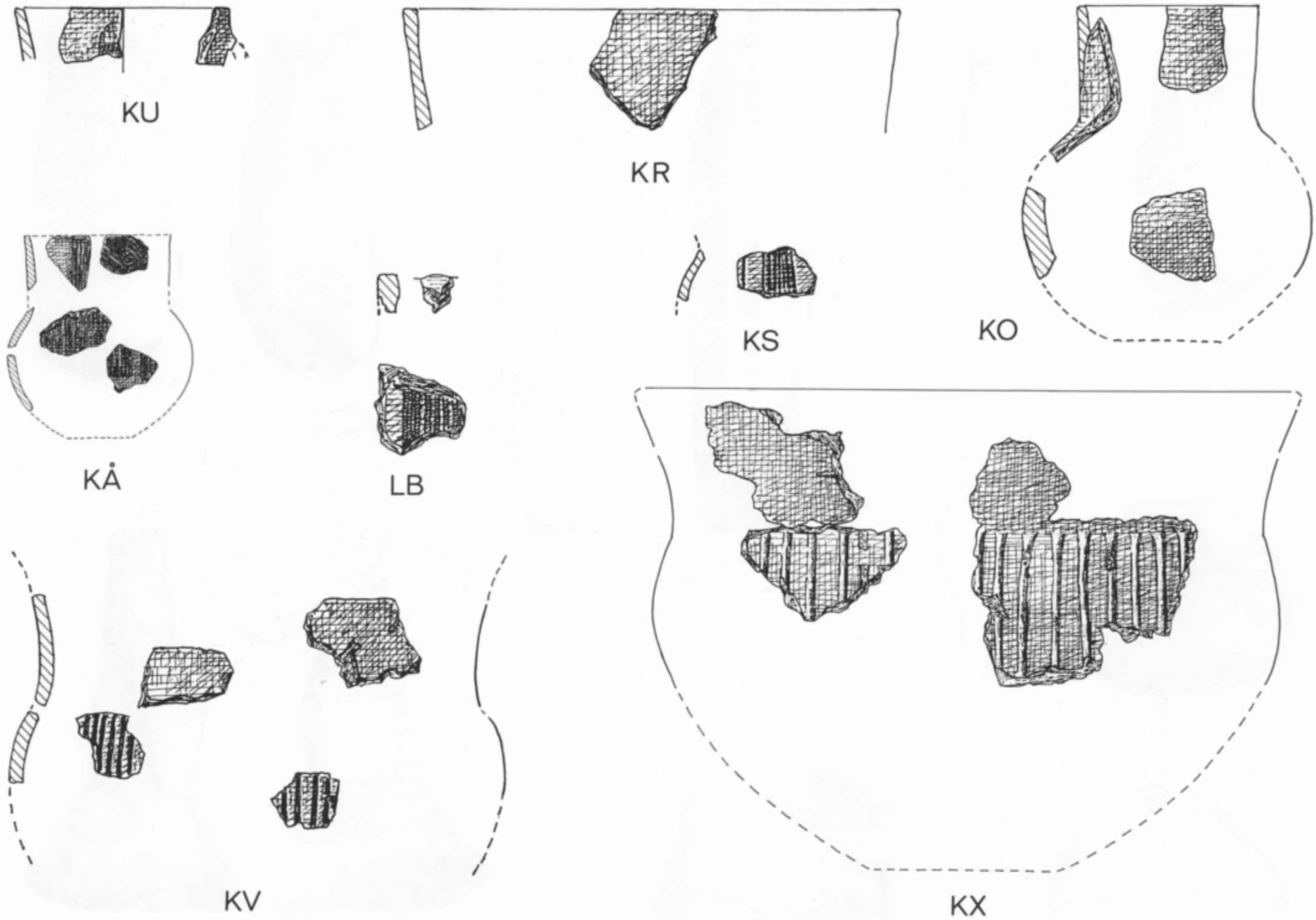

Fig. 10. Pottery from the area to the east of pit IN. Measured by H. Nielsen and drawn by H. Ørsnes. 1:4.

cord ornament on bossed funnel beakers (*idem*, figs. 21, 24, 25) suggest that these pots were functionally related to the lugged beakers.

Placement of pots in pit IN

Based on the observations made during the excavation, the placement of the 14 vessels found as sherds at the bottom of the pit may be reconstructed with considerable certainty (fig. 5).

The exact position of pots KA, KB, KC, KD, KE and KF was recorded on excavation (fig. 4). The other vessels may be placed in accordance with the frequency with which the sherds are found together. The pots had been placed in two groups along the western and eastern sides of the pit, respectively, with most of them to the south.

The western group comprises KA, KB, KD, KG, KI, KK and LD.

The eastern group comprises KC, KE, KF, KH, KL, KM and KN.

With two exceptions, each group comprises uniform vessel types, viz. 1 large lugged beaker with cord decoration, 2 large ribbed funnel beakers, 1 medium-sized ribbed funnel beaker, a striped funnel beaker and a lugged flask. These are augmented by a large ribbed lugged jar in the eastern group and a little striped funnel beaker in the western group.

A closer investigation of the pots has revealed that the large beakers have slightly larger dimensions in the eastern than in the western group, where there is a com-

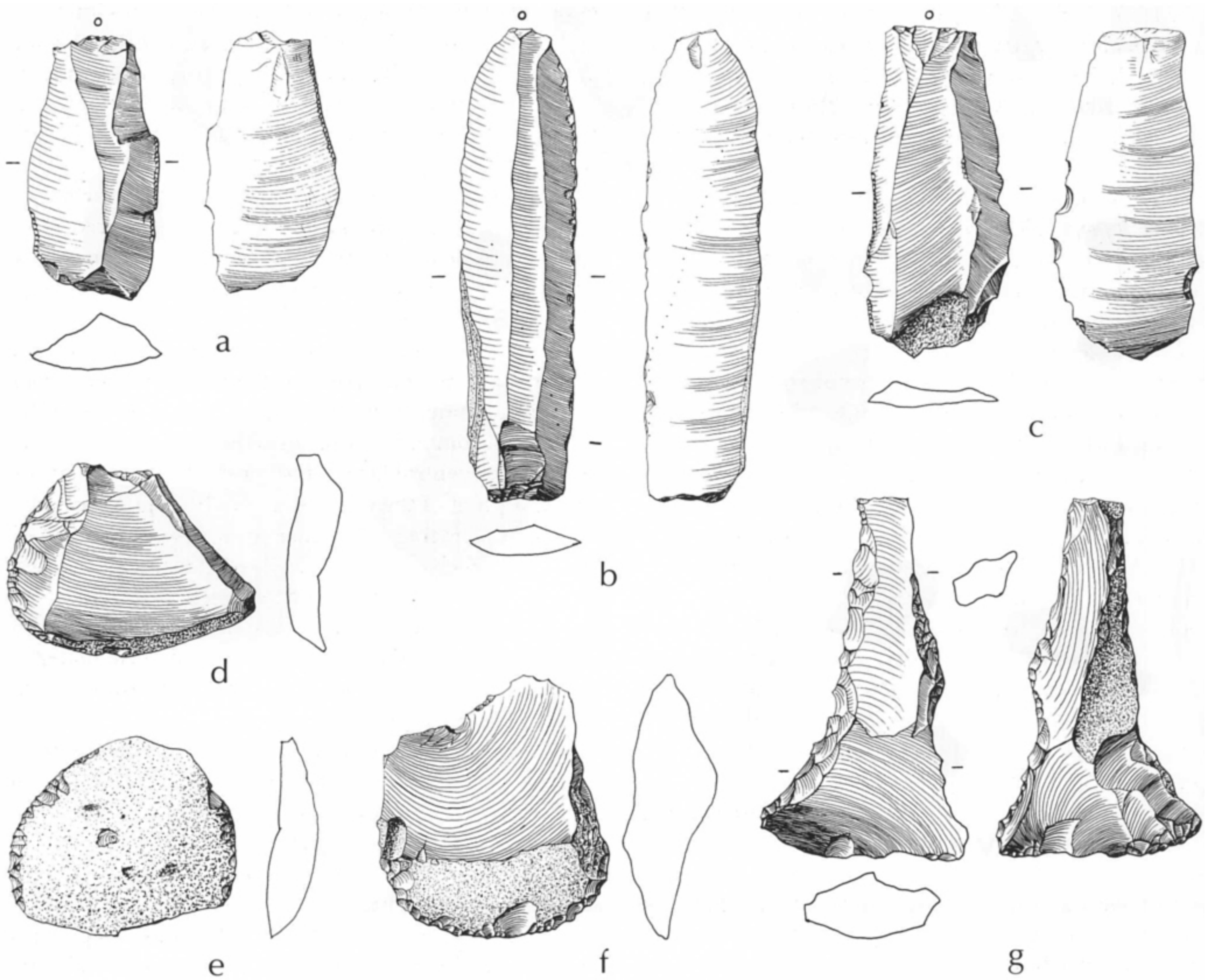

Fig. 11. Flint implements. a: blade knife; b: blade sickle; c: retouched B-blade; d–f: flake scrapers; g: flake axe. Drawn by Lars Holten. 2:3.

pensatory more carefully executed decoration. The collared flasks in the two groups are differently made.

It is tempting to perceive the two groups of vessels as two sets of crockery placed in pit IN on one occasion, and the differences in crafting mean that these represent two different households.

Unfortunately the circumstances of find do not permit equally certain conclusions about the pots found in the other parts of feature CE, but the accumulation of sherds in the smaller pits suggests, in conjunction with the variation in vessel types and ornament, that these represent corresponding, but not identical sets.

Flint

The excavation yielded 184 pieces of flint. 77 were recovered from pit IN and 66 from the area to the east of IN, while only 6 pieces have been recorded to the west of IN. In addition 35 pieces found outside IN lack information on provenance.

Since a thorough investigation of the flint material has yet to be carried out, i.a. an analysis of wear marks, only a survey of this material will be given (fig. 11), with mention of special features (3).

The material includes 22 *unworked flint pieces*, 7 of which are *fire-brittle*. That part of the unworked flint that has not been affected by fire comprises fragments, some of which derive from frost-shattering.

2 cores and 1 core *flake* derive from the eastern part of feature CE. The cores are crude, with remains of cortex present.

The most numerous group of flint objects consists of *unretouched flakes*, 105 of which were found: 48 in pit IN, 2 in pit IP, 4 in the area west of pit IN and 38 to the east of it. Precise information is lacking for 20 other pieces. In 21 pieces, traces of use in the form of wear marks or damage to the edges has been recorded. An examination of the wear marks shows that some specimens have been used for working in wood, while others have been used for work in siliceous plant material.

27 *retouched flakes* cannot be assigned to particular types of implements. 7 derive from pit IN and 13 from the area east of this, while information is lacking for a further 7 pieces. 5 flakes show wear marks on the edges, and one of them also exhibits hafting wear. To this group is also assigned a retouched flint flake with lustre and a retouched piece derived from frost-shattering.

Blades and *blade implements* were represented by 18 pieces. Among these there was only 1 A-blade, the rest being B-blades.

In the area east of pit IN a *blade sickle* was found between the stones of layer *b*, made from an A-blade (fig. 11b). The length is 10 cm and the width 2.6 cm. The distal end has been retouched. The edge is highly lustrous with a border diagonally across the blade. A wear trace analysis showed many scratches perpendicular to the edge but also to a lesser degree parallel and oblique to it. The wear and lustre indicate that the piece was in use for a long time, presumably for several years.

From pit IN derive 2 *blade knives*, 5.5–6.7 cm long (fig. 11a). Judging by the wear marks they had been used for work in both wood and plant material, including siliceous plants. Several of the 14 *unretouched B-blades*, which were 5.4–6.8 cm long and 2.8–3.3 cm wide, may have served the same purpose as the blade knives (fig. 11c). 10 of them were found in pit IN, 2 more were found to the west and east of feature CE, respectively, and information is lacking for two others. One of the B-blades from pit IN exhibits wear marks. 2 broken proximal ends presumably derive from B-blades.

Only 1 *retouched B-blade* was found. It has wear marks on the edge and was perhaps used as a knife (fig. 11c).

There are 9 *flake implements* in the find. Among these *flake scrapers* predominate with 7 pieces. 1 was found in pit IN and 3 east of IN, while information is lacking for 3 others. The majority have evenly retouched, rounded distal ends. In one piece, most of the scraping edge is broken. The scrapers are 3.8–5 cm long and 3.7–5.7 cm wide (fig. 11 d–f).

At the east end of feature CE, 1 strongly refurbished *flake borer* on a large retouched disc was recovered.

In the stone layer, but without certain provenance, a narrow *flake axe* with trimmed sides and splayed edge was found (fig. 11 g). The length was 7.3 cm and the width 1.1–4.6 cm. The neck extremity seems to have been broken off. The axe was irregularly trimmed from the ventral side of the flake. The edge is damaged by desquamation. Part of the dorsal face is covered by cortex. On the ventral face, grinding-marks are seen at the thickest point of the axe and along the edge splay.

The implements are made mainly of greyish, spotted flint. Relatively many pieces have remnants of cortex on the surface, which, in conjunction with the rather small blocks and the occurrence of retouche on pieces derived by frost shatter, indicates that raw material must have been present in limited quantities and in none too good a quality.

The distribution of flint material in feature CE does not form any clear picture. The many flint flakes seem to be evenly spread over the entire structure, although the western part, where flint was not taken up, escapes evaluation. Most noticeable is the distribution of blades and *flake* implements in relation to pit IN, 10 unretouched blades out of a total of 14 lying in this pit with the two sole blade knives of the find, whereas only one of the finds's 7 *flake* scrapers was found in the pit.

Bone implements

Only 1 object of worked bone was found, a well-preserved *bone chisel* from pit IN (fig. 12). The chisel was fashioned from the proximal end of a long bone, presumably of domestic ox. The bone was split and scraped smooth, especially on the inner surface, and slightly pointed, with a slightly rounded edge. It was 10 cm long, 3.7 cm wide above and 1.2 cm wide at the edge.

Bone chisels are common within the Funnel Beaker Culture, where they are usually between 11 and 16 cm long (Becker 1962). The chisel from Ellerødgård I is thus below average size.

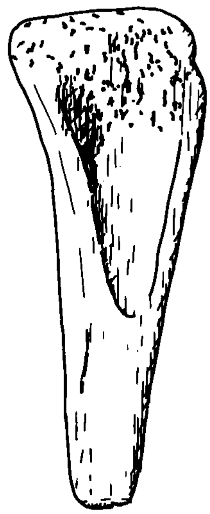

Fig. 12. Bone chisel from pit IN. 2:3.

Animal bones

Owing to the high water-table in the area, bone was well preserved, but the individual pieces suffered from excavation, so an exact figure cannot be given. Within feature CE, animal bones were found mainly over and between the stones, although a few were found between or under the large pieces of pottery, e.g. under pot KQ in pit IP. Domestic ox (*Bos taurus*), domestic pig (*Sus domesticus*), sheep (*Ovis aries*) and roe deer (*Capreolus capreolus*) have been identified (4).

In pit IN, fragmented bones of ox, sheep and pig were found: teeth, limb-bones, vertebrae and skull fragments. In particular an almost entire lower jaw of an old pig found in the centre of the pit should be remarked.

Pit IP contained fragments of limb-bones of roe deer and possibly also of sheep.

The area to the west of pit IN yielded limb-bone fragments and a rib of ox.

The area to the east of pit IN yielded limb-bone and molar tooth fragments of ox. The provenance of other limb-bone fragments is not known.

Proper observations on the bone material were made only in pit IN, where it could be seen that the fragmentation derived from marrow-splitting.

The teeth and jaw parts of pig show that at least 3 individuals are represented, viz. two old ones in pit IN and the eastern part of feature CE and one young one in pit IP.

Botanical material

Soil samples for pollen analysis were taken in pit IN from the neck of collared flask KF, which was placed deepest in the pit, and from the soil under the flask. Both samples contained very little pollen. The first yielded pollen of saltwort and of alder and birch, but none from forest trees, indicating that feature CE was located in an area open to the light. The other sample contained a little black, heat-affected birch pollen, which agrees with the fact that the soil around it contained charcoal (5).

A sample of charcoal from the soil around lugged jar KE was identified as alder (6).

INTERPRETATION

It is not possible to reconstruct the original appearance of the structure on the basis of the limited information the excavation yielded. What could be seen was that groups of entire pots had been placed in or near pits in the floor of the depression and under or inside stone constructions that during the later decay of the structure subsided or collapsed and compressed the pots. It is not known whether there is any connection between the latter phenomenon and the fire which has affected some of the pots.

On or near these stone constructions were placed bones of consumed animals, with scrapers and cutting tools of flint, some of which seem to have been produced on the spot, perhaps for working wood and other plant material used in building the structure. Unfortunately it cannot be decided whether any of the flint implements have been employed in butchering.

Most important is the demonstration of two or more sets of clay pots, which must represent an equal number of households, a circumstance supported by the occurrence of bones of at least three domesticated pigs in different parts of the structure.

Feature CE must consequently be regarded as a place where several families or groups were gathered for a meal. That this meal may have been of a ritual nature is suggested by the utensils used being left behind and arranged in sets, with cutlery and food remains. The arrangement was associated with a wood and stone structure of uncertain appearance and function.

The Ellerødgård find brings to mind several of the bog-offering sites in eastern Denmark, mentioned by Becker (1947: 270–284), but while these, as Becker has established, are characterized as individual depositions – sometimes repeated – of a single pot, the Ellerødgård find pertains to a single *group* ritual. The find is more akin to the early Middle Neolithic finds from Nr. Onsild and Kvong in Jutland (Ebbesen 1979: 35 ff.).

Pottery depositions with meal remains, consisting of both animals and human bones, are a widely found phenomenon within the early Funnel Beaker Culture (Becker 1947: 270–84; Rech 1979: 45–53). They reflect special patterns of religious and social behaviour. There is much to suggest that the Neolithic population lived in tribal societies consisting of clans. This type of society was particularly prone to internal conflict and petty feuding (Jensen 1982: 115). It was of great importance for the continued existence of a group that stable relations were maintained, both within the group and with neighbouring clans. An important means could be the exchange of gifts, marriage and feasts.

The deposition of food, implements and crockery may be understood in this light. In societies of this kind, feasts are employed to mark the community of the participating families, clans or age groups, just as the giving of or contribution to a feast is for the donor a means of obtaining prestige and social status.

Status marking reaches a peak in Early Neolithic C with the building of the dolmens. At about the same time, the first causewayed enclosures appear, which are thought by many to have been ritual assembly sites (e.g. Sarup: Andersen 1981; Toftum: Madsen 1978, *et al.*).

In connection with these structures depositions of whole pots, in pits and moats, occur in a manner comparable to that of Ellerødgård I. The excavation at Ellerødgård could, however, not confirm the presence of a fortified structure of this kind, just as the location of the site cannot be said to be typical of this kind of place.

The Ellerødgård find is thus one of the few known examples of pottery depositions on dry land. It has afforded the opportunity of a very precise description of such a deposition, while also giving the hitherto most detailed and varied picture of the east Danish pottery of Early Neolithic period C.

Translated by Peter Crabb

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NOTES

1. Sydsjællands Museum, Vordingborg. SMV case no. 5/82. Ørslev Parish, Bårse District, Præstø County. The investigation was carried out by the author under the auspices of the museum, funded by *Fredningsstyrelsen* in accordance with the Conservation of Nature Act §49. An interim description of the find has been published in *Skalk* 1984: 1 p. 26 ff.
2. The excavation, which covered 1500 sq.m. and took 15 working days, was hard-pressed by the motorway construction, which occurred in the immediate vicinity. From the Iron Age settlement, for example, which was the primary object of excavation, a maximum 25% of the existing artefact material was recovered. Pit IN in feature CE was excavated in the afternoon and evening of the very last day of the campaign.
3. The author wishes to thank Peter Rasmussen, of the Department of the Natural Environment of the National Museum, who has kindly examined the flint material and investigated parts of it for wear marks.
4. Universitetets Zoologiske Museum, ZMK no. 52 1983. Information in letters of 21.11.1983 and 31.8.1983 from Tove Hatting, whom the author thanks for identification of the bone material.
5. Verbal report from Ingrid Sørensen, Universitetets Zoologiske Museum. The author wishes to thank Ingrid Sørensen, who was so kind as to carry out the analysis.
6. Kindly identified by Kjeld Christensen of the National Museum, Department of Natural Science.

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Pottery Manufacture at a Neolithic Causewayed Enclosure near Hevringholm, East Jutland

by BO MADSEN and RENO FIEDEL

This article has two purposes. The first is to present an important new findspot belonging to the Funnel Beaker culture, and the second is to put forward the main subject matter of this article: a hitherto unknown type of feature which turned up quite unexpectedly during the excavation. This type of feature is (optimistically) to be expected during future excavations on similar sites.

INTRODUCTION

In the last century Store Brokhøj was the site of what was apparently a large tumulus. Now the site consists of overgrown sand diggings (fig. 2,A). The locality to be discussed lies immediately to the east of Hevringholm manor (1) on the northwestern part of the Djursland peninsula, only four kilometres from the well-known complex of megalithic sites at Tustrup (Kjærum 1957). On this hummocky northwest-southeast oriented plateau c. 30 m above sealevel, the Randers Culture Historical Museum in 1985–86 excavated the remains of a causewayed enclosure around Store Brokhøj, dating to the earliest part of the Middle Neolithic (2). It was during this work that the remarkable feature to be described was found. From the point of view of excavation this feature required a much more intensive investigation than is normally allocated to settlement pits filled with pottery during the large and expensive settlement excavations of the present day.

THE FEATURE

Survey and Sondage

A surface concentration of potsherds and burnt clay daubing was found during intensive survey of the field north of Store Brokhøj; this led to the excavation of a sondage (fig. 3). This revealed parts of respectively the eastern and westernmost sections of the feature. To the east was uncovered the outline of a zone filled with potsherds and large quantities of burnt clay daubing in a matrix of partially washed out sand containing charcoal. The sondage to the west of the pottery zone confirmed that the feature extended to the west in the form of a limited area of different coloured deposit around a stone setting. These observations, and not least the state of manufacture of the large quantities of pottery, led to a full-scale excavation being carried out in November and December 1986.

Observations during excavation

Feature AAA (fig. 2B) turned out to comprise four main elements: an oblong pit (AAM) in which was a tight concentration of burnt clay daubing and potsherds (C); a stone setting (AX); and a charred treetrunk (SX) (fig. 4). It was decided to excavate a series of transverse sections across the unknown feature, with a local section through C. This decision – together with the adverse weather conditions – meant that it was impossible just to empty pit AAM. A rectangular trench was therefore laid out around the feature. The various components are described in the following.

Pit AAM

The pit was oriented ESE-WNW, and was placed as an extension of the ditch system to the west, lying only 1.5 m from its eastern edge (fig. 2C). Below the 0.25 m deep plough horizon, the outline of the pit was a long oval, 4 m long and 1.5 m wide. The depth of the pit was 0.6 to 0.7 m, and its sides were sloping or (along the north side of the stone setting) partially vertical. The subsoil con-

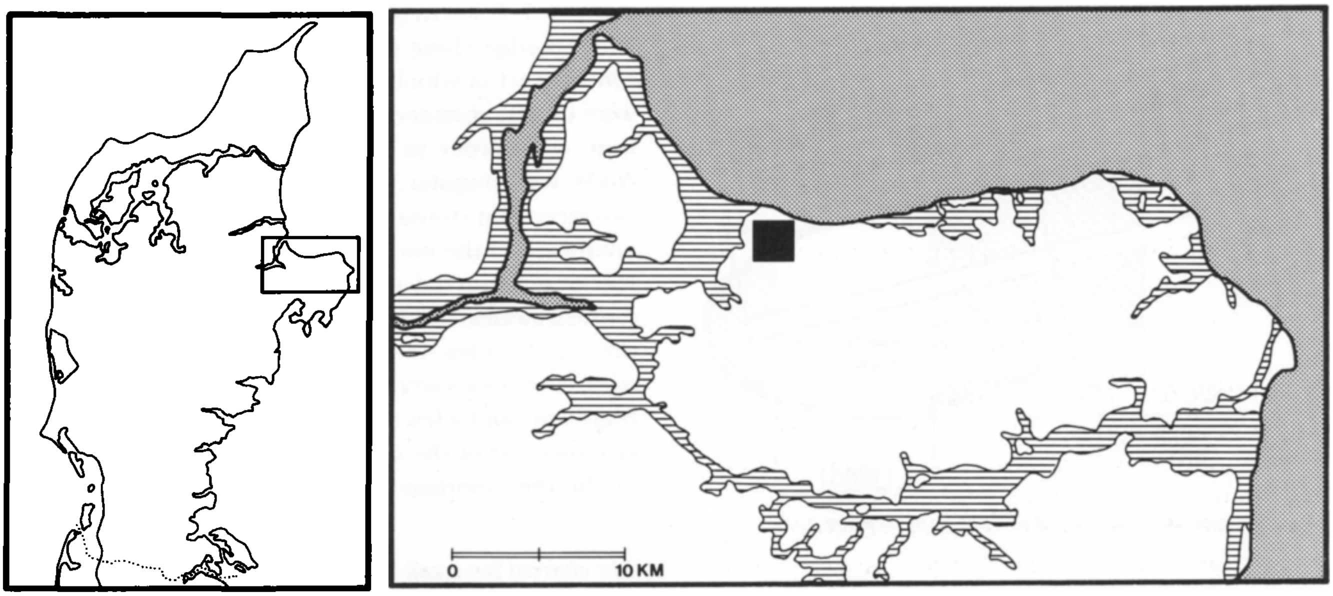


Fig. 1. The location of the causewayed enclosure in relation to the Littorina land – sea configuration.

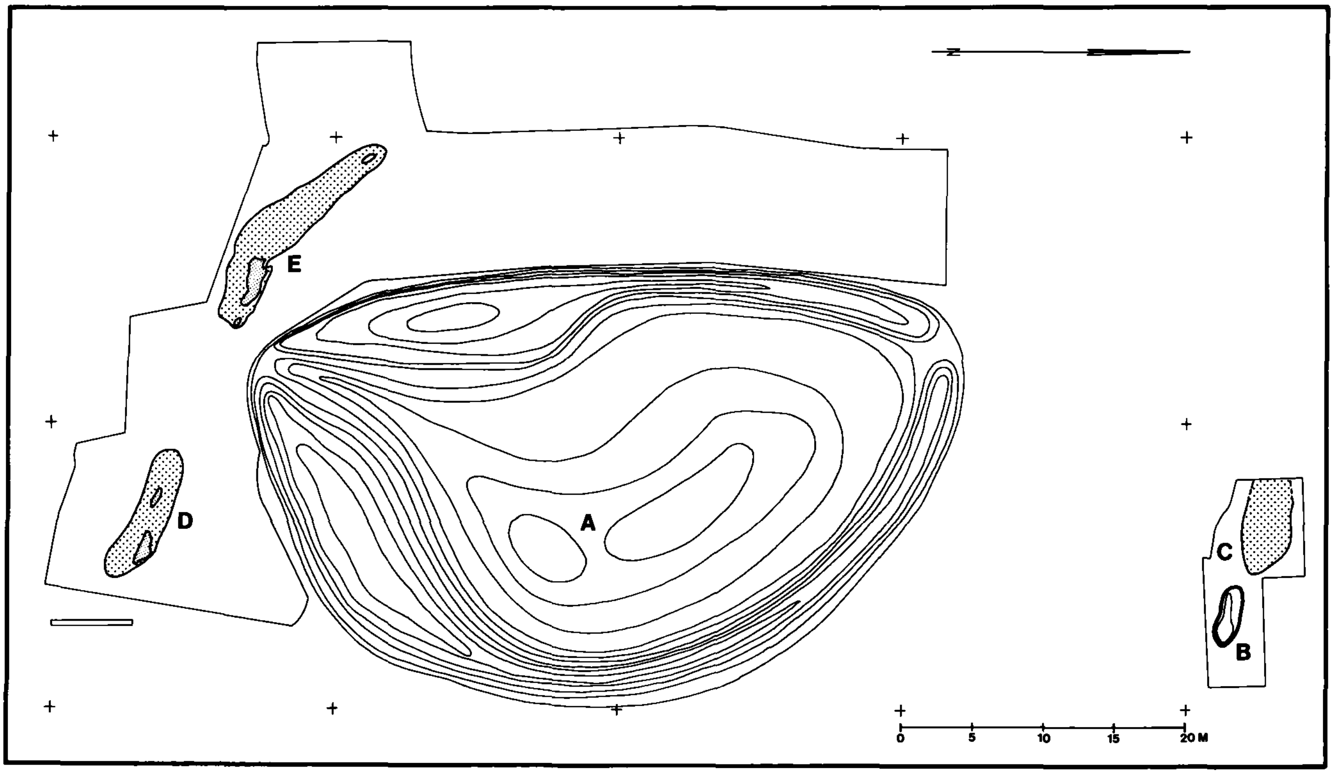


Fig. 2. The excavation area. A: Sand pit. B: Structure *AAA*. C, D, E: Remains of ditch system.

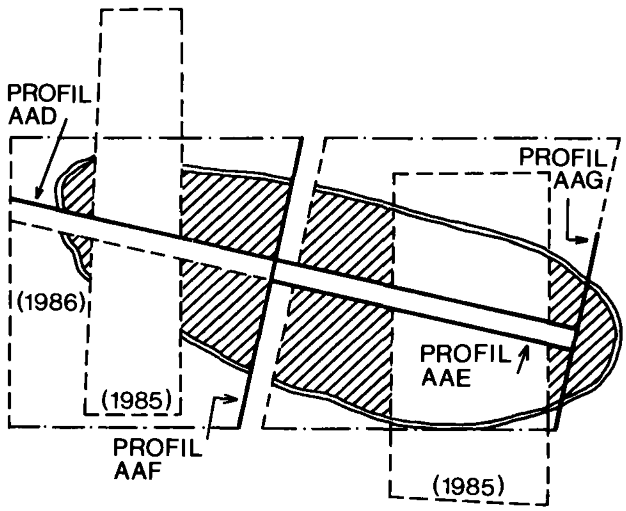


Fig. 3. The extent of sondage and excavation in structure *AAA*.

sisted of clay with a little sand, and in several places it was difficult to follow the transition to this. The bottom of the pit was flat, although irregular, and inclined slightly downwards towards the east.

Pottery concentration C

This consisted of sherds, sections of vessels, and nearly complete pots, intermingled with large quantities (more than half a cubic metre) of lightly or heavily burnt clay daubing with clear impressions of heavy wattling. Among this scattered fragments of burnt stone and two burnt flints were also found: a waste flake and a core. These finds, together with areas of lightly humified sand slightly stained with charcoal, filled a pit at least 0.4 m deep, which formed the entire eastern end of AAM. To the west, the boundary between the pit and the stone setting AX and the treetrunk SX was unclear, partly because of disturbances caused by the hasty excavation of the sondage in 1985 (fig. 3). Area C is roughly the shape of a horse's hoof, and covers c. 1.2 m^2. The broader western side is 1.3 m in length, while from west to east it measures 1.3–1.4 m. The bottom of the pit is flat, and is formed by a stone setting – the easternmost part of stone setting AX.

Stone setting AX

The position can be seen in fig. 4A and to some extent in the section in fig. 4B. The concentration comprises stones 0.1–0.3 m in diameter, and has a straight, clearly marked edge along the northern side of pit AAM, the central part of which was slightly concave. The stones were mostly rounded, and formed no recognizable pattern; the border to the west and south, towards pit AAM, was irregular. In the top of the stone setting were two larger flat stones, 0.3 and 0.4 m long, positioned immediately to the north of the charred treetrunk SX. In AX were observed many burnt, partly fragmented or reddish stones – several with traces of burnt material on their undersides. In the washed out grey sandy fill between the stones were observed a few scattered charcoal fragments and a few pieces of burnt daubing. The westernmost end of the stone setting was a little disturbed by the 1985 sondage.

The charred treetrunk SX

This surprising find came from the southern side of AAM, near the bottom of the pit. The completely charred treetrunk was preserved as a 1–2 mm thick layer of charcoal without any visible woody structure. The upper side, however, displayed a three-dimensional wood structure with longitudinal lines. The trunk was preserved to a length of 2.2 m and was 0.45 m wide. SX clearly had a concave, trough-shaped cross-section (fig. 4B). The edge/outline of the trunk were encountered at a level of 0.02–0.04 m above its base. Charcoal traces showed that the trunk must originally have continued to the centre of the base of C, so that it would thus have had a full length of nearly 2.5 m. The trunk is resting on a few burnt stones, and along its northeastern edge is covered by the stone setting AX. Just where the trunk ran into C two flat stone slabs were observed. These stone slabs, now standing at an angle, were supported by smaller stones resting on the edge of the treetrunk; together with the two slabs (mentioned above) which were found immediately to the northwest, they seemed to have formed a covered duct (fig. 5). This duct, some 0.2 m wide and 0.1 m high, was filled with material from C.

The two stone slabs from the top of the stone setting, and so not in their original position, without doubt formed a westerly extension of this construction.

The whole of the eastern metre of the treetrunk was covered and partly filled by large potsherds and in particular fragments of clay daubing. It is clear that the treetrunk is a part of a partially stone-built construc-

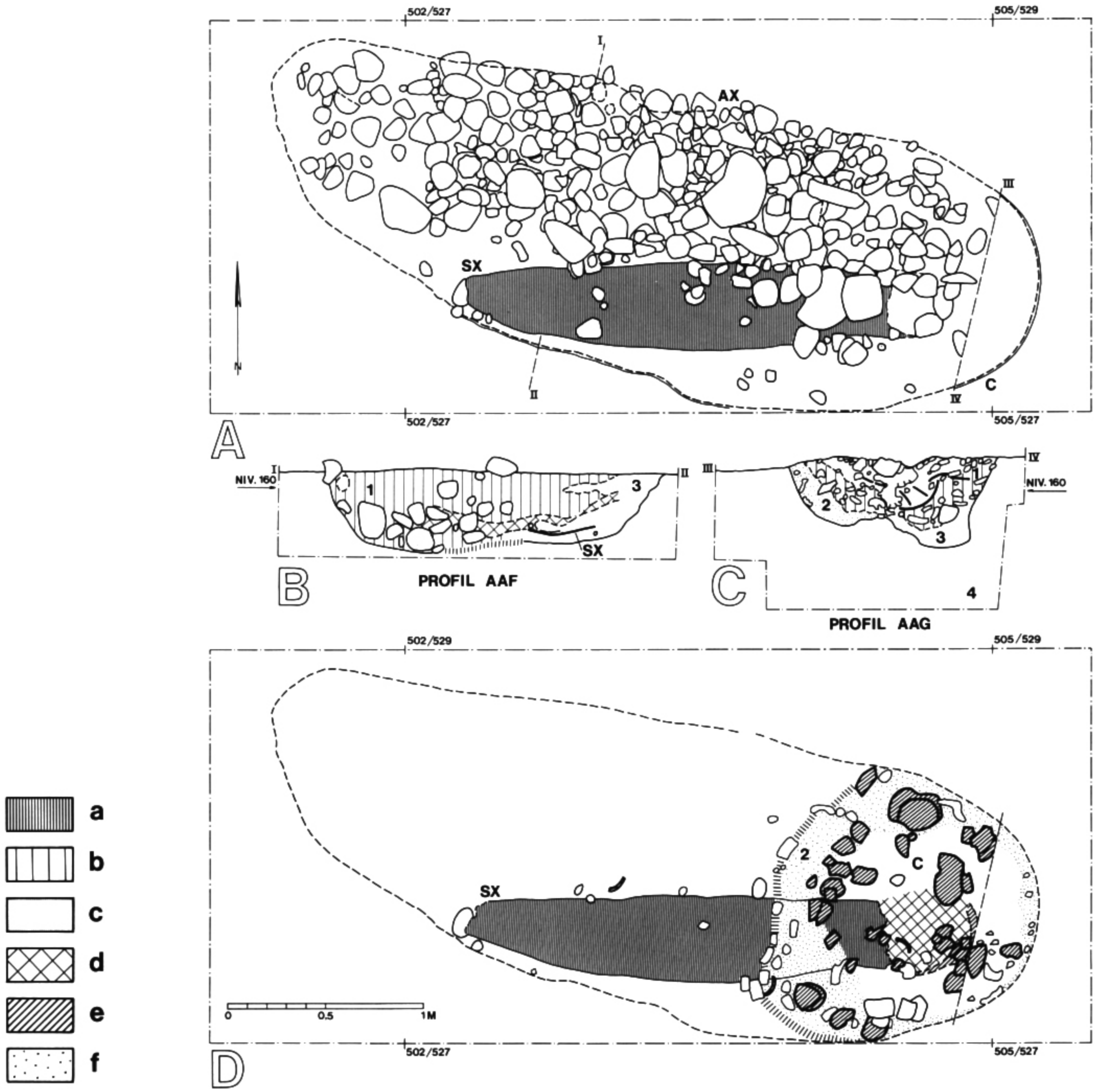


Fig. 4. Excavation plan. A: Structural remains of *AAA*. B, C: Sections. D: Plot of ceramic finds in area *C*. – Legend: a, charred wood; b, grey sand; c, burnt daub; d, charcoal; e, pottery fragments; f, white and ash coloured sand. (G. Rasmussen *del.*)

tion, which formed a duct running beneath C; this is also visible from the section through C (fig. 4C).

Stratigraphy and distribution of finds

Feature AAA is dug down into the sandy clay subsoil which covers the whole of the north side of the Store

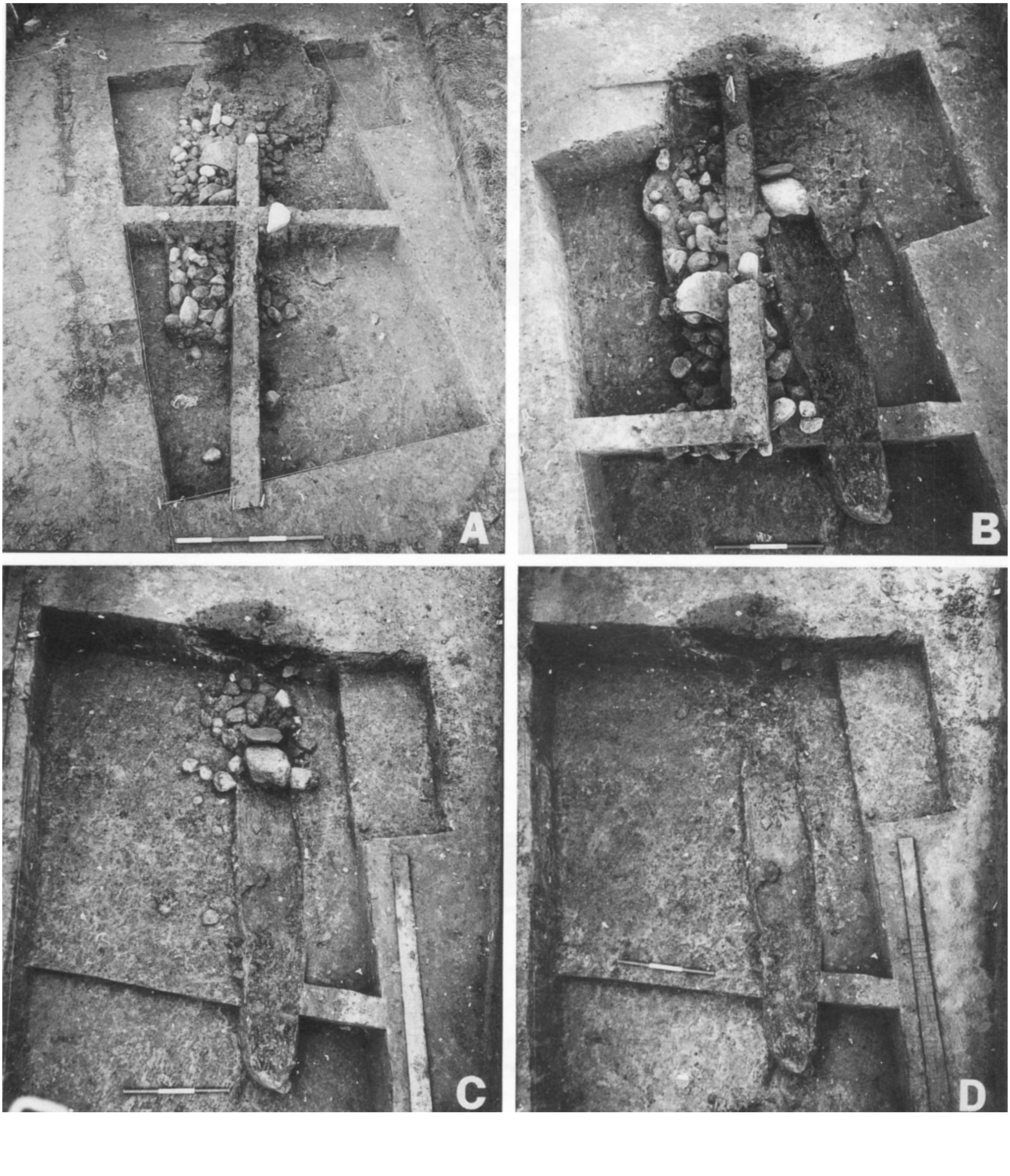
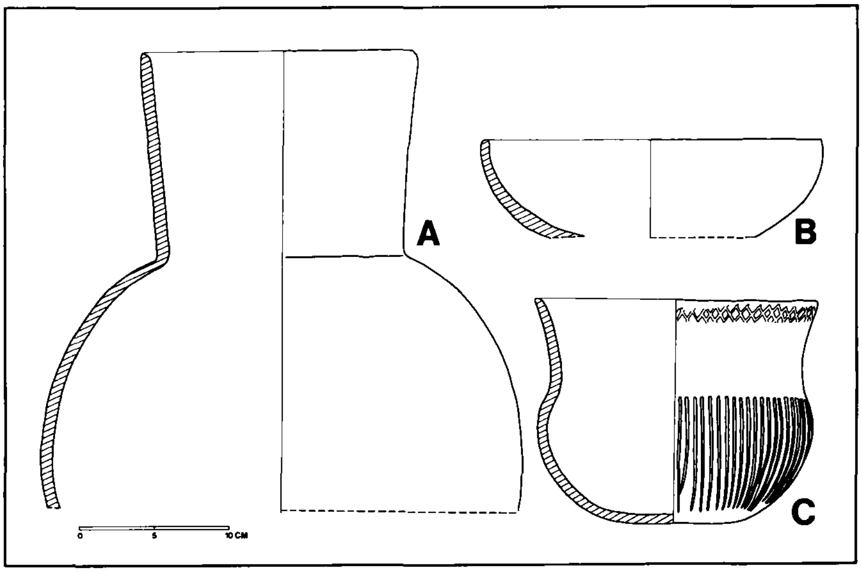


Fig. 5. The excavation in progress. Structure *AAA* seen from the west. (photoes: K. Nijkamp)

Fig. 6. Examples of pottery finds from structure *AAA*, area *C*. Scale 1:5.



Brokhøj hill. This subsoil contains hardly any stones or boulders. The primary fill of the pit consists, as mentioned, of washed out grey sand with a few scattered fragments of charcoal, and a complete lack of humified soil. Downwashed or collapsed subsoil was observed in several places along the edges of the pit (fig. 4C, layer 3). The grey sand, layer 1, could be seen as far down as the base of the pit, both in and under the stone setting. The section through the treetrunk SX (fig. 4A, points I to II), which is a view from the west, shows the relationship between the treetrunk, the stone setting, and the base of the pit. The trunk is placed 0.05–0.10 m above the diffuse base of the pit. Along the whole length of the trunk a zone of scattered charcoal fragments was observed between the trunk and the bottom of the pit. Traces of charcoal were also visible somewhat higher in the pit, running from the northern edge of the treetrunk in among the stones of AX. The interior concavity of the trunk outside C was also filled with the grey sand. Very close to the charred wood, an ashy sand layer only a millimetre thick was observed.

The section through C (fig. 4C) between points III and IV (fig. 4A) shows the structure of this pit-like concentration of clay daubing and pottery. The edge of the pit is marked on the surface by a diffuse zone of grey to white sand, layer 2, which along the northern side can be traced right down to the bottom. The interior of the pit, consisting of potsherds and burnt clay daubing in a matrix of partially washed out dark sandy fill containing charcoal staining, revealed a depressed, concave structure. The clay daubing lay tightly packed in C, with the largest pieces in the centre. Despite careful exposure, no definite patterning was visible in the distribution of the clay daubing, which lay completely randomly. In layer 2, the greyish white sand, the clay daubing was more scattered, although it was burnt completely red in a way very similar to the potsherds found in this zone along the edge of the pit (fig. 4D). Potsherds and vessel sections lay throughout the entire pit. In the central part were sherds of a large undecorated lugged jar (WZ) and most of a richly decorated lugged beaker (XR). High up in C, near its northern edge, was a complete side of a funnel beaker (TB) of type D (Becker 1948), with its base uppermost.

The many vessel sections along the edges of the pit were mainly bases, strongly reddened in firing, of crumbly consistency, and with a black interior. In the bottom of C there were also a few sherds of unfired or weakly fired ware.

Dating

Feature AAA is a structural unit, and can be dated by the pot types it contains. A preliminary evaluation of the pottery from C (analysis of the assemblage has not yet been completed) reveals sections and fragments of

15 vessels, of which a selection is illustrated in fig. 6. On the basis of shape and decoration this pottery aligns itself with the Fuchsberg group, which appears in Schleswig-Holstein, on the island of Funen, and in eastern Jutland, at the transition from Early to Middle Neolithic at c. 3400 BC (recalibrated) (Andersen and Madsen 1977). The vessel types from feature AAA are excellent examples of this cultural context, and contain (apart from those mentioned above) a small undecorated bowl.

INTERPRETATION

As the excavation of area C progressed it became clear that the feature was not a normal pit filled with potsherds and other refuse from a settlement. The large quantities of clay daubing, burnt red, yellow and brown, were in themselves noteworthy. The ceramics also displayed a degree of variation in ware, colour and surface unknown from settlement contexts. In particular their surfaces and interiors showed extreme variation in colour and hardness, from red with grey areas and black core, via yellowish-brown ware with a more common dark brown core, to apparently unfired pottery.

If these observations are linked to the charred remains of the trough-shaped treetrunk and the existence of a stone-covered duct under pit C, then feature AAA (and in particular area C) must be interpreted as the remains of a structure for firing pottery.

What we do not yet know with any certainty is whether the Store Brokhøj 'kiln' is a unique undertaking, or reflects a more widespread technology involving the firing of pottery in a partly sealed kiln and the attempted control of temperature and atmosphere. The second is the more likely of these two possibilities, and we must regard the treetrunk as being not merely deliberately utilised, but as an apparently vital element in the operation of the kiln. The stratigraphic situation indicates that feature AAA was used for several firings, and that the heat source was placed outside the entrance to the kiln itself (C) – the shape of which (possibly a cupola: Bjørn and Hingst 1973, p. 110) cannot yet be described.

Finds of kilns – or of features interpreted as kilns – are not completely unknown within the Scandinavian Funnel Beaker culture. Apart from a series of inexpertly or inadequately documented cases (Bjørn 1969, p. 60; Silow 1962 p. 27; and Davidsen 1978 p. 61) there are three Scandinavian examples of features interpreted as pottery kilns (Strömberg 1978, p. 97; Larsson 1982, p. 71; and Nielsen 1984, p. 34). In the present context a particularly interesting find comes from the causewayed enclosure at Sarup (Andersen 1976); this is a 2 m long oval pit, no. A 258, containing sherds from at least 44 vessels of MN II date, which represent, according to the excavator, the results of an unsuccessful firing. A thick layer of burnt clay daubing was observed on top of the eastern part of this ceramic material. In the bottom of the pit was material resembling occupation debris, with partially burnt finds of flint and bone.

A deeper understanding and technical interpretation of the hitherto unknown kiln type from the Hevringholm causewayed enclosure must be based upon: 1) future excavation of similar features; 2) an archaeometric and morphological analysis of the pottery from the kiln chamber, along with that of samples from other finds of unsuccessful firings; and 3) an experimental testing by reconstruction of the components and totality of the feature.

THE CAUSEWAYED ENCLOSURE

Only a small area of the site has so far been excavated, namely just over 1200 m^2. This is mainly to the south of the tumulus (fig. 2). So far three elongated pits have been uncovered, each up to one metre deep, two to the south and one to the north of the tumulus. These are interpreted as ditch segments. Traces of narrow trenches containing post rows up to 1.5 m deep have been found in the southern area. So far they form no recognizable pattern.

Despite the limited excavation area, however, the features and finds mean that the site must be classified as a so-called causewayed enclosure. The best locational parallel is the site of Bjerggårde, near Horsens in Eastern Jutland (Madsen 1982), but it is still too early to examine the size and plan of the Hevringholm site.

The Hevringholm site lies in a generally sandy and clayey region with few stones and boulders and little morainic flint. This may be why there are virtually no flint artifacts on the site. Only in connection with a single small pit containing shells and charcoal in the west of ditch segment E did worked flint appear, together with bones and pottery.

The most remarkable finds from the causewayed en-

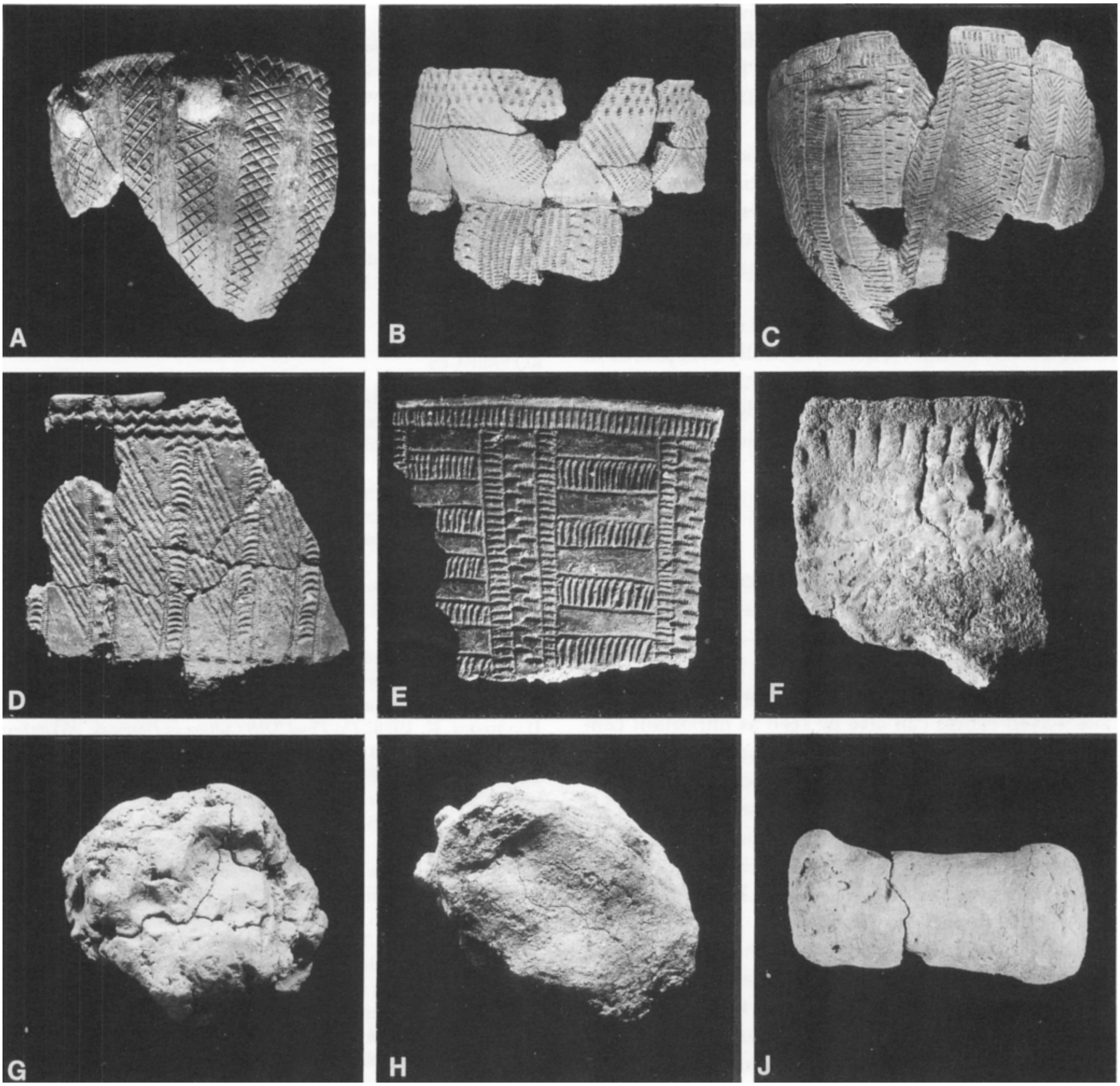


Fig. 7. Finds from the Hevringholm site found in or adjacent to the ditch structures. A–E: Funnelbeaker pottery typical of the MN I period in Jutland. F: Secondarily burnt rim sherd. G, H: The potter's raw material; note finger and hand impressions. H is tempered with granite. J is a straw tempered, burnt clay object. Individual scale, heights in cm: A = 12.2; B = 14.1; C = 18.6; D = 6.4; E = 5.9; F = 6.2; G = 9.0; H = 10.0; J = 4.0 (photo: K. Nijkamp)

closure, from both ditch segments E and D, consist of large, dense concentrations of pot sherds and burnt clay daubing. The richest such concentration has so far yielded evidence of more than 70 vessels. Together with these pottery concentrations, which appear to be the results of unsuccessful firings, occur weakly fired lumps of both raw and granite-tempered paste – with impressions of the hands of the potters preserved (fig. 7). Especial mention must be made of three cylindrical fired objects of clay tempered with straw (fig. 7). Are these used for stacking up pots for firing? – or are they anvils for performing the 'paddle-and-anvil' technique? The vessel types comprise funnel and lugged beakers, decorated and undecorated bowls, lugged flasks and lugged jars.

We regard these concentrations of pottery and burnt clay daubing as the dumping of rubbish from unsuccessful firing episodes (3). They occur so tightly packed and undisturbed that it is tempting to conclude that, as for pit A 258 at Sarup, the firing took place close to the ditch segments.

This large ceramic assemblage, and in particular the decorated bowls (fig. 7), are stylistically best placed in the East Jutland Fuchsberg phase, although there are hints of the Troldebjerg phase (MN 1a) with its more developed modelling and ornamentation.

GENERAL PERSPECTIVES

Causewayed camps have now been located throughout most of Denmark as well as Scania (Madsen 1982, Larsson 1982). The number of these so-called assembly places is now over 15. As suggested by N. Andersen (1981) and T. Madsen (1982), the South Scandinavian causewayed camps can also be seen as important centres of socioeconomic and ritual activities.

The causewayed camp at Hevringholm underlines a further significant dimension of these activities. This dimension, also visible at the Scanian site of Stävie (Larsson 1982), at the only extensively excavated site Sarup, and at the site of Büdelsdorf in Holstein (Hingst 1971), is the manufacture of pottery.

From a more general perspective, the demonstration that pottery manufacture took place at several central places – "places of assembly" – may be important for our future understanding of the dynamics of ceramic/stylistic uniformity in the earliest phases of the later Funnel Beaker culture. Precisely at this time, ideas about pottery design seem to develop and spread effectively and rapidly through Schleswig-Holstein and South Scandinavia.

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NOTES

1. The owner of Hevringholm manor, Mrs. S. Balling, is thanked for her kindness in connection with the excavations at Store Brokhøj. The excavations were supported by *Rigsantikvaren*.
2. Kulturhistorisk Museum, Randers, j. no. 73/85, Vivild parish, Sønderhald district, Århus county. Ass. curator N.T. Sterum is thanked for his co-operation and for permission to publish the find. The excavation was directed by Reno Fiedel. Feature AAA was investigated by Bo Madsen.
3. Eva Koch Nielsen of the National Museum is warmly thanked for her expertise in the field of pottery, and for her positive criticism and loyal support (cf. E.K. Nielsen 1987).

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A Single Grave Barrow at Harreskov, Jutland

Excavation and Pollen Analysis of a Fossil Soil

by BENT VAD ODGAARD and HANS ROSTHOLM

INTRODUCTION

In the winter 1982–83 Herning Museum excavated a Single Grave barrow at Harreskov in Assing parish, Jutland (1). The burial mound was situated in a tree belt, which was to be replanted. Prior to the planting the barrow had to be excavated, as the soil would be ploughed to the depth of 60–80 cm. The archaeological investigation resulted in 3 graves from the Single Grave Culture and 1 grave from the Early Bronze Age.

Beneath the barrow was a well-preserved fossil soil, buried about 2600 B.C. A pollen analytical study of this soil has given knowledge about the environment at the time of the erection of the barrow, about the primeval forest on dry poor soil in western Jutland, and about early heathland development. This local pollen diagram forms part of an investigation of the post-glacial vegetational history of western Jutland and supplements the pollen diagram from a soil beneath a Single Grave barrow at Skarrild, 5 km SSW of Harreskov.

The excavation was carried out in December 1982 and January 1983 by Hans Rostholm, Herning Museum. On the 10th. and 11th. January 1983 samples for pollen, physical and chemical analyses were taken by Bent Vad Odgaard, Geological Survey of Denmark.

The site

Harreskov is situated in the middle of western Jutland, about 12 km SSW of Herning (fig. 1). The area is located in the southern part of the large "hill island" *Skovbjerg Bakkeø*. The last ice-cap which covered this area was the Saalian ice (last-but-one glaciation), while the Weichselian (last glaciation) ice-border remained some tens of kilometers to the east. The original Saalian topography of the area was strongly modified by erosion and solifluction during the Weichselian.

The deposits around the Harreskov barrow are mostly meltwater sand, while scattered clay and eolian sand occur. In the low lying areas freshwater sand and peat predominate (fig. 2). The eolian sand is probably of late-glacial or Subatlantic age (Milthers 1939). Inside the area within a radius of 200 m around the barrow, which probably includes the main pollen source area of the fossil soil, only meltwater sand is found. Today the area is covered by fields and plantations, but until the late 19'th century extensive heaths dominated.

The barrow is situated about 500 m from other registrated barrows. A few kilometers to the west and

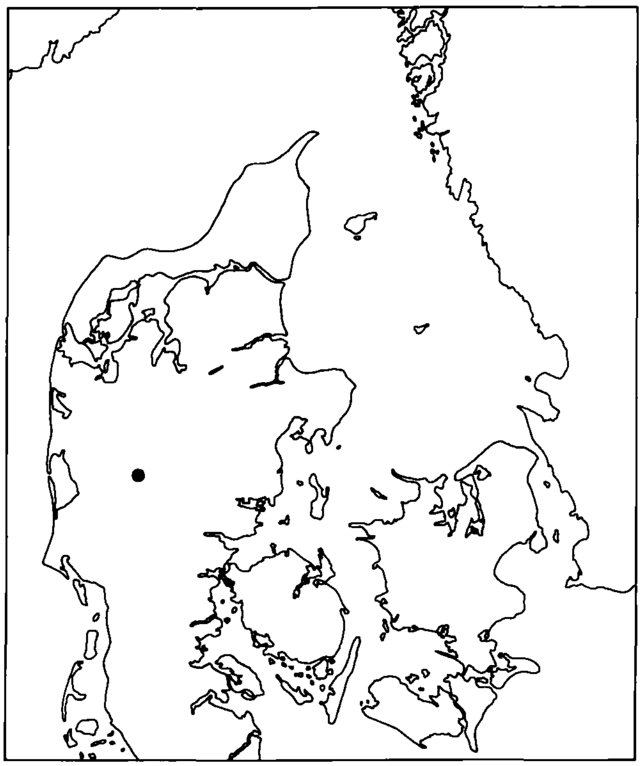

Fig. 1. The location of Harreskov.

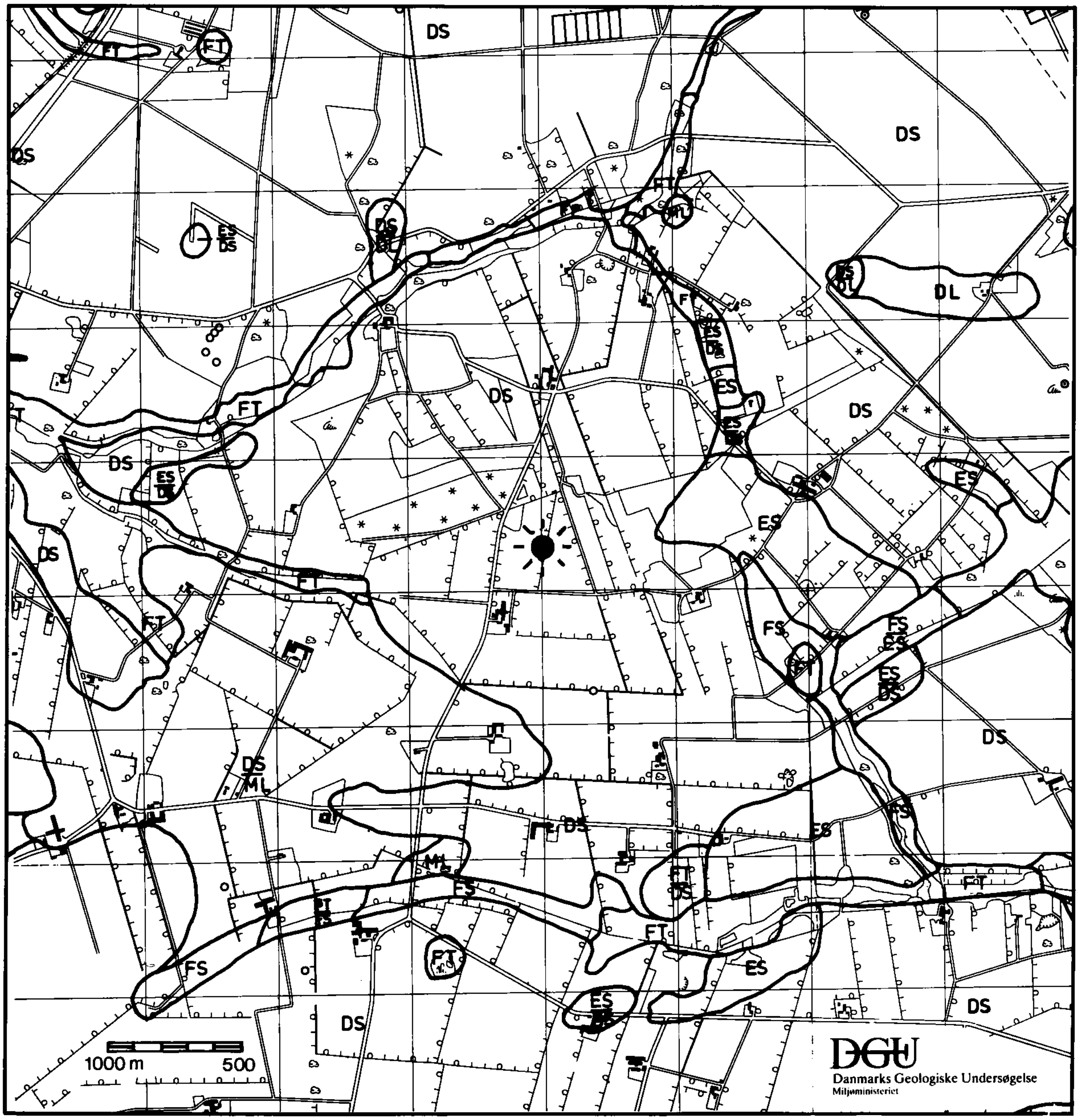

Fig. 2. Surface deposits at Harreskov. The asterisk marks the position of the investigated barrow. DL = meltwater clay, DS = meltwater sand, ES = eolian sand, FT = peat, FS = freshwater sand, ML = clayey till. Preliminary geological map produced by the Geological Survey of Denmark. Topographic map reproduced with permission from the Geodetic Institute (A. 881/71).

south-west a great number of burial mounds are known in the parishes of Assing and Skarrild. None of the burial mounds in the vicinity of the barrow in question has been excavated.

EXCAVATION

The burial mound was situated in a c. 5½ m wide tree belt, in which was left a 15 m long, 5 m wide and up to 1.6 m high barrow (fig. 3). Outside the tree belt the barrow was completely ploughed-down, but still visible as a

Fig. 3. The Harreskov Barrow seen from SSE, December 1982. The barrow lies in a tree belt, in which the trees have been felled before replanting. H. Rostholm fot.

lighter mould with an extension of approx. 4½ m and 5½ m to the west and east respectively. In the year 1894 The National Museum, Copenhagen, registrated a well-preserved barrow with a height of 1.73 m and a diameter of 17.25 m.

Most of the mound was carefully removed mechanically. No traces of graves were found in the outer part of the barrow. Therefore the excavation could be concentrated on the central area, about 5 × 4 m, and section 2 across the barrow (cf. fig. 11).

The excavation revealed 4 graves in the central area, partly overlying each other. They are named grave 73 (the oldest one), grave 16, grave 1, and grave 21 (the youngest one). The three first mentioned belong to the Single Grave Culture, and the last-named can most likely be dated to the Early Bronze Age. The plan on fig. 4 shows the excavated area, the tree belt, the barrow, the sections and the 4 graves. In the centre of the barrow was a rather new digging (No. 20), which was 140–150 cm in diameter at the top and reached to approx. 35 cm above the old soil surface (cf. fig. 5 and 10 b).

Grave 73. The earliest grave, grave 73, was placed directly upon the old soil surface. The grave fill consisted of brown or yellowish brown humic sand, dark grey humic sand, and yellow sand (fig. 10 j). This fill could be distinguished from the surrounding part of the barrow by being more mixed and by having no visible turf-structure. Furthermore the top of the old soil beneath the grave had a more uneven surface than under the rest of the barrow.

Grave 73 can be seen on plans fig. 4 and 5. The eastern end of the grave was not recognizable. The grave was approx. west-east orientated, at least 120 cm long, and 50–55 cm wide at the bottom.

In the western part of the grave, 20 cm from the end, battle-axe 75 was found (fig. 6 a). Between the battle-axe and the dark soil beneath the barrow was a c. 2 cm thick layer of the mixed grave fill mentioned above. The battle-axe lay in the direction north-south with the egg towards the north and the under side turning to the east. The battle-axe is 14.5 cm long. It belongs to Globs type H and dates the grave to the Ground Grave period of the Single Grave Culture (Glob 1945: 40f).

Grave 16 was situated approx. west-east and partly overlying the southern end of grave 73 (cf. fig. 4 and 5). The grave had a strong stone frame with external dimensions of 395 × 160 cm. The stone frame formed a 30–50 cm wide and 55–65 cm high "bank", partly with vertical sides and consisting of several stones both in the height and the width. The burial area within the stone frame was about 280 cm long and 60–100 cm wide. Leaning against the inner side of the stone frame was a sunk layer of small broken stones from grave 1. This layer also covered the bottom in the most of the grave.

Grave 16 can be seen on the plans fig. 4 and 5 and in section 2 (fig. 10 i). The lower part of the stone frame is

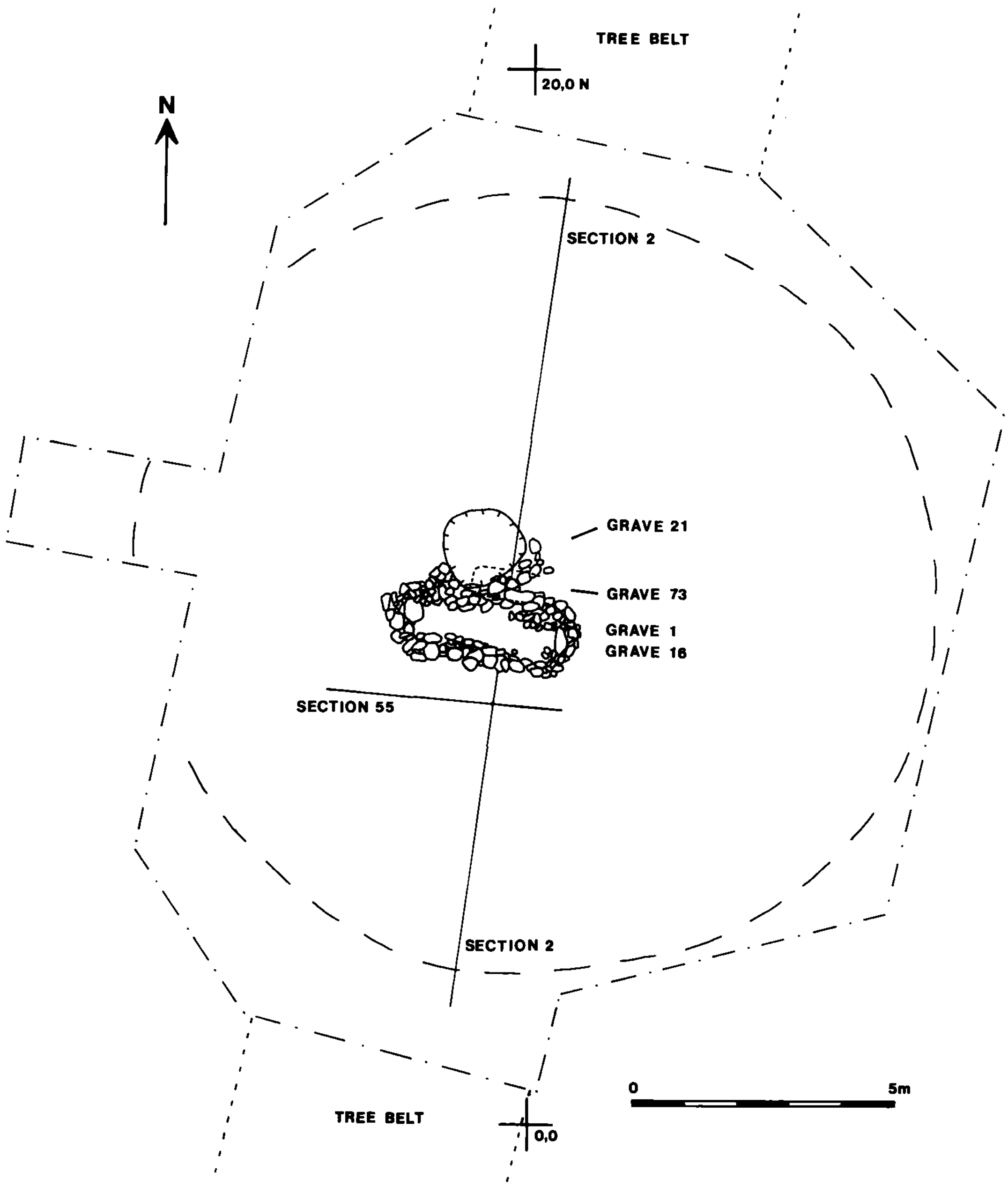

Fig. 4. Plan of the excavated area with the tree belt, the barrow, the sections and the graves 73, 16, 1 and 21. H. Rostholm and J.J. Kærgaard *del.*

shown on fig. 8. The bottom of the grave, i.e. the lower edge of the stone frame, lay 25–40 cm above the old soil surface, and the top of the stone frame reached to 90–95 cm above the old soil surface.

In the eastern end of the grave stood a big stone, measuring c. 70 × 52 × 32 cm and turning a flat side to the grave. Part of the stone can be seen on fig. 8 and 11. In the opposite end of the grave were 2 big stones, 60 cm and 48 cm high respectively. Among the stones in the stone frame were 5 fragments of quern-stones (hatched on fig. 5).

On the bottom in the western part of grave 16 lay 40 amber beads and pendants, mostly in small groups within a total area of c. 70 × 50 cm (cf. fig. 5). They have

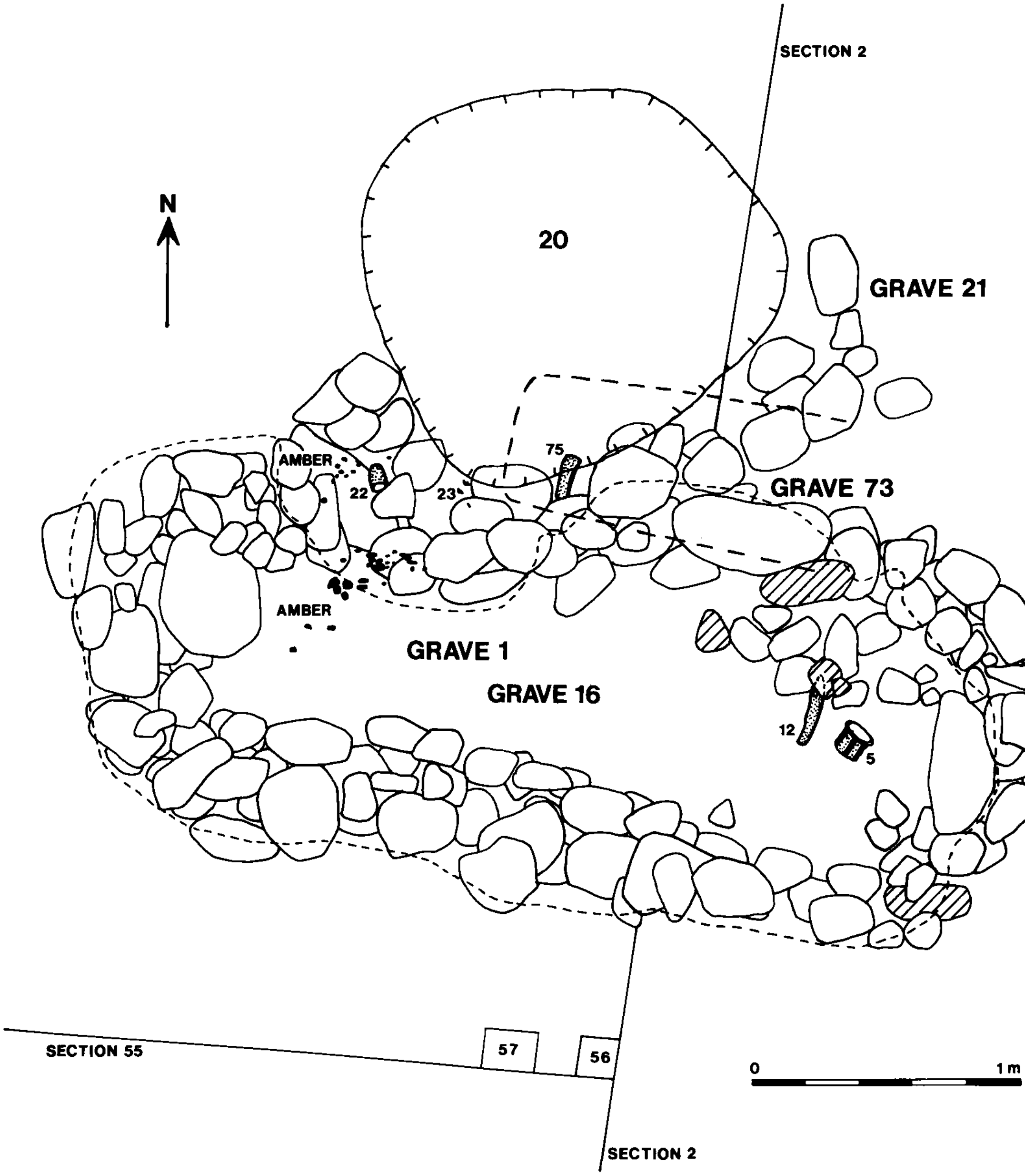

Fig. 5. Plan of the 4 graves in the central part of the barrow. *Grave 73*: battle-axe 75. *Grave 16*: 40 amber beads and pendants. *Grave 1*: straight-walled beaker 5 and battle-axe 12. *Grave 21*: beaker 22 and bronze ring 23. No. 20 is a rather new digging. In sections 2 and 55 are shown the samples 56 and 57 for pollen and other analyses. H. Rostholm and J.J. Kærgaard *del.*

the numbers 24–54 and 59–68 (fig. 7: 1–40). Nos. 30 and 31 make out one bead, found in 2 pieces (fig. 7:7).

There are 9 pendants, mainly pierced in the narrower end. 12 flat pieces are pierced from edge to edge; 5 of them are rather big, up to 4.5 cm long; amber 30–31 has one longitudinal hole and four transverse holes (fig. 7:7). Besides there are 19 small beads, one of them has cruciformed holes (No. 62, fig. 7:34) and the others are mainly short tubular beads.

Some of the amber beads lay under the stone frame, the northernmost ones were found 30–37 cm from the inner edge of the stone frame (amber 59–68, fig. 7: 31–

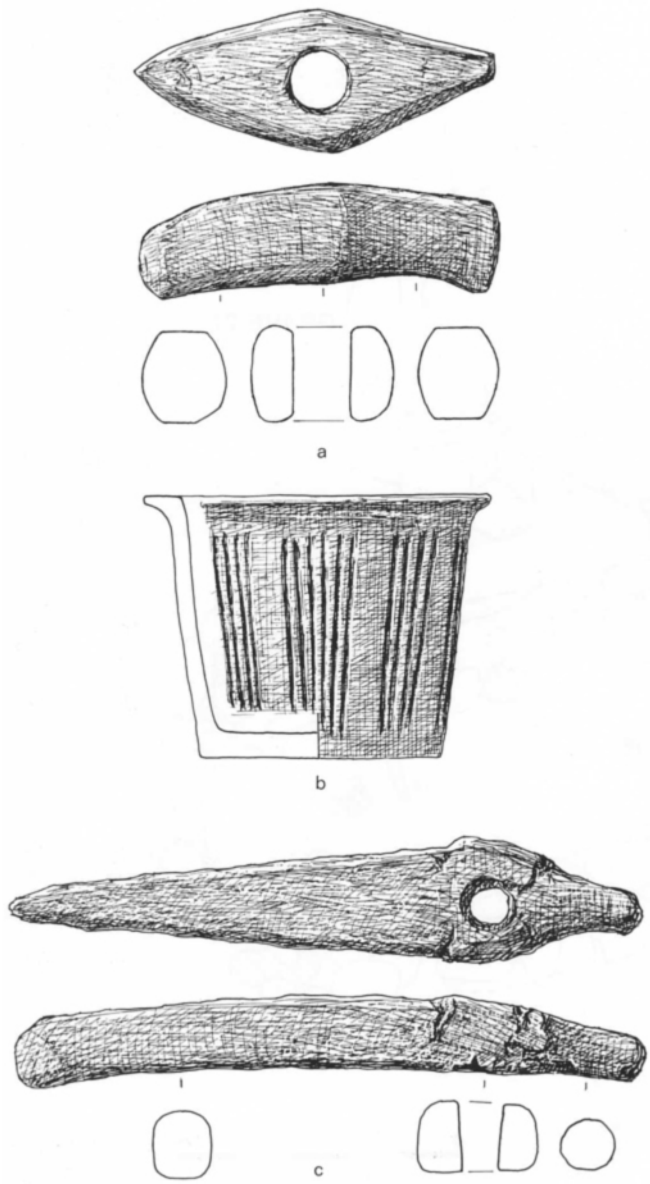

Fig. 6. Grave finds from the Single Grave Culture. *Grave 73*: battle-axe 75 (a). *Grave 1*: straight-walled beaker 5 (b) and battle-axe 12 (c). 1:3. H. Ørsnes *del.*

40). On the whole these beads were situated in the same level as the rest of the beads, but they may have been displaced and moved towards the north, when grave 21 was made.

The amber beads and pendants from grave 16 can be related to the Single Grave Culture in general. The grave can only be more precisely dated within the culture by means of stratigraphy. Grave 16 lay between grave 73 from the Ground Grave period and grave 1 from the Upper Grave period.

Grave 1 was situated in the top of the barrow exactly over grave 16. The grave was marked by a layer of small broken stones, consisting of yellowish brown and reddish brown granite (fig. 10 h). This layer was placed directly on the top of the stone frame in grave 16 (fig. 10 i). The layer of broken stones covered an area of 345 cm in the length c. west-east and 150–165 cm in the width (indicated by a dot-and-dash line on fig. 5).

Inside the stone frame the layer of broken stones had sunk and lay in a curved layer against the inner side of the stone frame and partly in a horizontal layer over the bottom of grave 16. The sunken layer of broken stones can be seen in section 2, which ran transversely to the grave (fig. 10 and 12). In section 2 the curved layer of broken stones was up to 15 cm thick (fig. 10 h). The lowest broken stones were found about 50 cm under the top of the layer. Section 2 indicates, that this layer originally was placed horizontally over the stone frame of grave 16. Thus the bottom of grave 1 lay 90–100 cm above the old soil surface. In the western end of the grave the layer of broken stones was partly situated directly on the amber beads and pendants in grave 16.

Beaker 5 and battle-axe 12 were found in the sunken layer of broken stones in the eastern end of grave 1 (fig. 8). The beaker lay in a sloping position and was nearly covered by broken stones. The beaker is 10.5 cm high, straight-walled and decorated with groups of flat, vertical grooves separated by undecorated zones (fig. 6 b).

The battle-axe, which was found in the middle of the layer of broken stones, is unusually long, 25.5 cm, and made of a very soft and badly preserved sandstone (fig. 6 c).

By means of the straight-walled beaker belonging to Globs type N and the battle-axe of Globs type L grave 1 can be dated to the Upper Grave period of the Single Grave Culture (Glob 1945: 50 and 117f).

The very close connection between the stone frame in grave 16 and the layer of broken stones in grave 1 must imply, that the 2 graves were made immediately after each other, and grave 16 could not possibly be covered by a burial mound, until grave 1 was constructed.

Collapsed graves, and sunken fill and artifacts, are not unusual in Single Grave barrows, because the tree coffins have totally disappeared and the graves often are placed directly over each other (Rostholm 1977: 99,

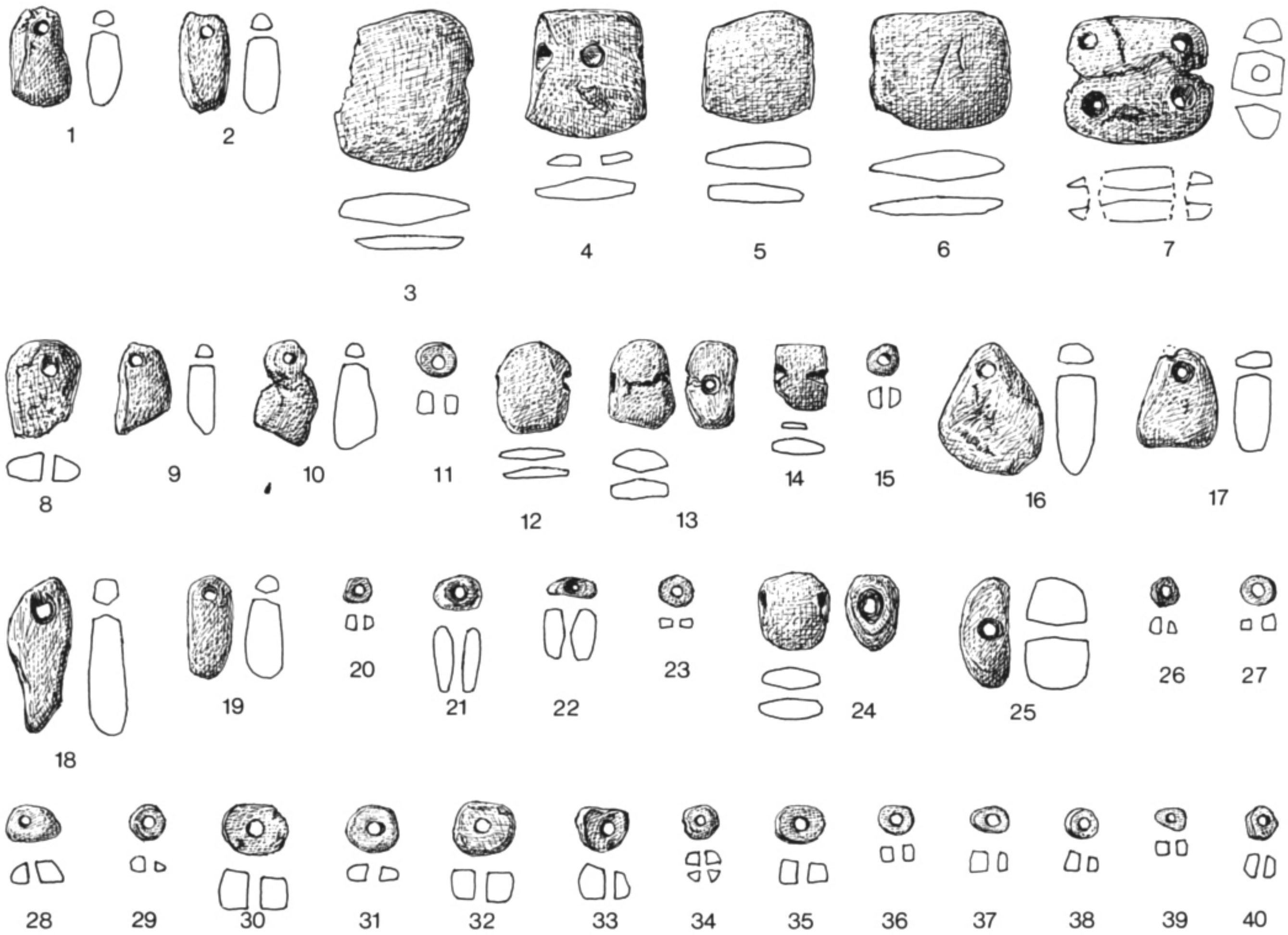

Fig. 7. Grave finds from the Single Grave Culture. *Grave 16*: 40 amber beads and pendants (Nos. 24–54 and 59–68). The bead 7 was found in 2 pieces. 1:2. H. Ørsnes *del.*

1982: 54f, and 1986: 16f). The 2 graves in the Harreskov barrow could easily be separated thanks to the thick layer of broken stones. Without this layer, grave 16 and grave 1 would most likely have appeared like a big double grave with male and female equipment in the eastern and western ends respectively.

Grave 21 was found directly to the north of grave 1 and grave 16, and partly over grave 73 (cf. fig. 5). When grave 21 was made, the northern side of the stone frame in grave 16 and the layer of broken stones in grave 1 were disturbed. The central and eastern parts of grave 21 were destroyed by a rather new digging right to the bottom of the grave (fig. 5, No. 20 and fig. 10 b).

Grave 21 had remains of a 40–45 cm high stone frame orientated approx. WSW-ENE. Only the southern side and the western end were left. Originally the length was c. 2.15 m and the width c. 1.1 m. The area inside the stone setting was about 50 cm wide. The bottom of the grave consisted of a rather uneven stone layer, c. 35 cm over the old soil surface. Beaker 22 was found on the stone layer in the western end of the grave, and bronze 23 lay about 30 cm eastwards.

The beaker is a little irregular, up to 8 cm high and undecorated (fig. 9 a). Bronze 23 consisted of 16 tiny fragments lying within an area of 5 × 3 cm. The pieces are put together to a bronze ring, 2.2 cm in internal diameter and made of a round, c. 1½ mm thick bronze bar (fig. 9 b).

In section 2, which runs across the eastern end of

Fig. 8. Battle-axe 12 and beaker 5 from grave 1 lying in the sunken layer of broken stones inside the stone frame of grave 16. To the right a big standing stone in the eastern end of grave 16. Most of the stone frame in grave 16 has been removed. H. Rostholm fot.

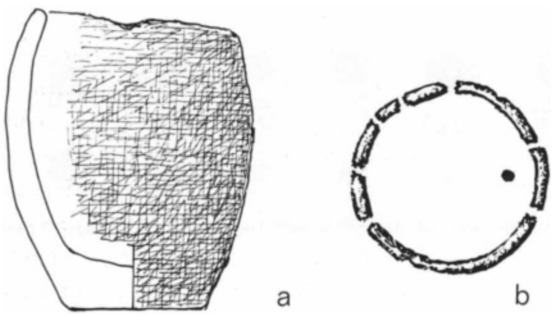

Fig. 9. Grave finds from the Early Bronze Age. *Grave 21:* beaker 22 (a) and bronze ring 23 (b). a: 1:2 and b: 1:1. H. Ørsnes *del.*

grave 21, only a few stones of the stone frame of grave 21 can be seen (fig. 10 and 12). The fill of the grave could not be separated from the fill of the second phase of the barrow, in which it was buried (fig. 10 e and f).

Grave 21 is stratigraphically younger than the 3 other graves and can most likely be dated to the Early Bronze Age.

Section 2 was made approx. south-north across the preserved part of the barrow and ran in the same direction as the tree belt (cf. fig. 4). A drawing of the section is reproduced on fig. 10. Besides fig. 11 shows the section seen from SSE and fig. 12 the central part of the section with the 4 graves.

The section indicates that the barrow has three phases, represented by different sorts of fill. The earliest barrow, phase 1, consisted of yellowish brown humic sand with distinct turfs of dark grey and partly dark brownish grey humic sand (fig. 10 f). On the drawing the dark turfs are marked in the central and southern parts of the section. The first barrow was 13 m in diameter and up to 85 cm in the height. This barrow was erected over grave 73 (fig. 10 j). Later on the 3 other graves were buried in the barrow, which twice (at least) was heightened and widened.

Phase 2 was represented by yellowish brown, spotted humic sand (fig. 10 d). No turf-structure could be recognized. Phase 2 was only found as an up to 30 cm thick layer over the earliest barrow. This layer reached a little higher than the top of grave 1 and grave 16 (fig. 10 h and i) and can most likely be connected with these 2 graves.

Phase 3 consisted of turfs with dark grey humic sand separated by thin layers of yellowish brown humic sand (fig. 10 c). On the drawing the distinct turf-structure in the central part of the barrow is marked. This fill was darker than the first phase and was found in an up to 35 cm thick layer, which was not present in the southern part of the barrow. Phase 3 and grave 21 may belong together.

Beneath the barrow the upper humic layer could be seen as a distinct, dark layer (fig. 10 k), which was sharply delimited from the fill of the barrow (cf. fig. 11 and 12). This layer is identical to the Ah-layer described below in the soil section from the pollen analysis (cf. fig. 13 and 14). The layer, too, is similar to the dark turfs in phase 1 of the barrow (fig. 10 f). The fill of the first phase of the barrow consisted of the dark, upper humus layer of that time, and by taking off the turfs they have been mixed up with the underlying yellowish brown sand.

Section 55 was made in the direction c. west-east about ½ m to the south of the graves. From the fossil soil in this section sample-series 56 and 57 for pollen and other analyses were taken (cf. fig. 5 and 10). Besides samples from the turfs in phase 1 of the barrow were taken.

Sample-series 56 and 57 come from the fossil soil, which was sealed in the Ground Grave period of the

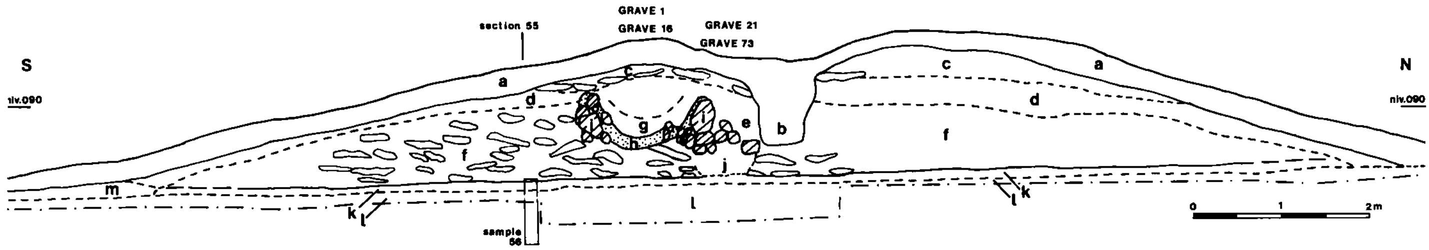

Fig. 10. Section 2 south-north across the barrow, seen from the east. a: grey and blackish grey humic sand. b: new digging, fill as a, downwards more brownish (No. 20). c: phase 3 of the barrow (see text). d: phase 2 of the barrow (see text). e: fill as d (grave 21). f: phase 1 of the barrow (see text). g: brown and brownish grey humic sand, a little darker than d. h: broken stones (grave 1). i: stone frame (grave 16). j: brown and yellowish brown humic sand and yellow sand (grave 73). k: dark grey, downwards dark brownish grey, humic sand (upper humic layer beneath the barrow). l: yellowish and reddish brown, silty-clayey sand, downwards yellow sand. m: dark brown, faintly yellowish brown humic sand. Sample 56 for pollen and other analyses can be seen in the section. H. Rostholm and J.J. Kærgaard *del.*

Single Grave Culture, about 2600 BC, when grave 73 was covered by phase 1 of the barrow. The analyses of sample-series 56 and 57 are described below.

POLLEN ANALYSIS

Introduction

Pollen diagrams from lakes, bogs, and soils provide information on vegetational changes through time. The scale of the changes reflected depend on the pollen source area, larger lakes and bogs have large source areas while very small kettleholes and soils have small ones. Well-dated pollen diagrams from large sites offer a framework of large-scale, *regional* pollen-depositional events. Although these events may have a straightforward interpretation such as a sudden and persistent appearance of new pollen types, the reconstruction of past vegetational changes from regional pollen diagrams is often hampered by a number of methodological problems. Such problems are *i.a.* 1) the ecological complexity of the pollen source area consisting of a mosaic of several vegetation types, 2) the fact that some plant species may occur in more vegetation types, 3) the fact that the same pollen type may be produced by different plant species (e.g. the grass pollen type), 4) the possibility of two or more vegetational events to occur simultaneously inside the source area which may obscure or even counterbalance each other.

Pollen diagrams from small sites on the other hand reflect pollen events inside a small area which properly chosen is homogenous in relation to geology, hydrology, topography and soil type. Hence it has probably also supported a homogenous vegetation in the past. In these *local* sites the interpretation of the pollen diagrams is greatly simplified by the reduction of the number of vegetation types to one (in soil sites) or two (in kettleholes: the kettlehole vegetation and the surrounding vegetation type).

As part of an investigation of the post-glacial vegetational history of western Jutland (Odgaard 1985a, 1985b), the present paper presents the main result of a pollen analytical study of a fossil soil buried beneath the Harreskov barrow, about 2600 BC. This local pollen diagram reveals details about the primeval forest on *dry*, poor soil in western Jutland, reflects the very first forest destruction and heathland expansion, and describes the environment at the time of the erection of the barrow. The diagram thus supplements the soil pollen diagram from a humus podzol buried beneath the Single Grave mound at Skarrild, 5 km SSW of Harreskov, which reflects the local late Atlantic/early Subboreal vegetational development on slightly *moist* soil (Odgaard 1985a).

Methods

A sample series (56) for pollen, physical and chemical analyses were taken at section 55 (figs. 5, 10). Continuous samples of 0.5–5 cm thickness were taken from 0.5 cm above the surface of the fossil soil to 70 cm below. Close nearby, at 57 (fig. 5), volumetric samples were taken. Finally 6 samples for pollen analysis were

Fig. 11. The barrow partly excavated, seen from SSE. Section 2, which runs across the barrow, shows the turfs in the fill of the barrow and the dark humus layer beneath the barrow. In the centre of the barrow part of the stone frame in grave 16 can be seen. H. Rostholm fot.

Fig. 12. Detail of section 2 in the central part of the barrow with the 4 graves and the dark humic layer beneath the barrow. Cf. fig. 10. H. Rostholm fot.

taken from humic sand layers, 'turfs', of the barrow soil (phase 1). At the laboratory the bulk samples were divided into subsamples for pollen analysis, loss on ignition, grain size analysis and chemical analysis. Loss on ignition was determined as the loss in dry weight after 3 hours at 550°C. Aluminium (Al) and iron (Fe) were extracted by 20% boiling HCl and measured by atomic absorption spectrophotometry.

The soil section

The upper humic layer of the fossil soil was clearly seen on the section as a dark band (fig. 10 k, 11 and 12), sharply delimited towards the overlying soil of the barrow.

The description of the soil section below is according to the central European system for soil classification (e.g. Scheffer *et al.* 1976). In this system Ah denotes a top layer of dark, humic soil. A Bv-layer is characterized by a brownish colour (v from German: *verbraunt*) derived from iron-oxides formed by weathering of iron-containing minerals. As another result of weathering clay-minerals are formed in a Bv-horizon, which is therefore enriched in fine particles. The C-horizon is the bottom part of the soil, untransformed by soil processes. If the soil was originally homogeneous the C-horizon is identical to the parent material of the upper layers.

0 – 7 cm	Ah. Dark grey, downwards dark brownish grey, humic sand. Upper boundary sharp.
7 – 35 cm	Bv. Reddish brown, silty-clayey sand with some pebbles. Upper boundary gradual.
35 – 52 cm	C. Yellow, medium-grained sand with a few pebbles. Upper boundary gradual.
52 – 63 cm	C. Greyish yellow, gravelly, coarse sand. Upper boundary sharp and dipping towards east.
63 – (100) cm	C. Yellow, medium-grained, well-sorted sand. Upper boundary sharp and dipping towards east.

The grain size analyses (fig. 13) show accumulation of silt/clay particles (‹0.075 mm) in the topsoil especially in the upper part of the Bv-horizon. This accumulation is probably due to *in situ* weathering of coarse particles and formation of clay minerals (cf. Nørnberg 1980). Loss on ignition decreases downwards through the Ah horizon reflecting a decreasing organic content, while the raised values of loss on ignition in the Bv horizon are probably due to dehydration of clay minerals during ignition. There is hardly any differentiation in the pH-profile while iron and aluminium concentrations show beginning eluviation from the Ah layer and raised

HARRESKOV

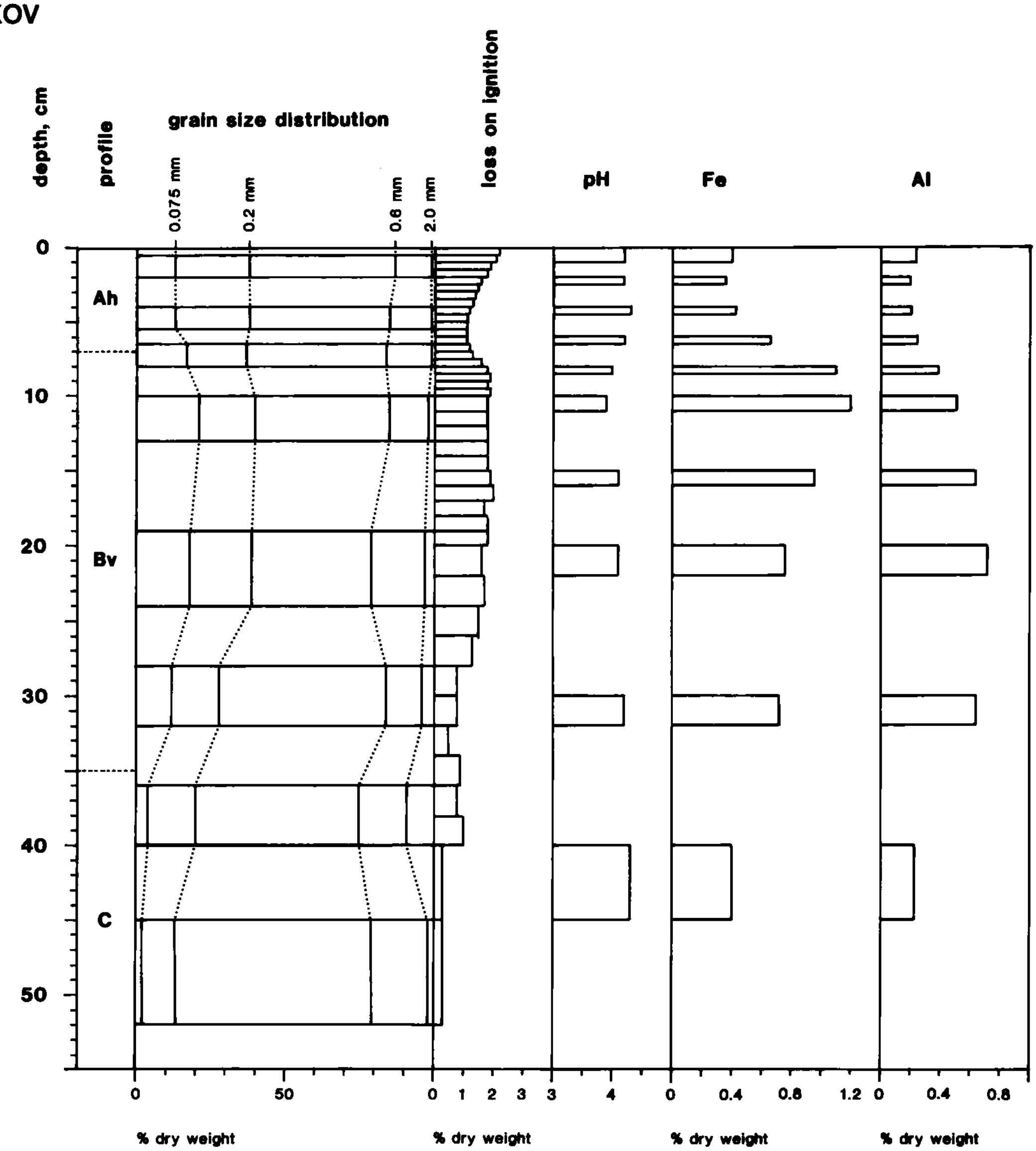

Fig. 13. Physical and chemical profiles from the Harreskov section.

values in the Bv horizon. Thus the soil can be characterized as an oligotrophic, slightly podzolized brown-earth.

The pollen diagram

Fig. 14 shows the pollen profile from the upper 10 centimeters. The original pollen stratigraphy is undoubtedly somewhat disturbed by the mixing activity of the soil fauna and no zonation of the diagram has been attempted. Nevertheless the diagram shows a clear development. In the lower part tree pollen, especially *birch*, *lime* and *hazel* dominate, while herbs are represented by ca. 15% and *heather* by 25%. Charcoal values are low and cultural indicators are virtually absent. In the upper part of the diagram *heather* increases to 45% at the expense of tree pollen, *ribwort* (*Plantago lanceolata*) is represented by 0.5% and charcoal values rise strongly. Among the trees *lime* decreases while *alder*, and also *hazel*, rise.

Discussion

The well-established natural soil development from basic or slightly acid brown-earth with a rich soil fauna to acid podzol devoid of effectively mixing animals has important implications for the interpretation of soil pollen diagrams. First, pollen grains are only preserved in acid soils (pH ‹ ca. 5), and second, pollen deposited on a soil is liable to downwards transportation by soil animals (bioturbation) and percolating water.

In a comparison of three neighbouring acid forest soils, a brown-earth, a podzoloid and a podzol, Andersen (1979) found records of past vegetational stages in all soil types. But whereas vegetational changes were reflected sharply in the humus layer of the podzol these were less sharp in the mineral soil of the podzoloid, and in the brown-earth bioturbation by earthworms had made only the strongest changes detectable. This study also indicates that downwashing of pollen grains in soils is of insignificant importance.

Although a brown-earth the low pH-values as well as the beginning podzolization of the Harreskov soil indicate that large earthworms were already absent at the time of burial. The youngest pollen assemblages have therefore been incorporated only in the topmost part of the profile, which explains why vegetational changes are reflected quite sharply in the upper 3 cm of the diagram (fig. 14). Except for the time of burial, about 2600 BC, no level in the pollen diagram can be dated. Calculations based on pollen concentrations, however, indicate that the diagram represents a time span of at least a few hundred years, indeed probably more. The lower part of the diagram reflects an open forest of *birch*, *lime* and *hazel* with *heather* and grasses in the field layer. *Alder* may have been present locally as scattered individuals but the pollen recorded may also have been transported from extra-local stands. Conventionally *alder* is regarded as a tree of wet soils but the soil pollen diagram from Skarrild suggests that *alder* has been important also on slightly moist soil (Odgaard 1985a). Judging from topography and surface deposits (fig. 2) wet ground was probably not present near the Harreskov barrow, but spots of moist soil may have existed. *Oak*, *ash*, *pine* and *elm* were absent locally. The single grains of *ribwort* (*Plantago lanceolata*) found in this part of the diagram as well as the microscopical charcoal have most likely been transported down from younger assemblages, and the *birch-lime-hazel-heather*-grass forest thus represents the virgin forest on dry ground in western Jutland during the late Atlantic/early Subboreal. The composition of this forest type may seem ecologically strange since there is no modern analog. However, this open forest type is in accordance with expectations based on regional pollen diagrams, which during this period show presence of *heather*, high values of *birch* and grasses and moderate values of *hazel* and *lime* (Jonassen 1950, Odgaard 1985a).

The upper part of the diagram reflects a heath or a very open forest with extensive *heather*-dominated glades. The forest reduction manifests itself in the decrease of *lime*, while the rises of *hazel* and *alder* percentages probably are due to increasing extra-local transport as the landscape was growing more open. The increases in *ribwort* pollen and charcoal values document that the forest destruction and heath expansion was due to cultural impact, probably cutting, grazing and burning. There is no indication of tilling of the soil.

DRY SOIL	MOIST/WET
birch-lime-hazel-heather-grass	alder-birch-(oak)-(lime)-grass

Table 1. Tentative scheme of distribution of natural late Atlantic/early Subboreal forest types on dry and moist/wet, poor soils in western Jutland.

Conclusion

The soil pollen diagrams from Harreskov and Skarrild (Odgaard 1985a) give information about the late Atlantic/early Subboreal virgin forest of western Jutland on dry and slightly moist soil before farming began. Some of the results are supported by regional pollen diagrams, and although more local studies are needed a rough pattern of the distribution of natural forest types on different soils is suggested (tab. 1).

The forest on dry ground was very open with much heather in the field layer. The first cultural impact of importance was apparently grazing, burning and cutting, which gradually turned the open forest into heath. Heathland was the inevitable result of this farming practice. On slightly moist soil, like at Skarrild, *heather* was not present naturally but was "introduced" locally and favoured by early farming, and also here heathland was the result. Age calculations based on pollen concentrations at Skarrild indicate that the heath was maintained in a young *heather*-dominated stage by burning and grazing through at least two centuries (Odgaard 1985a). Based on a number of regional pollen diagrams from western Jutland, Jonassen (1950) concluded that prehistoric heathland expansions were the result of temporary arable farming. In his opinion, the expansions took place at the transition between the Subboreal and the Subatlantic, when *heather* invaded abandoned fields and persisted here favoured by an assumed cool, humid climate. However, the local pollen diagrams from Harreskov and Skarrild do not support Jonassen's hypothesis, but suggest pastoral farming as

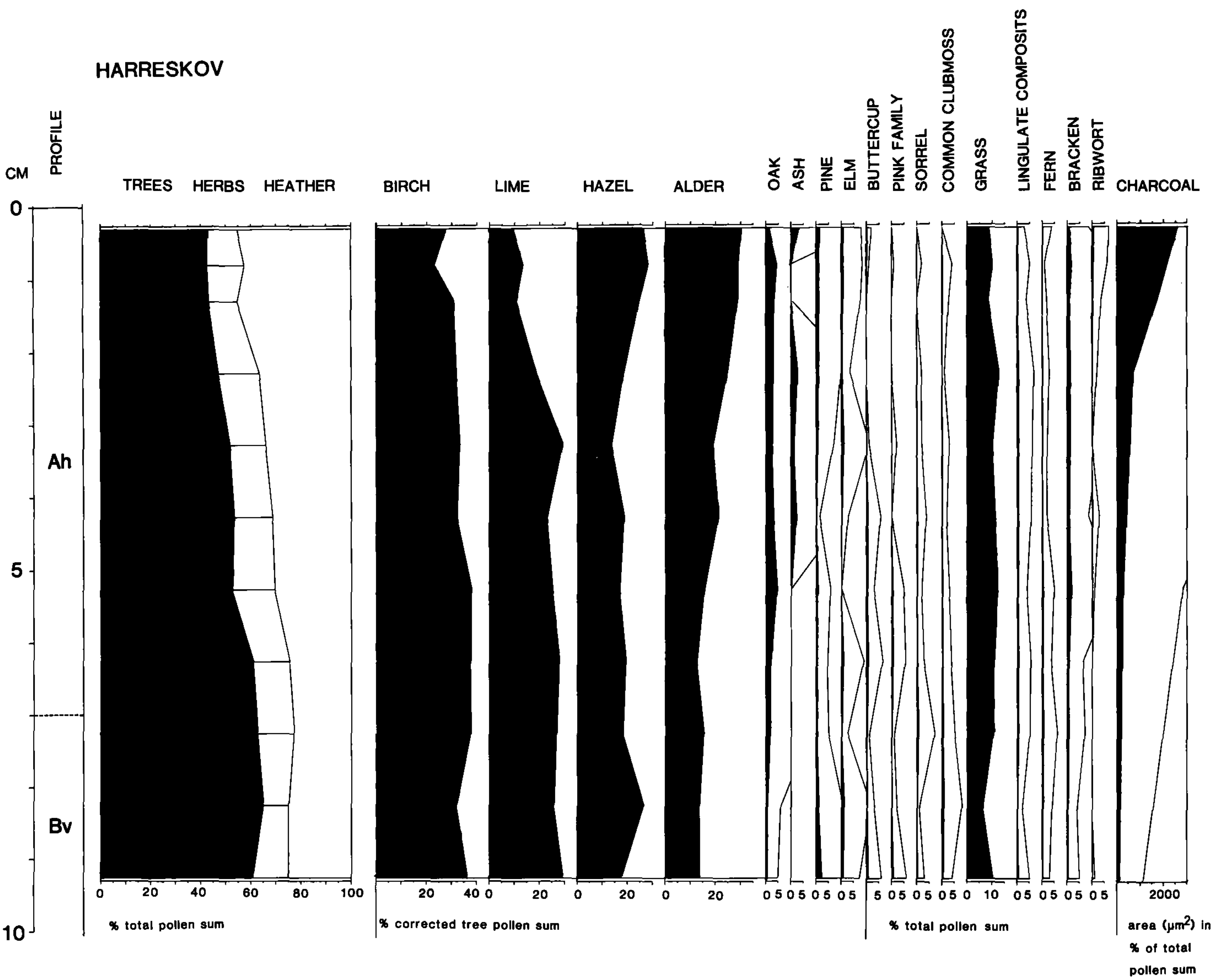

Fig. 14. Summary pollendiagram from the Harreskov soil section. The survey diagram to the left shows the relationship between pollen from trees, herbs and heather. The central tree pollen diagram is corrected for unequal pollen productivity according to Andersen (1970). The right part shows separate curves for selected herb pollen types: buttercup (*Ranunculus acris* type), pink family (Caryophyllaceae), sorrel (*Rumex acetosa* type), common clubmoss (*Lycopodium clavatum*), grass (Poaceae), lingulate composits (Cichorioideae), fern (*Dryopteris* type), bracken (*Pteridium*) and ribwort (*Plantago lanceolata*). Finally a graph for microscopical charcoal is shown.

the main cause of early heathland expansion. Furthermore, the results indicate that neolithic farmers deliberately maintained the heath, like it is known from historical time. It may be supposed that this nursing was done to provide winter grazing, in which young *heather*-dominated heath is superior to grass-dominated pasture.

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NOTE

1. Harreskov, Assing *sogn*, Hammerum *herred*, Ringkøbing *amt*. Sb (Central Register) no. 47. Herning Museum 2517.

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Mortens Sande 2

– A Single Grave Camp Site in Northwest Jutland

by DAVID LIVERSAGE

In 1984 a thin, charcoal-rich stratum appeared in the cliff cut by the North Sea into the dunes in the northern part of Lodbjerg parish, which is close north of the western end of the Limfjord. A small test excavation by the National Museum showed that it came from a sealed Single Graves settlement deposit with structural traces, carbonized grain, amber working, etc.

It was decided the next year to remove a substantial amount of the overburden and obtain as complete a plan of the structures as possible. The actual removal was effectuated with great efficiency by a driver and machine from the Jutland Engineering Regiment, to whom we are greatly indebted. It enabled us to investigate an area of about 63 m^2 buried under three or four meters of blown sand and otherwise inaccessible. Part of the site had already been washed away by the North Sea, and it was found that damage had also been done by earlier wind erosion, but it is still one of the best-preserved Single Graves settlements discovered so far. As an unexpected piece of luck it was found that later archaeological horizons lay above the original one, so three separate find-bearing layers were stratified above one another.

EXCAVATION

Method of excavation

Excavation of sandhill sites presents the special problem of sifting sand that blows in over cleaned surfaces and can fill up the excavation overnight. For this reason the site was dug in 1985 in a grid of meter squares, which could be excavated to the bottom one at a time if required. This made it possible to produce layer by layer maps of find distribution (fig. 6), but it would have been interesting if we had been able to expose the finds *in situ* over larger areas before removing them. The first stage of the excavation was to dig the grid meters that exposed a section running inward from the cliff (fig. 2). Afterwards the whole area was cleared to the stage shown in fig. 4, and finally the postholes and stakeholes were sectioned (fig. 5). The test excavation in 1984 was done without grid.

Stratigraphy

The stratigraphy is shown by a section at right angles to the coast (section A-B, fig. 2, position shown in fig. 1) and a photograph of part of the same section (fig. 3).

The main occupation layer, find stratum O, consisted of slightly sticky black-brown sand (10YR 3/2) with much finely-divided charcoal. In the western 1–1.5 m of the section it was about 6 cm thick and fairly rich in flint and pottery. Further east it was thinner and poor in finds, though it still contained a good deal of charcoal. The finds and charcoal lay in the top part of a soil layer (a podzol), showing that sand accumulation had ceased and soil formation begun some time before the occupation took place.

The podzol had formed on the surface of an approximately 1.5 m thick layer of blown sand, which rested on another humic horizon formed on the top of a raised beach after the sea had withdrawn from it. The thickness of the beach sand is unknown as the bottom was not reached. Because of the distance to a geodetic benchmark it was not practicable to level in its surface, but it was approximately 5 m above sea-level.

Find stratum O was overlain by about 20 cm of clean blown sand. On top of this lay another soil layer, this time much paler (greyish yellow-brown, 10 YR 6/2), containing charcoal and artifacts in less concentration than in find stratum O. This is called find stratum A. The pottery does not suggest it was much younger than find stratum O.

The next settlement layer upwards, find stratum B,

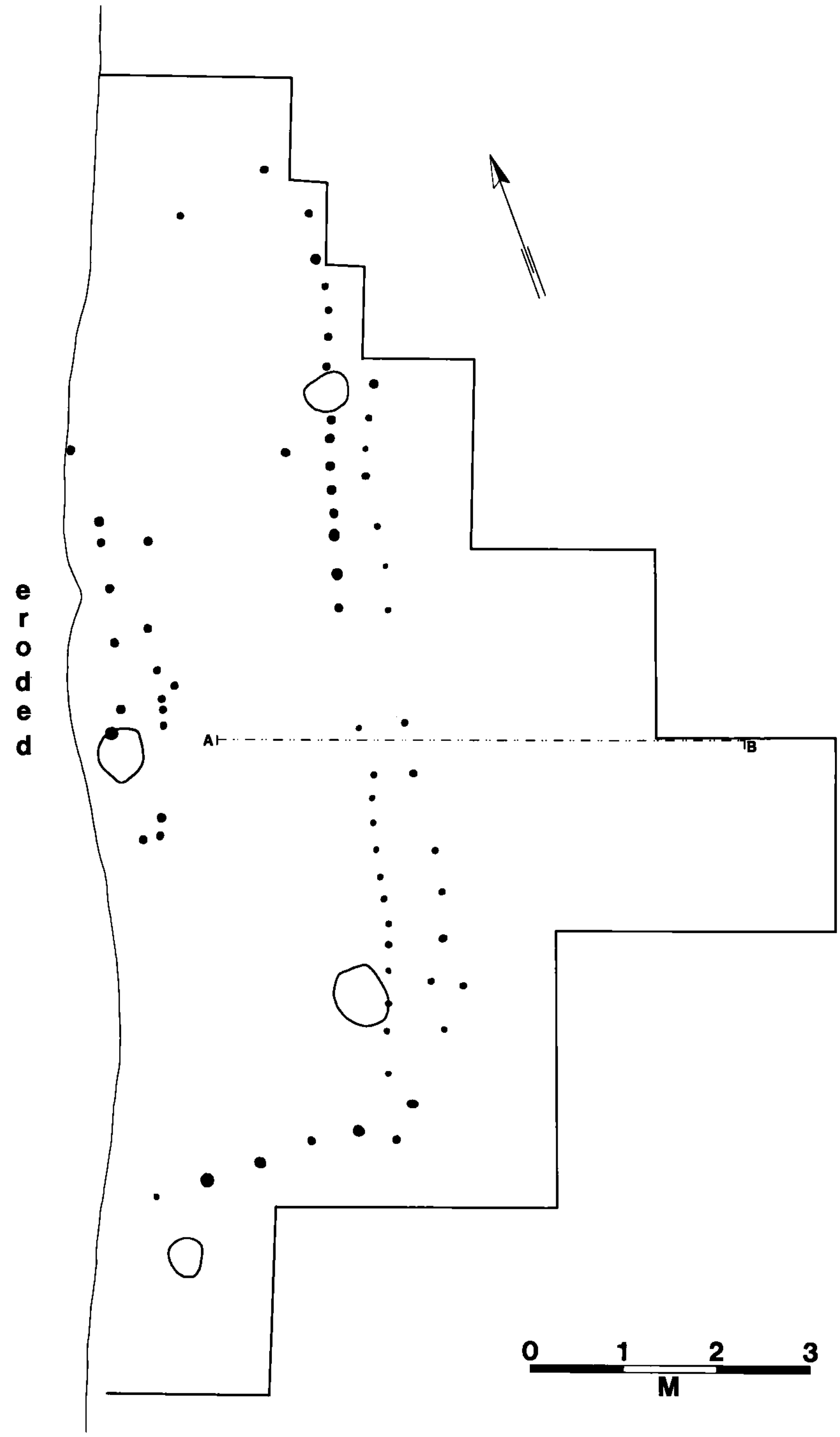

Fig. 1. Mortens Sande 2: excavation plan. The E-W row of stakeholes at the S end of the site is from a younger layer than the others.

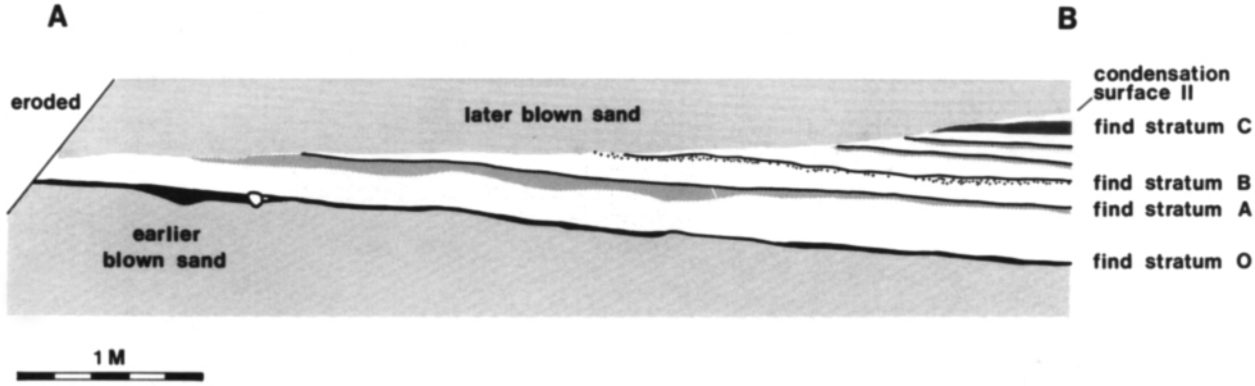

Fig. 2. Mortens Sande 2. Section A-B.

was separated from find stratum A by another thin layer of clean blown sand. Find stratum B did not seem to be a soil horizon at all, and may only have been charcoal redeposited by the wind from hearths near by. The artifact material was very small.

Above find stratum B followed two slight humic layers, which were archaeologically sterile, and at the top another soil layer, brown in colour (7.5YR 4/3), containing a few artifacts (find stratum C). A stake-hole was found in this layer when probing further east a year afterwards, and the amount of pottery seemed to be increasing. Possibly a new site will emerge and be washed away here as coastal erosion continues.

These regular strata had been disturbed by two phases of wind erosion, during which the sand had been blown away and artifacts left behind on denuded surfaces cutting obliquely across the layers. Condensation surface II is thought on account of the character of the overlying sand to be fairly new, and is seen at the top of section A-B cutting obliquely across find layers O to C. Further south and west it had destroyed all layers, including O. The mixed flint and stone on this surface was derived from all the layers that had been blown away.

Condensation surface I was only present in the north-western part of the excavation and does not appear in section A-B. It cut across strata A and O, while its relationship to strata B and C is unknown because the contact between them was later destroyed by erosion II. The sand that overlay condensation surface I was humic and very like the old soil layers in the immediate vicinity. Condensation surface I was certainly ancient and probably strictly local, while condensation surface II belonged to an erosion phase that had denuded the early layers over a long stretch of cliff and is probably recent.

Structural remains

After removal of the find layer the underlying surface was cleaned, as seen in fig. 1. Altogether 65 stake-holes, 3 larger postholes, and one small pit came to light. The stakeholes were 5–10 cm across and 20–40 cm deep. They narrowed at the bottom, and were clearly the marks of pointed stakes driven into the sand (fig. 5). As seen in the excavation plan, they stood in several straight rows. In the northeastern part of the excavation is seen a slightly over 4 m long alignment of 14 stakes accompanied half a meter to the east by a parallel row, of which seven stakeholes were uncovered, and others may have been lost further north in a corner where it would have been unsafe to dig. The two rows obviously belonged together, and the holes in the western row were slightly larger and deeper than those in the eastern, and also more closely and regularly spaced. They came down from find stratum O and were sealed by the clean sand that separated strata O and A.

The same pattern repeated itself in the south-eastern part of the excavation. Here also there was a main western row nearly 4 m long with 13 stakeholes, and a subsidiary eastern row of 7 or 8 holes. These two rows are removed very slightly to the east out of the line of the first rows, and are separated from them by a little over a meter with no holes. Their stratigraphical position was the same as that of the north-eastern rows.

A fifth row ran in a roughly east to west direction

Fig. 3. Section A-B seen from SW.

Fig. 4. Stakeholes and postholes in the underlying surface after removal of find stratum O. Seen from S.

Fig. 5. The main north-eastern row of stakeholes sectioned. Seen from NW.

across the southern part of the excavation. Six stakes were preserved giving a length of under 3 m, but the western end of the row may have disappeared already into the North Sea. It was only a single row, but the stakes were larger than in the other cases. In this area all the stratigraphy had been denuded, but the radiocarbon dates show that this feature was too young to belong to find stratum O and probably belonged to find stratum A (see p. 123).

Yet another double row of stakeholes was found in the 1984 trial excavation in the western part of the plan. Stratigraphically it belonged to find stratum O. The western row was just over 4 m long. It is not known for sure whether there was any consistent difference in the size and depth of the two rows dug in 1984.

The three postholes were larger than the stakeholes. Two of them are clearly seen in fig. 4, because the black occupation layer has sunk into them. When sectioned they were found to be very indistinct at lower levels, but it was just possible to see the "shadow" of the posts, which was about 20 cm wide, and the outline of the holes themselves, which had been about 40–50 cm in diameter and 50–60 cm deep. Each posthole was associated with a particular row of stakes. One was at about the middle of the north-eastern alignment, another was a little south of the middle of the south-eastern alignment, while the third was close south of what might before erosion have been the middle of the southern alignment.

During the 1984 test excavation a hole of similar size, but only about 40 cm deep was found in the western alignment. It seemed however only to be a small cooking pit with sides and base lined with a burned layer a centimeter thick, and refilled with alternating clean and dirty deposits of sand with artifacts. This sand contained charred grains and seeds. Perhaps a cooking pit had been deliberately sited on an old post, but as no deeper part of the hole was observed during the test excavation no clear conclusion is possible. In all events its placing in or close to a line of stakes corresponded to that of the other three postholes.

It is not immediately clear what was the purpose of all these post and stake holes. The plan may give a rapid impression of a N-S orientated long house, but this cannot bear closer scrutiny. The house would have been only about 2½ meters wide, there are too many gaps where there should be walls, and the position of the large posts is not compatible with an intelligible roof

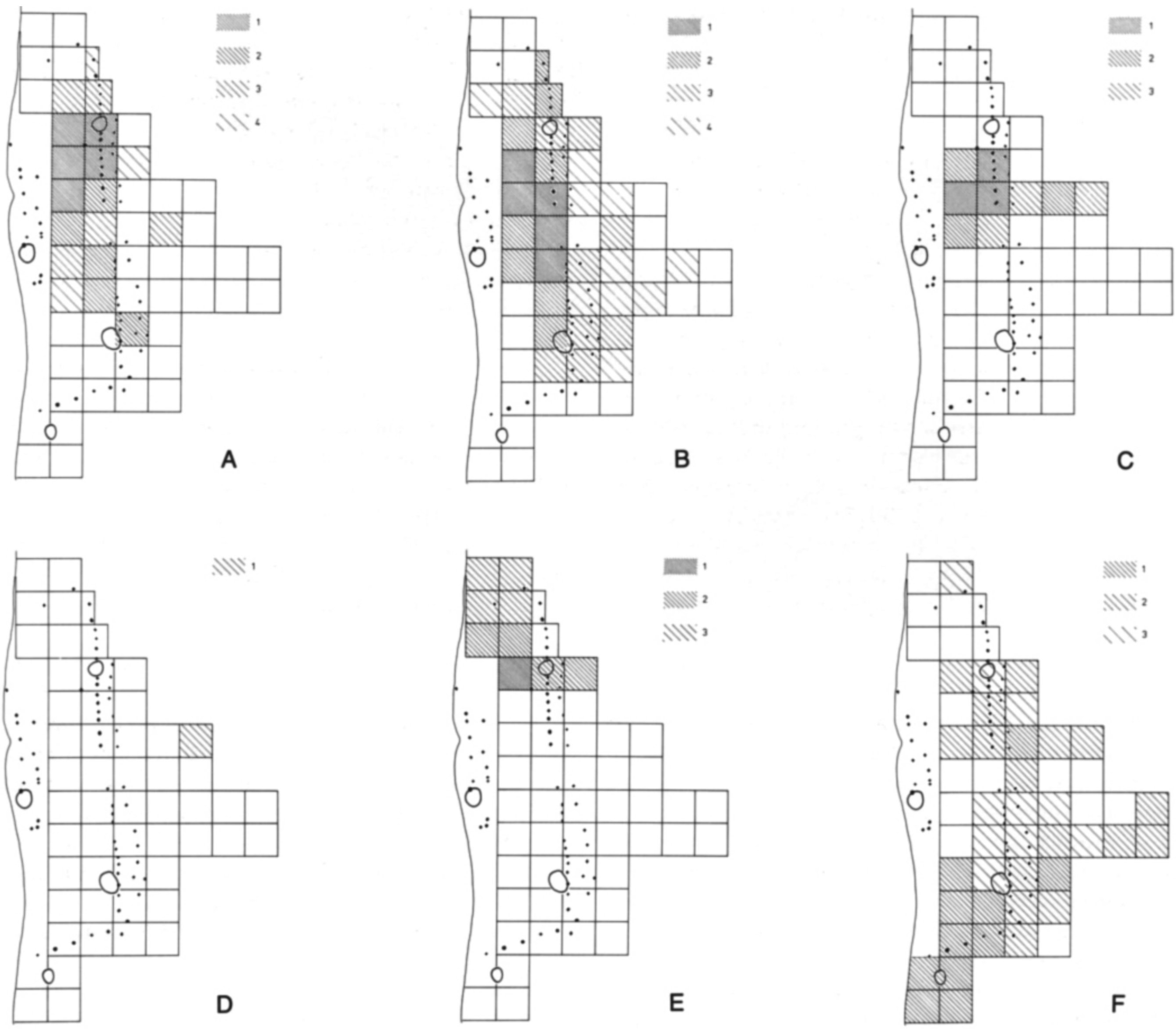

Fig. 6. Mortens Sande 2: distribution of finds in the meter grid. A – find stratum O, pottery: B – find stratum O, flint: C – find stratum A, pottery: D – find stratum C, pottery: E – condensation surface I, pottery: F – condensation surface II, pottery.

construction. Most probably we have separate and consecutive structures, each consisting of a single or double stake alignment combined with a single larger post. The three belonging to find stratum O must have been close together in time, but the southern row was substantially later.

This interpretation is supported by other small details. The holes in the NE alignment were bigger and blacker than those in the SE one. Unfortunately those in the western alignment could not be compared directly, as they were excavated the year before. The holes in the southern alignment were paler, larger, and stood in a single row only. Also they were less deep as a result of denudation of the surface. The difference of colour points to difference of age, as later holes tend to have dirtier fill than earlier ones owing to the increasing amount of charcoal and organic matter during the course of settlement.

Nature of the Structures

What kind of structures are indicated by these single or double stake alignments with one larger post each? Attention should be called to the following clues. The spacing of the stakes would be suitable for hurdling made by weaving horizontal branches back and forth between them. It is fairly definite that they formed barriers to the spread of artifact material. This is shown by some of the find density diagrams in fig. 6, in which diagram A shows by grid squares the weight of pottery and diagram B the number of pieces of flint in find stratum O. West of the north-eastern and to a lesser extent south-eastern rows of stakes the values were high, with over 40 g of sherds and over 50 pieces of flint per square meter being common. The values fall very sharply as soon as the rows of stakes are passed, with levels of flint under 16 and frequently under 4 pieces per m^2, and pottery often completely absent. There was also a difference in the character of the black layer, which was thinner and less greasy east of the rows. The rows of stakes must therefore have marked a physical boundary to the area with intense settlement activity.

Near the southern alignment the find strata had been completely blown away, and the find distribution is revealed only by the flint scatter on erosion surface II shown in fig. 6, F. Flint was present equally on both sides of the stake holes, but while the concentration north of them is likely to have belonged with the south-eastern alignment, the flint in the extreme south of the excavation can have belonged with the southern alignment, in which case this also bounded a concentration of settlement rubbish.

Unfortunately the western alignment lay close to the cliff and information is a little unclear. However there were plenty of finds west of it as well as east, so perhaps it was the eastern boundary of yet another concentration.

If we take as a working hypothesis that the remains belong to consecutive structures, each with a single hurdling wall that confined most of the flint chips and broken pottery and much of the crushed charcoal to one side of the hurdling, then the obvious explanation of the large posts would be that they held up something too heavy to be borne by the stakes, and presumably this could best be the roof. Since there is no sign of walls on any other side than that indicated by the hurdling, we may imagine a number of radiating struts going down to the ground, giving semi-circular structures with one straight hurdling wall about 4 m long. The roofing may be supposed to have been of thatch or hides. The subsidiary outer rows of shallower and less regular posts could have supported jutting eves giving little porches for storage or sheltering small stock. There was no unburned clay or burned daub, so the hurdling cannot have been made windproof by daub.

In our climate structures like these can hardly have been houses for use all year round, and it is reasonable to see them as intended for use in the summer half of the year only. From this it is only a short step to regarding the site as a seasonal one connected with some specific activity. The existence of specialized hunting sites is now accepted in the early Neolithic. The specialised activity easiest to imagine at our site is herding. Admittedly there is not a great deal of direct evidence, and it is hard to see what form such evidence could take. A badly preserved cow jaw (determination by Tove Hatting) was the only identifiable faunal remains, but as all neolithic communities are known to have consumed cattle this does not get us very far. However it is justified to suppose that stock keeping was an important economic activity in all prehistoric societies, perhaps the most important, and though the idea of shielings or säter does not normally enter into our picture of prehistoric life in Denmark, perhaps it should do. It is likely, though not yet certain, that this and similar sites with light dwelling structures were seasonal encampments connected with transhumance.

The upper layers

Find stratum O was the richest in finds, but as seen in the section, fig. 2, a whole series of soils were preserved above it. These represent pauses in blown sand deposition, and were separated from one another by a few centimeters (at most 20) of clean sand. Some of the surfaces had been occupied during the course of the Single Graves Culture, giving a stratigraphical sequence. A large part of these upper layers had been destroyed already by wind erosion, and Bell Beaker sherds on the eroded surfaces showed the age of some of the destroyed layers.

We may begin with find stratum A. The grid-distribution of the pottery is shown in fig. 6, C, but what we see in the figure is really only a remnant of the original distribution, as the deposit was cut off in the north by condensation surface I and in the south by condensation surface II. Eastwards it did not diminish so abruptly as find stratum O. Structural remains were in all probability represented by the E-W row of stakeholes at the southern end of the site and their accompanying posthole.

Find stratum B did not yield determinable pottery, but contained varying amounts of charcoal, not *in situ* where burned, but transported by wind from settlement presumably not very far away. The distribution of the charcoal was irregular as though blown into drifts, and it was not associated with a find layer and occupation earth in the usual way, but rested in fairly clean sand.

Find stratum C had been blown away everywhere except in the extreme east of the site (fig. 6, D). It may in the future yield interesting finds, as the coast erodes further.

Condensation surface I had cut away find stratum A in the northern part of the site, and in the extreme north it cut so deep as also to cut away find stratum O (fig. 6, E), as seen in the distribution diagrams for those layers. Probably many of its sherds derive from find stratum A, but in only a few cases were sherds of the same pot found in both contexts.

Condensation surface II had cut down through all layers in the southern part of the site, including find stratum O. The concentrated flint in it in this area must have derived from this (fig. 6, D), but most of the pottery had been destroyed by sand blasting in the wind. Further north it overrode both find stratum A and condensation surface I, so the material on it must derive from still younger layers that have been completely destroyed.

Phosphate analyses and carbonized grain

With the collaboration of P. Nørnberg from Århus University Geological Institute a trial was made to see if there was any clear patterning of phosphate values in find stratum O. Six soil samples were analysed – three west and three east of the lines of stakeholes. The results are shown in Table I. It can be seen that the P-values before ignition exactly follow the order of the values for ignition loss in the column to the left of them. As the ignition loss indicates the organic content of the sample by weight it is clear that organic content has an important influence on phosphate measured this way, and this is the way archaeological phosphate values are usually measured. To avoid this problem the values can be weighted in the way proposed by Nørnberg in Liversage, Munro, Courty and Nørnberg (1987), which gives the values shown in the last column of Table I. Unfortunately here the values do not suggest any significant patterning of phosphate around the site, and they are given mostly as an example of the level of phosphate to be expected in anthropogenic deposits of this kind.

The archaeobotanical study was more successful. About 100 liters of sand from find stratum O was processed, giving a yield of 318 cereal grains and 2½ other seeds. They were found both inside and outside the huts, being somewhat commoner outside, probably because more crushed underfoot inside. The place with most corn was the refill of the pit in the western stake alignment, a 20 liter sample of which produced 283 grains. Sampling methods and the results are dealt with by Robinson and Kempfner in this volume, so here it will be enough only to give their most important conclusions.

The material was nearly pure naked barley. One grain of emmer, 5 of hulled barley, and 3 of oats (likely

	sample no.	ignition loss %	phosphate before ignition ppm	content as P after ignition ppm	difference	difference / ignition loss
	p1	3.05	239	396	157	51
A	p2	1.76	152	252	100	57
	p6	1.04	74	150	76	73
	p3	1.12	109	186	76	68
B	p4	0.70	58	101	43	61
	p5	1.16	76	116	40	34

Table I. Phosphate analyses. Group A from rich occupation deposit of find stratum O. Group B from poor part of same layer east of stakeholes.

to be wild) form an only insignificant admixture. There were also a number of weed seeds, especially in the sample from the pit, but on the whole the proportion of weed seeds is low. They could perhaps be crop weeds brought in with the harvest, but could equally well be from plants that grew at the site, if some seeds of these had accidentally blown into the embers and thus been carbonized.

David Robinson reports that the crop, or part of it, had been harvested unripe, which would reduce losses owing to the ease with which naked barley falls out of the ear. The ears may have been cut or plucked individually into (for example) baskets. Suitable tools for cutting straw near the ground were not yet known at this time.

It is interesting to find a virtually pure crop of naked barley, because at the few hitherto-studied neolithic sites in Denmark barley played second fiddle to wheat. This is illustrated by the diagram, fig. 7, of Rowley-Conwy (1978), which shows wheat dominant in the Early Neolithic but beginning to give way to barley in later Middle Neolithic times. Three further studies that have since become available confirm the same tendency and show a more marked change-over to barley cultivation in final Funnel Beaker and Single Grave times, from which samples had earlier been lacking (Jørgensen and Fredskild 1978; Rostholm 1986; Robinson and Kempfner in this volume). Then the pendulum seems to swing the other way, with both wheat and barley present in the Late Neolithic and Bronze Age, with a greater variety of subspecies and evidence that different crops were grown and stored separately at the same farm.

However in other parts of northern Europe naked and also hulled barley play an important part even before the development of the Funnel Beaker Culture, and so does bread wheat (see Willerding 1970 for summary). Close in space and time there is a good deal of barley at Fuchsberg (EN/MN transition), and at Oldenburg-Dannau in eastern Holstein (middle of MN) barley already exceeds wheat (Kroll 1982). A large sample of impressions in pottery of the Corded Ware Culture in Saxo-Thuringia shows not nearly pure barley, as in contemporary Denmark, but wheat with a slight lead (Matthias 1969). It will be interesting to see if the pattern that is now emerging in Denmark will turn out to be the real one, or if it is just the result of insufficient sampling.

THE FINDS

Pottery (figs. 7–10)

Horizon O. About 4.5 kg of pottery was found in Horizon O from hardly more than 14 different pots, of which one by itself accounted for nearly half the sherds by weight. Probably this was the last pot broken before the site was abandoned, while the other broken pots were pulverised by being trampled on the floors of the huts.

The pottery is fired reasonably hard and except for pots 2 and 3 is gritted with small angular pieces of quartz, felspar, and mica, no doubt obtained by breaking up granite. The general impression is that the potters did not care much about the appearance of their wares, which are coarse and unsmoothed. Colour ranges from brownish black to dull yellow-orange. The following categories are present:

Storage jars (4 pots)
Globular vessels (about 3 pots)
Beakers (5–7 pots)

A further breakdown of the beakers gives 1–2 corded beakers, 2 with cardium ornament, 1 herringbone beaker, 1 with sparse jabs, and 1–2 with horizontal grooves. All these were archaeologically speaking contemporary.

Pot 1: most could be fitted together (ca. 2 kg sherds), but at the base only a single sherd survived. It was a fairly big vessel with a diameter of 26 cm and a height of about 33 cm. The rim is thickened and ornamented with fingertip impressions and the foot protrudes slightly (fig. 7).

Pot 3: a single large sherd with "short-wave" moulding and one of the two pots without a lot of stone grit. The 'short-wave moulding' is made by pressing a cordon first one way and then the other with the end of the finger (fig. 8:2).

Pot 15: this was represented by 3 sherds indicating a large, fairly straight-walled pot with a slight cordon under the rim. It was ornamented with fingertip impressions showing a long fingernail (fig. 8:6).

Pot 10 was only a single thick bulging belly sherd with irregular fingertip fluting, but it falls best into the storage jar category (fig. 8:10).

Pot 7: a globular-bodied vessel represented by the following: 3 sherds having a ledge shoulder with faint squarish impressions, 4 sherds with small applied knobs, a single small rim sherd (angle unsure), and about 20 other small sherds. Unfortunately it is not really sure where the knobs belong, and the diameter cannot be safely measured (fig. 8:1).

Pots 8 and 8a are two shoulder sherds similar to pot 7, but thinner and impressed with a smaller tool, a base sherd with similar impressions, and a plain rim sherd, all of which appear to derive from two or more further globular vessels (fig. 8:4, 8, 9, 11). These globular-profiled pots were smaller than the storage jars, but are so scrappily preserved as not to be closely measurable.

The 5–7 beakers were so far as can be seen of the tall-necked variety, but this cannot always be shown because of the small size and number of sherds.

Pot 2: this was the fitting rim and belly of a beaker with

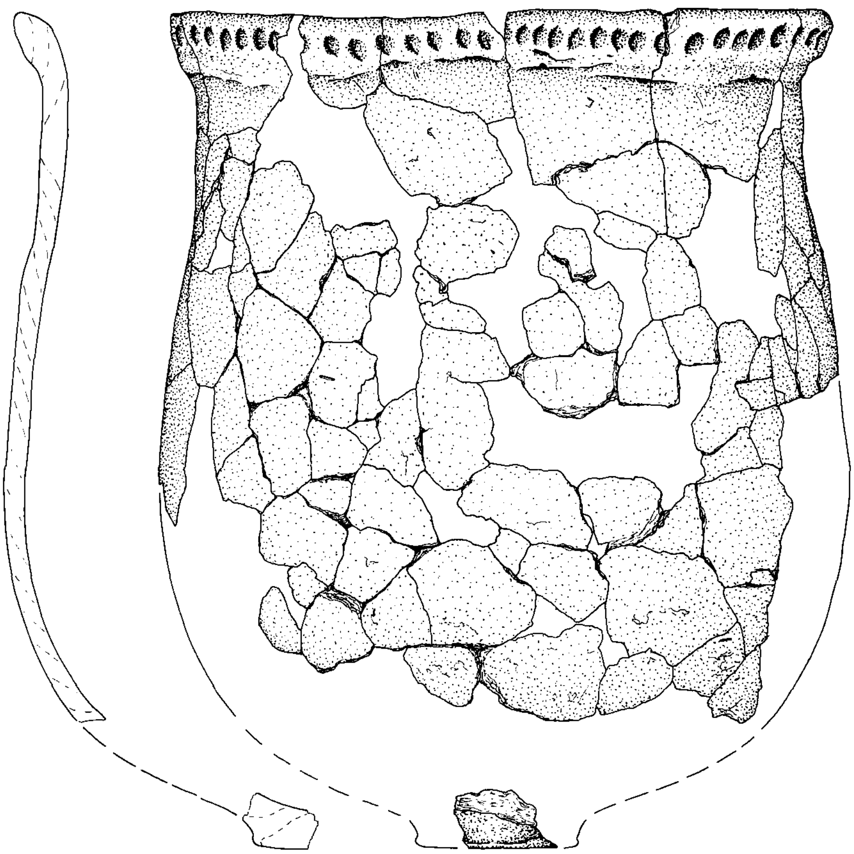

Fig. 7. Mortens Sande 2: pot 1. Scale 1:3. Drawn by Eva Koch Nielsen.

swayed profile and tall neck ornamented with a rough impressed herringbone pattern. Rim diameter about 14 cm. A separate sherd from the same pot has a small round pit bored almost through it after applying the herringbone ornament but before firing. The technique recalls that used to make holes in amber. This beaker was gritted only with a little sand and limestone (fig. 8:7).

Pot 6: represented by four small fitting rim sherds ornamented with rows of oblique cardium impressions. The pattern must be related to herringbone, but the alternation of tilt has been neglected, at any rate in the two rows preserved. Carelessness about tilt alternation is also seen on pot 2. Rim diameter about 10 cm. it is hard to complete the profile as a Single Grave beaker without allowing a tall neck (fig. 8:3).

Pot 11: fitting sherds from the middle of a neck, which must likewise have been fairly tall. It is ornamented with stacks of curved cardium impressions (fig. 8:12).

Pot 5: several sherds probably of a single small beaker with rim diameter about 14 cm, including a tall neck with a little below the rim a row of fingertip impressions with nail (fig. 8:5).

Pot 4: this may really be 2 or 3 separate beakers present only as a few very small sherds each. Horizontal cord lines on the neck and a closing row of impressions under the lowest of them are indicated (fig. 8:13).

Find stratum A. Only seven pots with recognizable traits could be distinguished in the 1.2 kg of pottery from this layer. They fall into the same categories as in find stratum O, and there does not seem to be any fundamental difference between the types present in the two assemblages.

Storage jars with thick straightish walls are indicated by pot 19, which had a slight cordon under the rim and scattered impressions made with a round-ended tool (fig. 9:3), and pot 20, which seems to have been similar, but only body sherds are present, one of them ornamented with flat round impressions (fig. 9:8), and pot 21, of somewhat different ware, with D-shaped impressions (fig. 9:6). The thick, grooved sherd, pot 23 (fig. 9:7), is probably also from a storage jar.

Globular pots are represented only by pot 18 (fig. 9:2), but these sherds give a better idea of the profile than the sherds in find stratum O. The shoulder had a row of impressions as on pots 7–8, there were little vertical applied strips with cross marks, and there were little notches on the outer edge of the rim.

Fig. 8. Mortens Sande 2: pottery from find stratum O. Scale 1:2. Drawn by Eva Koch Nielsen.

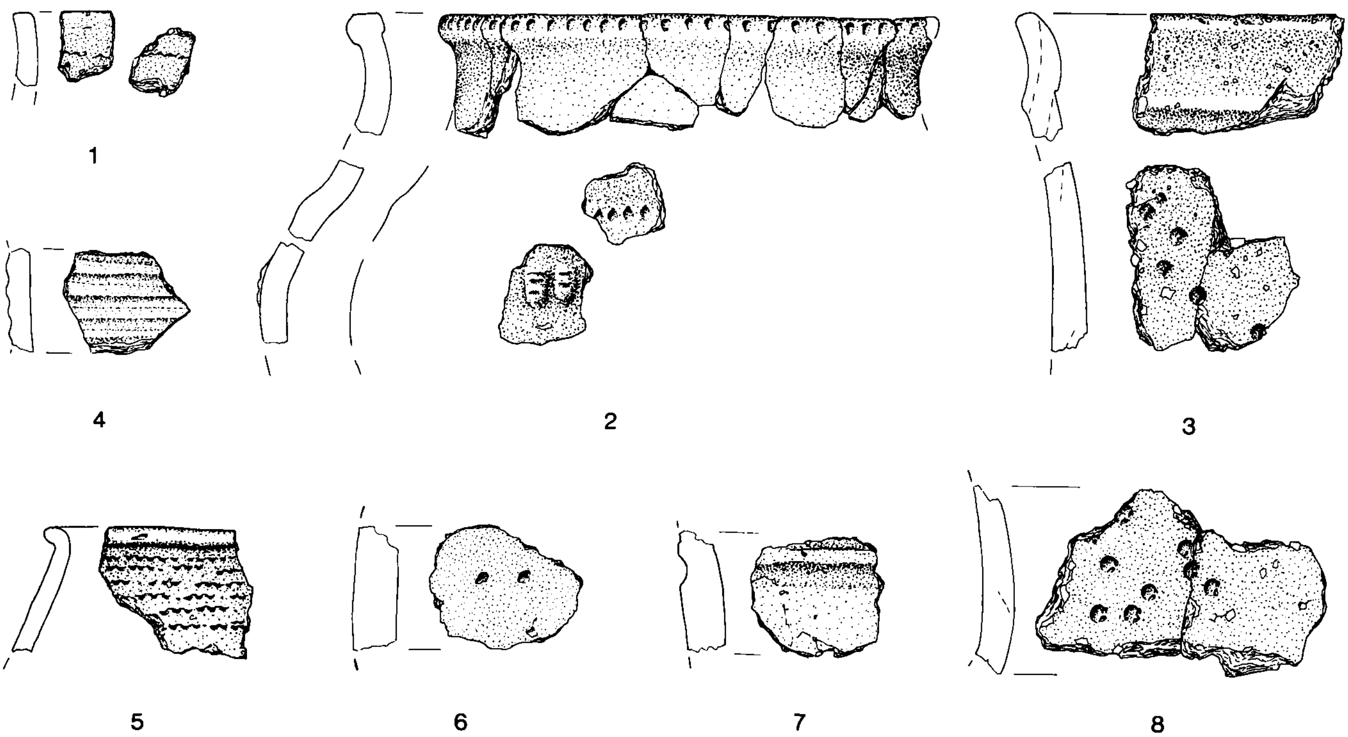

Fig. 9. Mortens Sande 2: 2–3 and 6–8, pottery from find stratum A. – 1, 4 and 5, pottery from find stratum C. Scale 1:2. Drawn by Eva Koch Nielsen.

Find Stratum C. There was no pottery from find stratum B, but that from find stratum C was quite informative considering that only 0.035 kg of sherds were found.

The rim-sherd (fig. 9:5) suggests an ovoid form. It is ornamented with cardium impressions. There are also two small beaker sherds with horizontal cardium lines (pot 39a, fig. 9:1). Seven body sherds (fig. 9:4) have horizontal grooves that have been smoothed over to give a corrugated effect rather than one of separate channeled grooves. The pottery seems to have developed appreciably since stratum A, but a larger sample would be desirable.

Pottery from the erosion surfaces. The pottery from the erosion surfaces is a mixture left behind from different overlying layers destroyed by wind erosion. Sherds belonging to pots from the find strata have been treated with them above. Some however belonged to vessels from which no sherds were found in situ, and some may even have originated in settlement layers younger than those preserved intact.

Pot 26: this is many small sherds indicating a straight-walled beaker. It is ornamented with oblique strokes on the rim, and horizontal toothed-stamp lines on the body. It comes closest to Glob's type K5, assigned to the Uppergrave period (fig. 10:10).

Pot 35: of this there are two thin but rather coarse sherds with ornament in Bell Beaker style consisting of narrow cross-hatched zones on the neck and a metopic pattern with hatched triangles lower down (fig. 10:6).

Pot 36: this is an unusual sherd of smooth, dark ware, which shows a fragment of a zone tightly filled with comb-like impressions made with some special stamp or by special application of an ordinary toothed stamp (fig. 10:7).

Pots 22 and 28 were ovoid beakers with recurved neck, and were ornamented with horizontal grooves (fig. 10:3 and 9). Further grooved sherds (fig. 10:1, 4, 8, 11) were probably from similar pots.

Pot 30 was a single rim sherd of a storage jar with fingertip impressions with fingernail near the rim (fig. 10:5).

Pot 37 was two sherds indicating a fairly large pot with horizontal cord lines (fig. 10:12).

Most of this pottery was from erosion surface I. The plain open bowl indicated by the rim sherd (fig. 10:2) is the only example of this form at the site. It was found on erosion surface II.

The typology of the pottery from Mortens Sande 2 can be summarised as follows. There are three main classes of pots – storage jars, globular-bodied vessels, and beakers. The storage jars are characterized by their larger size, thicker walls, and generally fairly straight profile. Fingertip decoration was common, sometimes taking the form of a "short-wave moulding". The globular-bodied vessels have everted rim and were decorated with notches or impressions at the rim, transition from neck to belly, and foot, and with small knobs or vertical ribs. The beakers in the main layer (O) appear to be of the long-necked variety and were ornamented with cord, cardium, jabs,

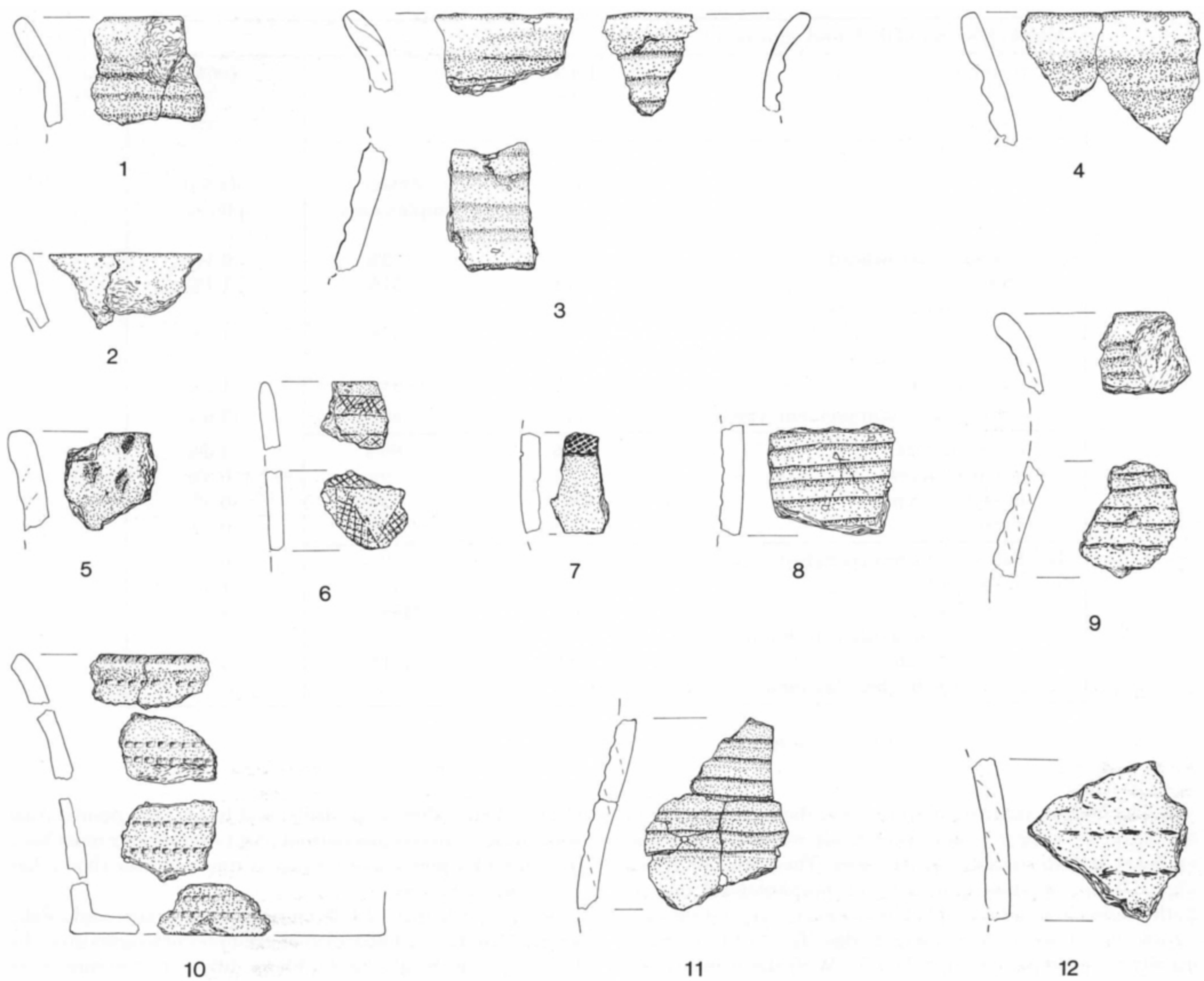

Fig. 10. Mortens Sande 2: pottery from condensation surfaces. Scale 1:2. Drawn by Eva Koch Nielsen.

or fingertip impressions. The patterns included herringbone and horizontal lines. In higher layers there were sherds of a straight-walled beaker and Bell Beakers with toothed stamp ornament, and also of ovoid beakers with horizontal grooves. These elements are confined to the later settlement layers.

Flint (figs. 11–14)

The special interest of the flint industry is its unusual character. It differs for instance from the two assemblages in the same cliff section studied by Liversage and Singh (1985). A summary of the material is given in table II. Here follow some remarks.

1. The raw material was morainic flint of a variety of colours and qualities. Mined flint is not present, and beach pebbles were apparently used only as hammer stones. The poor selection of raw material must have been one of the reasons for the poor quality of the working.

2. Flaking technique was somewhat rough. This shows in the frequent broad, randomly placed, striking platforms and obtuse angles between the striking platforms and the bulbar surface. A hard-hammer technique was used, giving big, swelling, and sometimes sharply localized bulbs. The cores are mostly very irregular, but a small number show residual blade technique. The treatment of the flint is much less skilled than usual at Danish sites, which could support the theory that the inhabitants were newcomers who lacked experience in the daily manipulation of flint.

MORTENS SANDE 2: find stratum O				
A	total number of pieces	1263		100%
	of these tools	96		7%
	cores	68		5%
		number	% of clear implements	% of total pieces
B	transverse arrowhead	1	2%	0.1%
	scrapers	14	31%	1.1%
	pointed tools: borers 2			
	drills 10	15	33%	1.2%
	picks 3			
	burins on flake	15	33%	1.2%
	(total of clear implement types)	(45)	(99%)	(3.6%)
C	burins on core	36	80%	3.0%
	notched pieces	4	9%	0.3%
	denticulated pieces	6	13%	0.5%
	various	6	13%	0.5%
D	flakes struck from polished axes	4	9%	0.3%
	burin spalls	19	42%	1.5%
	waste flakes	1075	2389%	85 %
	cores: residual blade technique 12			
	flattish 3	68	151%	5 %
	not further classified 53			

Table II. Mortens Sande 2: worked flint from find stratum O.

3. The biggest surprise, however, was the large number of burins. These appear to have been made without distinction on flakes and on suitable flattish cores. The burins on flakes (fig. 11:1–2, 5–6) show quite a lot of morphological variety. Both single-blow and multiple blow forms occur, and they are struck sometimes on a retouched edge (fig. 11:6) but more usually on a simple one (fig. 11:1,5). With the majority the there is a smaller group where it is nearer to 60°; in these cases the edge is situated medially near the axis rather than at a corner, as it is when the angle approximated to 90°. The working edges are frequently rather ragged, and examination under a binocular microscope sometimes reveals smoothing or rounding due to use.

The core burins (fig. 11:2,6 and 7) also usually have the working edge at a 90° corner but in some cases have a 60° angle and a medial placing. They are distinguished from other cores by the total shape of the implement and the narrowness of the burin facets, which are narrower than the scars found on cores, but there are transitional forms which create a demarcation problem. Like the flake burins, the core burins are found with single or with multiple burin facets.

The sharpening of burins created as by-product the small thick blades known as burin spalls fig. 13,1–3. Some of these were used as blanks for making drills.

4. The implements with working point are not a homogeneous group but belong functionally to three quite different classes, here called awls, drills, and heavy core points. Also some miscellaneous pieces from part C of the table must have been used for piercing or boring, as traces of wear shows that the points were used.

The two awls (fig. 12:1–2) on respectively a core and a flake weigh 23 and 9 g (compare other examples of weights given by Liversage and Singh, fig. 6). Quite different were three very large core tools with spike of which the largest (fig. 12,4) weighed just over a kilogram.

The commonest pointed tools, however, were narrow little drills recalling microliths (fig. 13:4–7). They were suitable for mounting in a wooden shaft and could have been used to bore holes in amber, as has been shown by experiments (Liversage and Hirsch 1987). The drills are usually made from burin spalls, which were given a minimum of retouch at the point. This raises the question whether the surprisingly many burins at the site were really only cores from which blanks had been struck to make drills for working amber. However some of the burins show traces of use, so it cannot be asserted that they were exclusively waste products. Nevertheless there may still be a connection between the large numbers of drills and of burins at Mortens Sande 2.

5. Scrapers occur with a lower percentage than usual in the Neolithic (1.1% of the total material, as against 3.1% at Penbjerg and 2.4% at the Barrel Site). There is also a difference in quality. The blanks were usually smaller, thicker, or less regu-

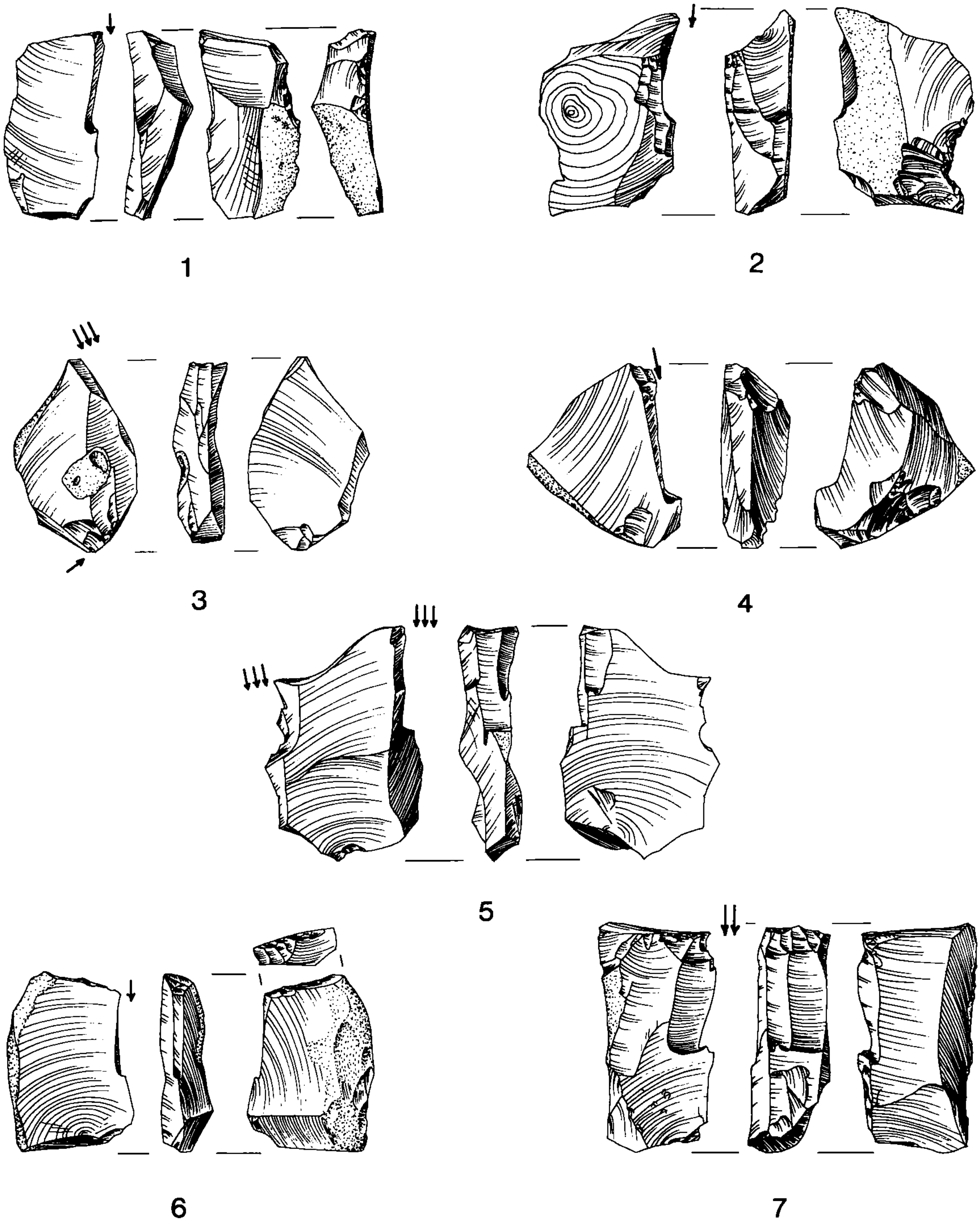

Fig. 11. Mortens Sande 2: worked flint from find stratum O. 1–7 burins. Scale 2:3. Drawn by Eva Koch Nielsen.

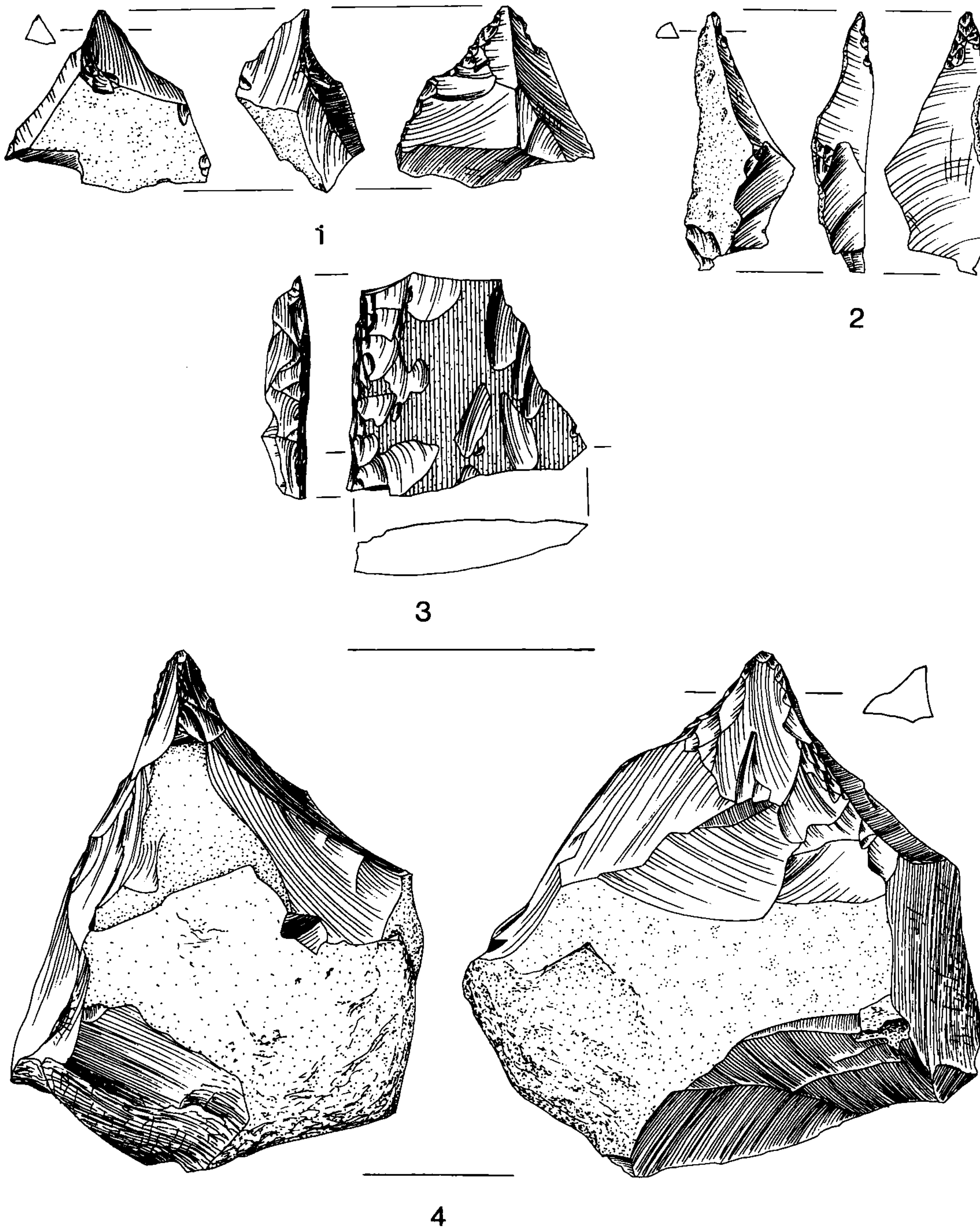

Fig. 12. Mortens Sande 2: worked flint from find stratum O. 1–2 borers, 3 flake from polished flint axe, 4 heavy core point. Scale 2:3. Drawn by Eva Koch Nielsen.

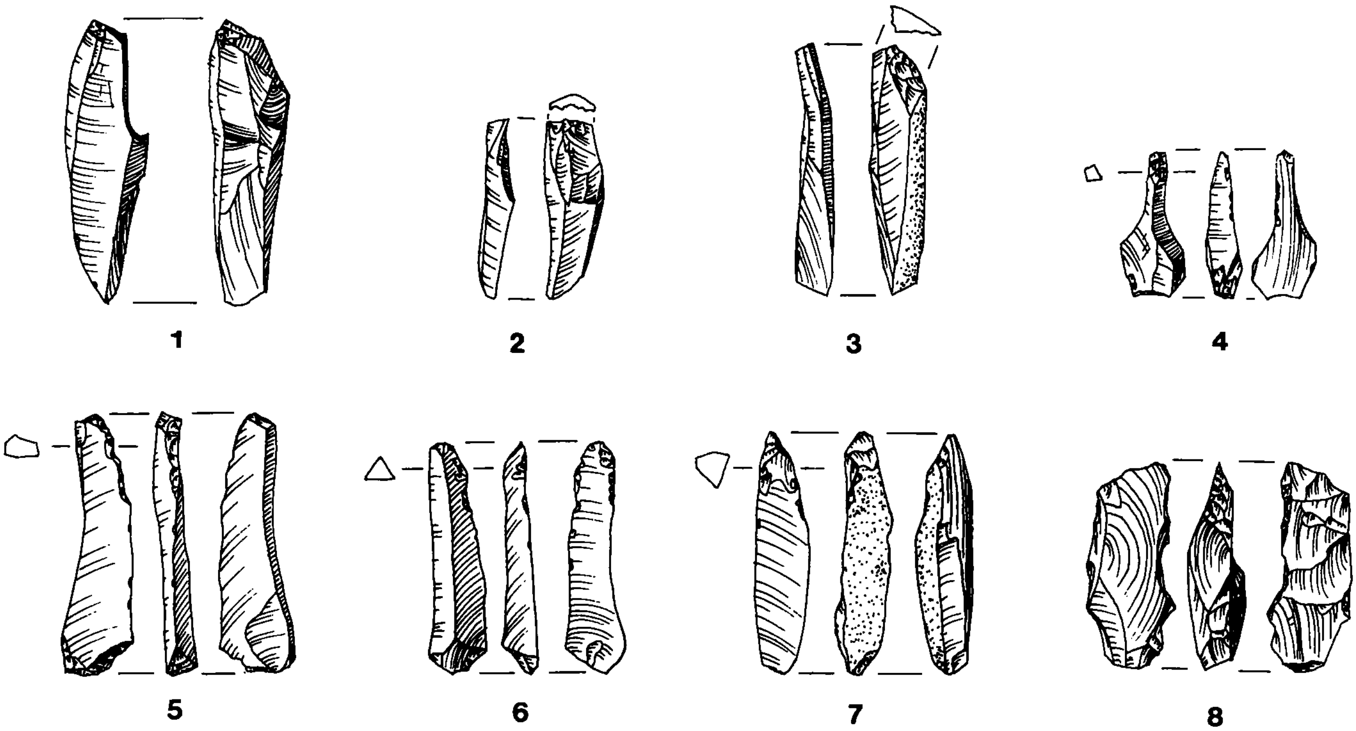

Fig. 13. Mortens Sande 2: worked flint from find stratum O. 1–3 burin spalls, 4–7 fine drills, 8 transverse arrowhead. Scale 1:1. Drawn by Eva Koch Nielsen.

lar than usual with scrapers in Denmark, and less edge was retouched (fig. 14: 1–4).

6. Attention may be called to a very poor transverse arrowhead (fig. 13:8), a form sometimes found in graves of the Single Graves Culture.

7. Part C of the diagram is used for those retouched tools that are difficult to define accurately or treat consistently. The core burins are included here, and also some other retouched forms that were made indifferently on flakes and cores. Use wear can be seen in some cases; also some of the unretouched waste seems to have been subjected to use. Fig. 14:5 and 7 may be described as notched and fig. 14: 6 and 8 as denticulated.

8. Cores: 12 out of the 68 cores showed broad blade scars struck in parallel from a platform. The majority however were very rough with much shattering, and without visible system.

9. A flake was found from a large polished axe (fig. 12:3), but is not big enough to show the axe's type.

The most characteristic traits of the Mortens Sande 2 flint industry was its rough flaking technique and numerous burins. Blunted-back knives seem to be absent as does flat retouch. The proportion of scrapers is lower and their workmanship poorer than in other Neolithic industries.

If further study shows that this distinctive flint industry is not an isolated occurrence, but is typical of the Single Graves Culture, it may be possible to identify Single Grave settlements by their flint alone when the pottery has all been destroyed. This could make new advances possible in the study of the culture and its settlement pattern through surface survey, as well as helping to identify sites for excavation.

Amber

In find stratum O there were abundant remains from working raw amber into ornaments. There was only a little amber in the other layers, but enough to show that it was still being used. Only in find stratum O was a workshop actually struck.

In this were found the following: a perforated disc; 3 beads, unfinished, but which look as if they could have been finished off if wished; 8 unfinished beads either with unfinished hole or broken when the hole was being bored; over 30 pieces with signs of working but without hole or final shape; 14 natural pieces of amber discarded at the site unworked; and finally an abundance of tiny crumbs and slivers hardly visible to the naked eye but recoverable when soil samples are sieved in water. The disc, the unbroken beads, and a few examples of broken beads-in-the-making are shown in fig. 15.

Experiments in amber working have shown that cutting and scraping with flint implements produces the same kind of waste as was sieved out of the soil samples and leaves marks like those found on the originals (Liversage and Hirsch 1987). There is no indication that amber was polished at this site – all

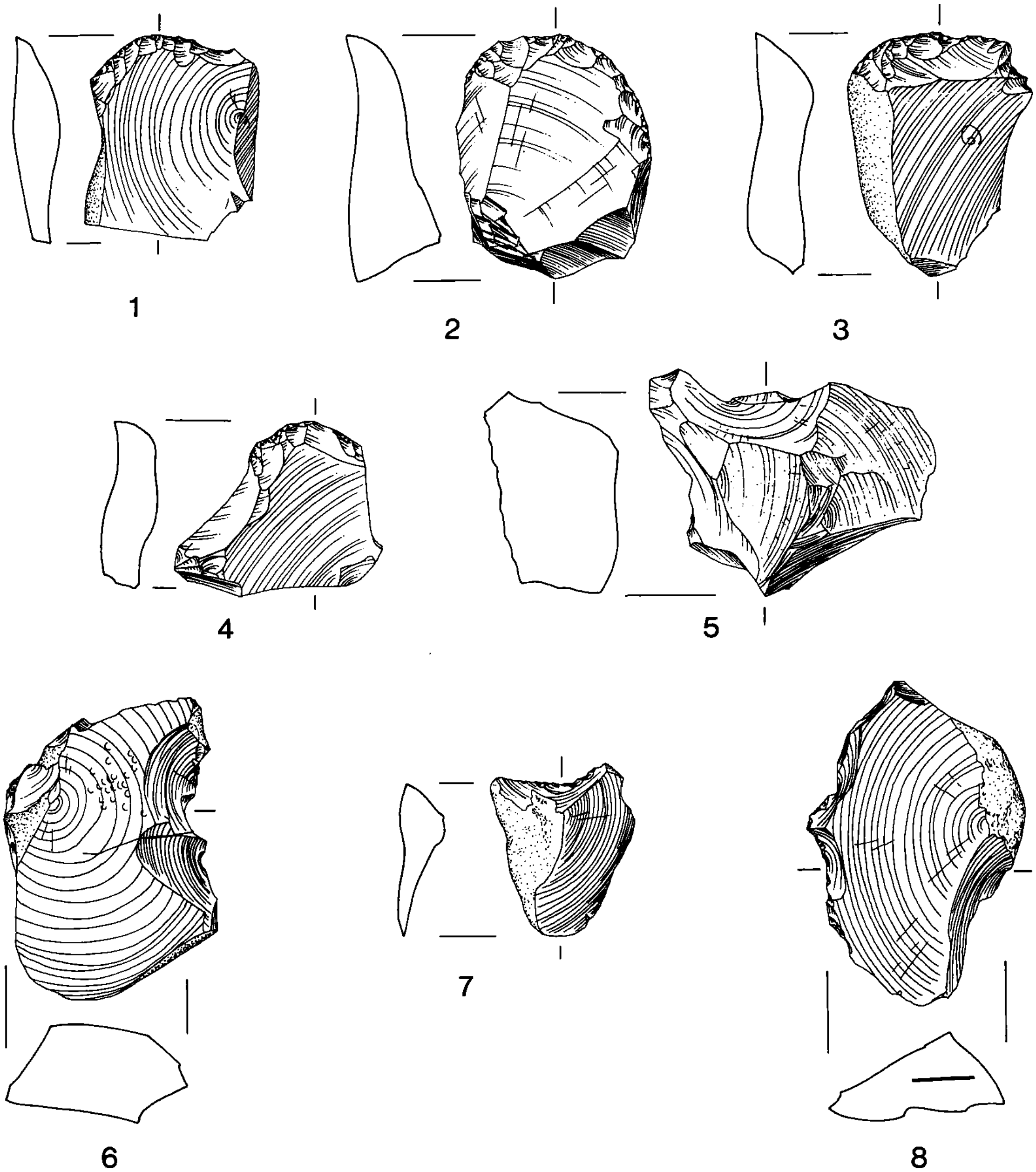

Fig. 14. Mortens Sande 2: worked flint from find stratum O. 1–4 scrapers, 5–8 miscellaneous. Scale 2:3. Drawn by Eva Koch Nielsen.

work seems to have been done by cutting, scraping and boring. The perforations in the beads were drilled, and fig. 16 shows an enlarged photograph of a bead that had broken through a hole. Similar marks can be produced using a pump drill armed with a narrow flint point like fig. 13:4–7, attached with resin to the end of the drill-shaft.

The most distinctive piece was the roughout for an amber disc, fig. 15:10. Finished examples are fairly common in male graves of the earlier part of the Single Graves Culture. The unfinished beads were rather uncharacteristic, but are not unlike the common beads from single graves (fig. 15:6–9). The fact that 14 natural lumps were discarded shows that the inhabitants were not very careful of their raw material, of which they probably had plenty (fig. 15:1–4).

The pendant, fig. 15:11, came from find stratum B, and the complete bead, fig. 15:5 came from condensation surface I. The hole is smaller in the last than in the other beads from the site.

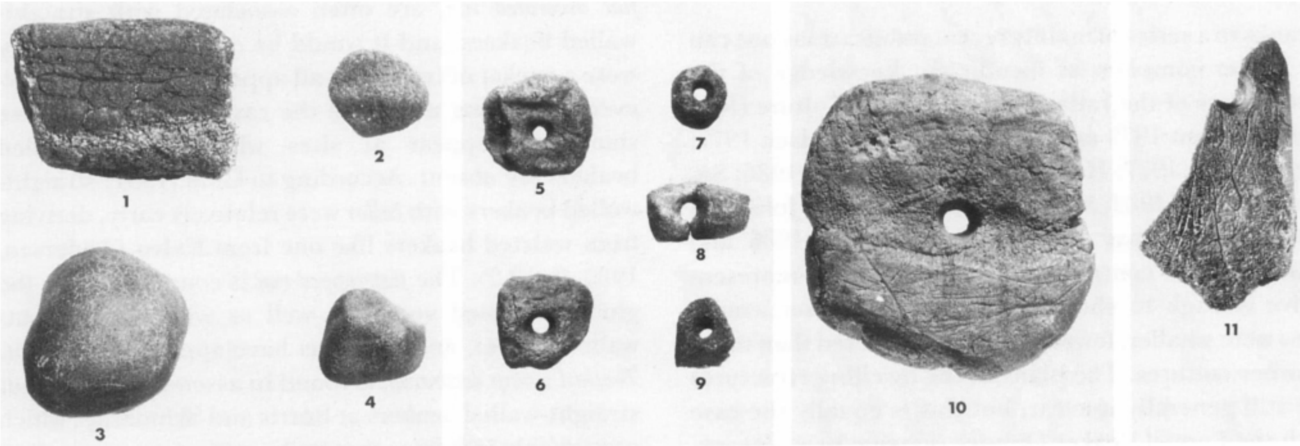

Fig. 15. Mortens Sande 2: amber. Scale 1:1. Phot. L. Larsen.

Fig. 16. Mortens Sande 2: Enlarged picture of a broken amber bead with drilled perforation. Scale 2:1. Phot. D. Liversage.

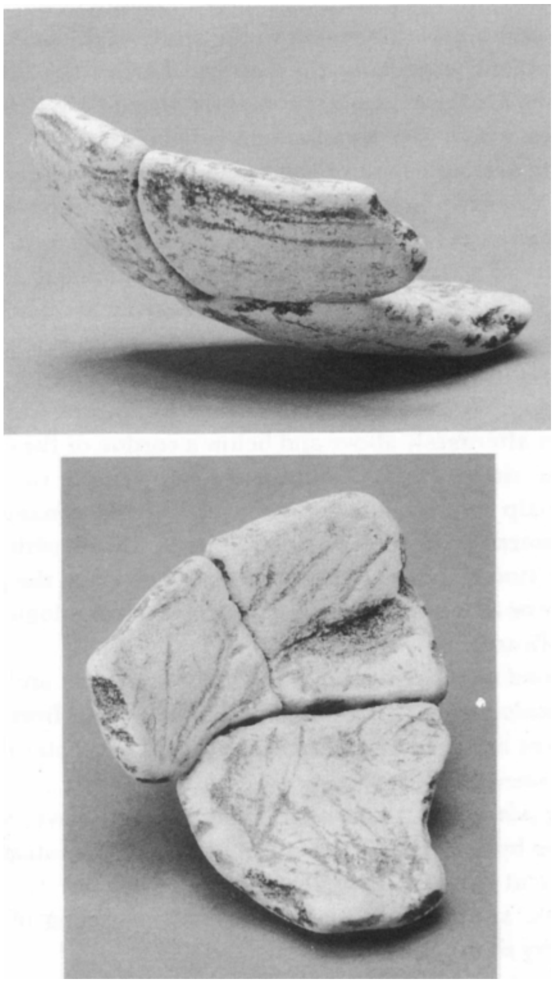

Fig. 17. Mortens Sande 2: Fragments from miniature stone bowl. Scale 2:1. Phot. J. Lee.

Other Materials

The three fitting fragments in fig. 17 have the shape of about one sixth of the side and base of a round-bottomed bowl about 2½ cm high and 5 cm in diameter. It is of a somewhat porous white material resembling limestone. Per Nørnberg of Århus University Geological Institute was kind enough to make a thin section from a fourth non-fitting fragment, and found it to be a decalcified limestone residue including the silicious skeletons of marine organisms. Such decalcified residues are not uncommon in the till. It is perhaps not quite certain that this one had been ground into a bowl, as only a small part is preserved and such objects have never been found before. The lines scratched on it are secondary and not from the original shaping. They include two horizontal lines under the rim that look like decoration, and parallel oblique scratches on the interior. The material is fairly soft and could probably be ground or rubbed to shape without leaving striations, or the striations have weathered away.

The only other objects were a small number of round quartzite pebbles that had been pocked by use as hammerstones, probably for striking flint.

CONCLUSIONS

Thanks to a series of mainly recent publications one can no longer complain of insufficient knowledge of the settlements of the Jutland Single Graves Culture (Jens Aarup Jensen 1973 and 1986; Karsten Davidsen 1977; Steen Hvass 1977; Hans Rostholm 1982 and 1986; Søren Andersen 1983; Mogens Hansen 1986; E. Johansen 1986; Lone Hvass 1986; John Simonsen 1986 and 1987). On the contrary, information is now representative enough to show that Single Grave settlement sites were smaller, fewer, and more scattered than those of other cultures. The plans of the dwelling structures are still generally unclear, but this is equally the case with the Funnel Beaker Culture (barring new discoveries on Bornholm, see Nielsen and Nielsen, 1985).

One of the special virtues of settlement sites is that they give a new dimension to the study of the material equipment, especially the pottery. Earlier the Single Graves Culture was seen mainly through its many graves, which gave a rather one-sided picture.

The available assemblages of settlement pottery are now divisible into broad chronological groups, with particular sets of traits being typical of each group. The results of a study of the published assemblages along lines indicates by Simonsen, (1967) is given in table III.

The following traits are important for chronological differentiation.

Short-wave moulding. This is made by impressing the finger alternately above and below a cordon or the edge of the rim, pushing it into a zig-zag. Simple rows of fingertip impressions are a closely related ornament. Ornament with finger impressions is linked with the large storage jars with fairly straight sides, and the presence or absence of these storage jars is chronologically significant.

Corded necks are linked with the beaker form and are chronologically significant. It does not emerge from the present material that short corded necks are later than long ones, but this was shown by Glob (1945).

Globular-bellied vessels with recurved rim have been shown by Simonsen to be one of the most characteristic forms at Single Grave settlements. They are rare in graves, and this has biased our understanding of the pottery of the culture.

Straight-walled beakers on the other hand are common in both graves and settlements and are very variously ornamented.

Three other traits, *collar*, *toothed stamp decoration*, and *flat decorated rim*, are often associated with straight-walled beakers, and it would be easy to suppose they were a packet of traits that all appeared together. However this seems not to be the case, for the last three sometimes appear at sites where straight-walled beakers are absent. According to Glob (1951) straight-walled beakers with *collar* were relatively early, deriving from waisted beakers like one from Kalvø (Andersen, 1983, fig. 8,2). The *flat-topped rim* is connected with the globular-bodied vessel as well as with the straight-walled beaker, and can thus have appeared before it. *Toothed stamp decoration* is found in assemblages without straight-walled beakers at Borris and Skinderup, which presumably indicates that it also came into use earlier.

Bowls occur both late and early. The late bowls are simple conical forms, while the early ones are more elaborate.

Following lines indicated by Simonsen the occurrence of these traits in twelve assemblages is shown in Table III. Lone Hvass (1986) and Mogens Hansen (1986) mention further settlement assemblages, but do not present them in enough detail for use here. The first and last sites, Lustrup and Myrhøj, belong to separate groups, so the table really only divides up the middle ten sites. In accordance with the diagram four chronological groupings can be set up for settlement pottery and named after Lustrup, Glattrup, Vindum, and Myrhøj.

The *Lustrup group* is only known from very small assemblages found in or under barrows (Rostholm 1986a). With its corded-neck beakers and large nearly straight-walled jars with short-wave moulding the Lustrup group stands out very clearly from the others.

Also the late *Myrhøj group* stands out clearly. Several sites are known, including some in the cliff section close to Mortens Sande, but Myrhøj is far the richest. Flint daggers date the group to the beginning of the Late Neolithic and it is the north Jutland local group of developed Bell Beaker pottery.

The ten remaining sites fall into the earlier Glattrup and the later Vindum groups. Typical Glattrup group pottery consists of beakers with corded necks and storage jars with fairly straight profiles, but it differs from the foregoing Lustrup group in the presence of globular-bellied vessels. Sometimes other forward-looking traits like the collar are present.

The *Vindum group* followed, which was characterized

	short-wave moulding	other finger-impressed jar	corded neck	bowls	cardium impressions	round-bellied vessels	collar	flat decorated rim	toothed stamp	straight-walled beaker	ovoid beaker	Bell-Beaker ornament
Lustrup	+		+	+								
Mortens Sande 2	+	+			+	+						
Glattrup			+	+		+						
Hvolris			+		+	+		+		+		
Kalvø		+				+	+					
Nr. Borris					+	+		+	+			
Blegind						+	+		+		+	
Skinderup								+	+	+		
Vorbasse									+	+		
Vindum Skovmark						+		+	+	+	+	
Fur					+	+		+	+	+		+
Myrhøj				+	+				+	+	+	+

Table III. Single Graves Culture settlement pottery – occurrence of traits at twelve sites.

by both toothed stamp ornament and straight-walled beakers, though the two elements are not always associated. Globular-bodied pots occur in the Glattrup and Vindum groups alike, but not in the Lustrup or Myrhøj groups.

This is only a working system for present use, and it will be interesting to see if it is confirmed by future discoveries. It could be made more detailed by taking account of a larger number of traits, but these would be mostly details of the ornament of straight-walled beakers, and it is likely that many of these would be regional variations without great chronological significance. Moreover the larger the number of traits considered, the less importance can be attributed to negative evidence (absence of traits).

At the 1986 symposium on the Single Grave Culture in Denmark (Adamsen and Ebbesen 1986) some contributors seemed willing to modify Glob's chronological system. Its fivefold chronological division certainly seems ambitious, but a final judgement must wait until the entire material had been re-examined. The present author has elsewhere indicated that grave and settlement chronologies should be set up separately and only afterwards correlated to produce an integrated system (Liversage 1980). The Lustrup, Glattrup, and Vindum phases should on no account be regarded as directly equivalent to the Undergrave, Groundgrave and Overgrave periods. Any attempt to date Mortens Sande 2 more closely than to the Glattrup group would be meaningless.

Settlement archaeology is not the only aspect of the Single Graves Culture being illuminated by recent research. We may take it as established by Lanting and van der Waals that Bell Beaker pottery developed in NW Germany and Holland out of Single Grave pottery (latest presentation van der Waals 1984). Earlier theories of a diffusion from Iberia are now rejected. If the Single Graves and Bell Beaker Cultures are then really only successive phases of the same culture, the question arises of an exact definition of the area in which the development took place. How much of Germany was involved? Was Jutland included?

An example is the Middle Rhine area studied by W. Gebers (1978). Gebers recognized the Dutch hypothesis on the origin of Bell Beaker pottery, but considered that in the middle Rhine it was introduced already developed from outside. Perhaps this was an unnecessarily cautious judgement, for his illustrations, which now enable the outsider to get a reasonable idea of the pottery in question, suggest that it developed through the same stages as in the Netherlands, so that the area of formation of the Maritime Bell Beaker style could very well include the Middle Rhine.

As for the situation in Jutland, Van der Waals showed that the Uppergrave period synchronized with Maritime beakers (perhaps beginning and ending a little later), and Developed beakers synchronized with an early part of the south Scandinavian Late Neolithic. The question is what kind of relationship did the Jutland Single Grave culture of the Uppergrave period have with its contemporary Bell Beaker cousin, and what was the significance of the appearance of Beaker pottery in Jutland when it finally did appear. Did it develop organically out of Single Grave pottery as happened in a not yet quite clearly defined Dutch/west German area, or did it not?

The relationship between Uppergrave and Bell Beaker pottery has been evaluated variously. When Glob dealt with the question (Glob 1945; 1952) it was still thought that Bell Beaker originated in Iberia and the whole chronological framework was somewhat diffuse. His pottery group K was defined by its supposed connection with Bell Beaker. However as Ebbesen (1978) pointed out, much of this pottery is not Single Grave, but Late Neolithic in Myrhøj style, and therefore not strictly relevant to the question of Bell Beaker influence on the Single Graves Culture. The rest of group K bears the simplest possible ornament of horizontal cord or toothed stamp lines, patterns so simple that they can appear nearly anywhere. More recently Lomborg (1977) tried to relate the horizontal cord decoration of K6 beakers specifically to the decoration of all-over corded beakers, but the motif could just as easily represent a continuation of the early Single Grave corded neck, and the argument cannot be seen as at all decisive.

Another of Glob's suggestions was that the low corded-neck beaker, and the use of broad chevron and narrow horizontal zones on "East Danish" beakers might reflect influence from Bell Beakers (Glob 1952, pp. 52–53). Also this is dubious. Some of the pots referred to relate to AOO rather than Maritime Beaker, and are therefore too early to be influenced by Bell Beaker, while nos. 426 and 427 of Glob (1952), both found in south Jutland close to the German border, fit in as epi-Maritime in Van der Waals' terminology and are probably too late to be relevant. These suggestions were put rather tentatively, for Glob treated the matter with caution.

A more recent paper illustrates how difficult it is to sort out the problems of chronology and cultural connections (Lomborg 1977). Lomborg saw two stages of Bell Beaker influence, one in Uppergrave times and the other at the beginning of the Late Neolithic. Unfortunately the pots which he regarded as bell beakers from Uppergrave times were really Late Neolithic, as in Myrhøj or related styles of developed Bell Beaker. Dealing with supposed stylistic influences on native pottery he rightly pointed out that Glob's group K6, if foreign at all, would show AOO rather than Maritime influences, but put forward the new idea that Glob's group L8 (straight-walled beakers with multiple chevron bounded by multiple horizontal lines) really did show Bell Beaker influence. This should be taken with a grain of salt, as real Bell Beakers with this pattern are rare and distant from Jutland and the motif has a rather wide geographical and chronological range. Cultural influences mean more than the occasional use of a widespread but not particularly common pattern.

Lomborg's second wave is dated to the beginning of the Late Neolithic and is said to be due to influences from "Western Europe", generally the British Isles. The typological arguments came from playing down the role of metopic ornament at Myrhøj and playing up the narrow zone ornament, giving a putative connection with English B-Beakers (*sensu* Abercromby). Emphasis was laid on the supposed origin of the Danish flint daggers in Britain, which was an important part of Lomborg's thesis. The daggers he cites from West Overton and Fakenham occur in an unexpectedly early context, but more would be needed to establish the derivation of the Danish daggers from Britain. In all events the style of the Myrhøj (and Bigum) pottery, with which daggers make their first appearance in Denmark, places them in chronological terms securely alongside the Veluwe beakers and therefore the British A and especially C beakers.

This does not exhaust the diversity of view about what constitutes Bell Beaker influence in Uppergrave times. Lone Hvass (1986) writes "Bell Beaker influence is felt in the shape of new pottery forms, close herringbone pattern, and use of the toothed stamp". This view was put with praiseworthy conciseness, but it can be objected that herringbone pattern is better parallelled in

Single Grave than Bell Beaker contexts, that the use of a toothed stamp is too generalized a feature to have much significance and in any case is coarser on Uppergrave than on Bell Beaker pottery. The pottery forms referred to are not specified, but possibly the waisted beakers of Groundgrave times were meant; they recall late English A-beakers several centuries younger.

What then really was the extend of Bell Beaker influence in Uppergrave times? Not very much it seems, and the best evidence comes from the settlements. Maritime Beaker pottery was found in a small apparently pure settlement assemblage from Husby in western Jutland, and a single Maritime sherd was found with Uppergrave sherds in a disturbed settlement deposit on Fur in the Limfjord (J.Aa. Jensen 1973; 1986). This shows the importance of settlement pottery as a separate source of information, for these are perhaps the only Bell Beakers from Denmark that can be assigned to the Uppergrave period. Otherwise Bell Beaker in Denmark seems to be Late Neolithic, with the possible exception of a very few Epi-Maritime beakers, which belong to the Schleswig-Holstein or insular Danish regional group and not to the Jutland Single Graves Culture proper (Glob 1952, nos. 426 and 427).

The answer to our original question then is that, unlike the northwest European group, the Jutland group of the Single Graves Culture did not develop smoothly into the Bell Beaker Culture. The Jutland culture was an isolated group little influenced by what was going on in other parts of Europe, and when Bell Beaker arrived in its area at the beginning of the Late Neolithic it did so very suddenly and in a rather massive way without having clear local antecedents. It is not intended to propose invasion theories, though population mobility may well have been greater in this period than in most others. What more than anything else would contribute to elucidating the question would be a better and geographically wider knowledge of the settlement pottery.

RADIOCARBON DATES

After near completion of this paper the following radiocarbon dates became available.

K-4768	2110 ± 85 bc (ca. 2590 B.C. cal.)
K-4767	1910 ± 85 bc (ca. 2465–2200 B.C. cal.)
K-4766	1880 ± 85 bc (ca. 2460–2140 B.C. cal.)

The first dating is of charcoal sieved out of find stratum O close west of the north-eastern row of stakes. This is the only date from find stratum O.

K-4767 is from charcoal sieved out of find stratum A, and suggests that a couple of centuries may have elapsed between these two occupations despite the apparent similarity of the pottery mentioned above.

K-4766 was from charcoal in the top of the large posthole at the southern end of the site, and was submitted in the belief that this hole and the row of stakes going with it were of the same age as the others. The date is, however, statistically identical with K-4767 from find stratum A, and as the occupation layers had been denuded at this end of the site and the posthole was sealed only by condensation surface II, we have concluded that the southern stake alignment belonged with stratum A. This is a warning of the pitfalls that lie in wait at multiple occupation sites. If strata O and A had not been separated by a little blown sand, it would never have been discovered that the post structures were not all contemporary, and the interpretation of both the structures and the finds would have been accordingly. All that would be left would be an inexplicable pattern of C-14 dates.

The dating gives the change from double to single-row shelters a potential chronological value, with the possibility that double-row shelters (with porch?) gave way later to more solidly built single-row shelters. It also suggests that structures of this kind were commoner than originally thought, and will encourage the search for more at other sites along the cliff.

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Carbonized Grain from Mortens Sande 2

– A Single Grave Site in Northwest Jutland

by DAVID ROBINSON and DORTHE KEMPFNER

INTRODUCTION

A great deal of our knowledge of prehistoric crops, and the agricultural practices associated with them, comes from the study of crop plants and crop weeds preserved by waterlogging, dessiccation, carbonization and mineralisation or as impressions in pottery. To date only carbonized remains and impressions are known from the Danish Neolithic and these records are almost exclusively from the Funnel Beaker Culture or from sites dated to the Late Neolithic/Early Bronze Age (Jørgensen 1976, 1979, 1981; Rowley-Conwy 1978). Records from the Single Grave Culture are rare. Hans Rostholm, in his recent review (Rostholm 1986), lists a total of 26 impressions and four carbonized grains for the whole Single Grave period.

Reviewing the Neolithic period as a whole, Jørgensen (1981) has shown that during the Early Neolithic it was wheat, in the form of einkorn and in particular emmer, that was the dominant crop. Other wheat species and barley were present but rare. In contrast, in sites of the Late Neolithic and Early Bronze Age it is barley, mostly of the naked form, which is most abundant. Spelt and bread wheat also achieve more prominance, being present in addition to emmer and einkorn. This changeover from wheat to barley cultivation, which was not a sudden phenomenon, apparently took place over the transition between the Funnel Beaker and Single Grave Cultures in the late Middle Neolithic (Davidsen 1978; Jørgensen 1981; Rostholm 1986). Naked barley is proportionately better represented in the later Funnel Beaker sites (Jørgensen 1981) and accounts for 20 of the 30 records from the Single Grave Culture (Rostholm 1986). Rather more convincing evidence for the important role of naked barley during the Single Grave Culture can now be seen in the find of carbonized grain from Mortens Sande 2, a settlement site in northwest Jutland, which was occupied several times in the centuries around 2000 bc.

METHODS

The site, which is described in detail by Liversage in this volume, lies in blown sand and was revealed by coastal erosion, which has subsequently continued and removed all traces of the site (Liversage, this volume, fig. 2). The samples came from stratum 0, at which level structural remains were located and which contained charcoal giving a radiocarbon date of 2110±85 bc. Samples were taken from the culture layer inside and outside the house and from a pit associated with the structure (Liversage, this volume).

The layers were excavated in plan and large samples were processed by the excavator who describes the sampling and processing methods as follows: 'During the excavation samples were taken for seed analysis. Sand was taken, normally a bucketful at a time, from a recorded layer and grid square, and was processed on site either by flotation or by sieving. Flotated samples were placed carefully, a handful at a time, into a specially constructed flotation bucket with weir (broad flat spout), containing sea water. The floating fraction drifted out over the spout and was caught in a piece of muslin with a mesh-size so small that it is very unlikely that any seeds were lost. The flotated material was later washed out of the muslin in the laboratory, dried, and then stored for laboratory analysis in glass bottles. Sieved samples were placed, a handful at a time, into a sieve with 0.8 mm apertures and agitated gently in water. This let through all the sand and left behind all charcoal big enough to be caught in the mesh, and this included cereal grains. Sieving was a good deal faster, and after about 60 litres had been flotated it was thought that the weed seeds would be adequately sampled and we continued sieving only for cereal grains. The sieved samples were also dried before being stored for laboratory analysis.'

In the laboratory the carbonized plant macrofossils were sorted, identified and, as far as was possible, measured. The results are presented in tables 1 and 2. All macrofossils have been retained for future reference.

Carbonized grain

It is clear from the archaeological evidence that the carbonized grain and other macrofossils in these layers do not represent a store or hoard and as such can not be taken as representative of a harvested and processed crop. They did, however, become charred and then incorporated into the layer as a result of normal day-to-day activities at the site which naturally would include crop processing and food preparation and the utilisation or disposal of the by-products which resulted. They must therefore relate, in some way, to the crops which were cultivated.

The overwhelming majority of the carbonized grains recovered were of naked barley (*Hordeum vulgare* var. *nudum*). They had the distinctive rounded outline and cross-section and on many, the transverse wrinkling across the surface of the grain was also apparent. A much smaller proportion of the grains had the angular outline and cross-section characteristic of hulled barley. This particular morphology is a consequence of the grain having being held fast between the lemma and palea or 'hulled'; hence the name. In addition there was a significant number of the carbonized grains which could be identified as barley, but damage to the surface of the grains prevented their being assigned to the hulled or naked categories. Some of the grains were obviously twisted, identifying them as being from six-rowed barley. However the proportion fell far short of the 66% which would be expected if all the grain was of the six-rowed type. It may therefore be possible that two-rowed barley is also present but it is not possible to prove this with the evidence to hand.

Within the naked and hulled forms of six-rowed barley there are also what are called dense-eared and lax-eared forms. The dense-eared forms have a short dense ear made up of short fat rachis internodes and which stands erect. Conversely the lax-eared forms have a longer less compacted ear made of longer slender rachis internodes which tends to bend over or 'nod'. Of the three complete rachis segments found at Mortens Sande 2, two measured 2.3 mm in the length and the third 2.4 mm. This is just at the lower size-limit for lax-eared barley and given their very slender nature and the overall small grain size, it seems almost certain that it is a lax-eared form which is present.

A few grains of oats were also recorded. They were very small and it seems likely that they are of wild oat (*Avena fatua*), although none of the distinctive 'sucker-mouth' floret bases were present to confirm this. One grain of emmer (*Triticum dicoccum*) was identified. The remaining grains were so badly damaged or deformed that identification to species was not possible. Many of the identified grains were, however, very well preserved in that the surface cell pattern was clearly visible even on very deformed examples. Surface damage and breakages which were apparent could well have occurred during sample processing rather than in antiquity and the grains show little sign of having been windblown. Many grains, although clearly identifiable as naked barley for the reasons given above, still had fragments of carbonized lemma attached to them. This is a most unusual feature, given the decidedly free-threshing nature of naked barley, as the grains tend to be lost from the spikelets as soon as they are ripe. There was also a large number of swollen and burst barley grains such as result from the charring of damp or unripe grain. This suggests that some if not all of the grains were still on the ear and possibly in an unripe or doughripe state when they were carbonized, firmly suggesting that this is food and not seed corn which we are dealing with. Contemporary ethnographical studies report a number of foods prepared from grain in such an immature state (Hillman 1985). The presence of several carbonized rachis internodes and an impression of the base of a lemma awn in a piece of fired clay also support, to some degree, the presence of unthreshed ears on the site.

Grain size

All grains not seriously deformed or broken were measured and the results are summarised in table 2. Within stratum 0 there is a clear difference in size between those grains found inside the structure and those found outside, the former being, on average, larger. Whether this is the result of some kind of selection process is not clear. The average grain size in the pit is identical to that for grains outside the structure in stratum 0. Seen in relation to more recent examples and even some contemporary finds, the grains are small. However they do correspond very well with the grain sizes from Sarup (Jørgensen 1976, 1981) and Nørre Sandegård (Helbæk

		inside	house	outside	house	pit	total
whether flotated or sieved		F	S	F	S	F&S	
approximate sample volume		40 1	34 1	18 1	33 1	20 1	145 1
FOOD PLANTS							
Avena sp. (? wild oats)	c		3		2	1	6
Hordeum vulgare var. *nudum* (naked barley)	c	8	49	45.5	39	139	280.5
Hordeum vulgare (hulled barley)	c		1	1.5		9	11.5
Hordeum vulgare undiff.	c	7.5	30.5	36.5	24	91	189.5
(badly preserved barley)	rachis					10	10
	clay impression of lemma awn		1				
Rubus idaeus/fructicosus (blackberry/raspberry)	s					5	5
Triticum dicoccum (emmer)	c			1			2
unidentified cereals		14	13	36.5	6	28	99.5
	straw		+	+	+		
total cereal		29.5	97.5	121	71	283	601
WEED SPECIES							
Anthemis sp. (mayweed)	a					1	1
Galium cf. *aparine* (goosegrass)	s					1	1
Polygonum sp. (persicarias)	fr					4	4
P. cf. *aviculare* (knotgrass)	fr					2.5	2.5
Rumex acetosella (sheep's sorrel)	fr					1	1
Solanaceae (nightshade family)	s					0.5	0.5
Urtica dioica (stinging nettle)	s	1		0.5			1.5
Vicia sp. (vetch)	s	1		0.5			1.5
OTHER							
Calluna vulgaris (heather)	twigs					+	+
Cirsium cf. *heterophyllum* (melancholy thistle)	a			2			2
Cyperaceae (sedge)	n					1	1
cf. *Ranunculus ficaria* (lesser celandine)	tuber				1		1
unident. charcoal	buds and twigs	+	+	+	+	+	+
Viola sp. (violet)	s					1	1
unidentified	plant macros		1			1	2
MISCELLANEOUS							
amber chips		+	+	+	+	+	
burnt bone	f		+			+	
burnt flint	f		+		+	+	
Cenococcum geophilum (fungus)	fruiting body	›4	+	many	48	6	
insect	f					+	
unidentified fungus	fruiting body					+	

Table 1. Mortens Sande 2. Plant macrofossil determinations. c = caryposis, s = seed, a = achene, fr = fruit, n = nutlet, f = fragment.

	inside structure	outside structure	pit
	Σ 44	Σ 60	Σ 88
L	5.4–3.3 (4.4)	4.8–3.2 (4.2)	5.3–2.7 (4.2)
B	3.8–1.7 (2.7)	3.2–1.6 (2.5)	3.7–1.2 (2.5)
T	2.5–1.4 (2.1)	2.4–1.2 (1.9)	2.7–1.0 (1.9)

Table 2. Mortens Sande 2. Grain measurements for *Hordeum vulgare* var. *nudum* (naked barley) in mm. L = length, B = breadth, T = thickness. Values: maximum – minimum (average).

1952) and contemporary sites from the Netherlands (van Zeist 1968). All of the sites mentioned above are, like Mortens Sande 2, on sandy soils, and although it is not sure and perhaps unlikely that the crops were cultivated locally in the dunes, poor soils may in part account for the small grain size.

Other plant remains

Seeds and fruits of weed species, that is species which grow in disturbed habitats such as found on cultivated ground and around human settlements, were rare in the layers and those which were present are rather difficult to interpret. Layer O produced 1.5 seeds of *Urtica dioica* (stinging nettle) in total. *Urtica dioica* is not a normal crop weed but it is a plant which grows on the enriched soils around human habitation sites. The seeds were probably charred by accident on a hearth. Its presence does suggest however that settlement and activity in the area had been such that there was sufficient enrichment of the soil to allow *Urtica* to grow.

Only the pit contained remains which can be considered to represent a weed flora and these could well have originated from a source other than the barley field. Weeds would have been an integral part of the environment around an established settlement such as this and the possible means by which their seeds could become carbonized and preserved are almost countless. The common arable and wasteland weeds, *Anthemis* (mayweeds), *Polygonum* (persicarias), *Galium* (bedstraws) and *Vicia* (vetches) were present. *Rumex acetosella* (sheeps's sorrel) is a also weedy plant but can be found on grazed pastures. *Solanum nigrum* (black nightshade) favours damp shady places, and grows well on rich manured soils. It is a common weed of cultivation today, particularly in gardens.

The purity, that is absence of weed seeds, of Neolithic crops has been commented upon by Jørgensen (1976) and Rowley-Conwy (1978). There are several possible explanations for why this should be so. Jørgensen (1976) considers that aspects of the sowing, weeding and, in particular, harvesting of the crop were responsible, although crop processing in the form of winnowing and sieving may also have been involved. At Mortens Sande 2 it appears likely that the ears of barley were harvested individually, possibly with the straw and attendant weeds being harvested at a later date (cf. Hillman 1985). This selective harvesting would, in addition to reducing the number of weed seeds in the harvest, have the added advantage of reducing grain-loss during harvest, which is always a major consideration with free-threshing cereal such as naked barley. Cutting the crop at the base of the straw and transporting it in this form can lead to enormous grain losses. This interpretation also fits in well with what has been said previously about the grain being slightly unripe and still on the ear when it was carbonized; the grain would have been much easier to harvest in this state.

A small number of remains of herbaceous species were recovered which were not obviously from cultivated or weedy habitats. *Cirsium heterophyllum* (melancholy thistle) is a plant of open scrubby woodland and streamsides although it can occur on grazed pastures. The presence of carbonized *Viola* (violet) seeds, *Carex* (sedge) nutlets and possible *Ranunculus ficaria* (lesser celandine) tubers, suggests the proximity of a damp shady area with a reasonably rich mull soil such as might be found in damp deciduous woodland. It is a little difficult to imagine how the tubers of *Ranunculus ficaria* came to be carbonized. The plant does have a long history of use medicinally, notably in the treatment of haemorroids, but it is not known how far back in time this practice extends.

Charcoal

All the samples examined contained substantial amounts of charcoal. No attempt was made in this study to make a systematic identification of the fragments, however a number of obvious stems of *Calluna vulgaris* (heather) charcoal were picked out from the pit. Charcoal fragments in samples from stratum 0, submitted for radiocarbon dating, were identified by Claus Malmros (pers. comm.) and the following species were recorded: *Corylus* (hazel), *Tilia* (lime), *Quercus* (oak), *Alnus* (alder) and *Pomoideae* (apple family). No heather charcoal was apparent. Although these samples may be far from representative with regard to the local vegetation, the analyses do suggest that there was both deciduous woodland and heath somewhere in the vicinity. The question of the origin of heaths in western Jutland and man's involvement in this, has been discussed by Odgaard (1985, 1986) in relation to his regional pollen diagram from Solsø and local pollen diagrams from fossil soils below burial mounds at Skarrild and Harreskov. At Solsø the changeover from forest to heath began around 5000 bp and this date is supported by preliminary pollen counts from Gjævhul Sø (Robinson, work in progress), a lake deposit buried under blown sand and now exposed on the foreshore c. two km south of Mortens Sande 2. Charcoal dust is present in the Solsø deposits and this is interpreted as being from the repeated burning of heath to maintain it in an optimum condition for grazing, which Odgaard considers to have been a major requirement at this time (Odgaard 1986).

CONCLUSIONS

Although caution should always be exercised when evaluating finds such as these described here, the macrofossil analyses from Mortens Sande 2 do provide some solid evidence for the importance of the role played by naked barley in the agriculture of the Single Grave Culture. The samples are overwhelmingly dominated by this cereal type. It is suggested that the crop was harvested by picking the individual ears, possibly in a slightly unripe state and it was in this form that they became carbonized. Collectively this would explain the virtual absence of weed seeds in the samples, the many very swollen and exploded carbonized grains and the fact that fragments of lemma were still attached to the surface of many naked barley grains, something which would be virtually impossible if the grains had been fully ripe. It is also suggested that the grain became carbonized accidentally at the site during the normal activities of crop processing and food preparation.

Other macrofossils recovered from the samples, notably charcoal of heather and deciduous woodland trees, allow the tentative suggestion that the local vegetation was a mosaic of heath and damp deciduous woodland.

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Diverhøj

– A Complex Burial Mound and a Neolithic Settlement

by PAULINE ASINGH

Until 1985 one of the large barrows characteristic of the Danish landscape stood on the top of a hill near Trustrup in Djursland (fig. 2) (1). Its earlier name was "Digerhøj", for which a rough English equivalent might be "Stout Hill", and with its height of 5 and diameter of 25 m it certainly lived up to its name.

Diverhøj was the largest of 7 barrows situated at the western end of a broad ridge (fig. 1). It was highest, standing on a prominence, while the others lay 50 to 100 meters from one another on slightly lower terrain 50 m further south. Only one of these is still grass-covered, the others being ploughed over and visible only as slight rises in the ploughed field surface (2).

The National Museum's records show that the southern part of Diverhøj was already destroyed at the end of the last century. This may explain why the monument was only placed in class C in the 1946 inspection and was not brought under protection. Under the revised law of 1978 these monuments acquired full protection unless their removal was demanded by the owner within a certain time. This demand was made in the case of Diverhøj, and was not to be altered.

The excavation – or demolition – was delegated to Djurslands Museum by the State Antiquary's Archaeological Secretariat and was undertaken in the summer of 1983 (3).

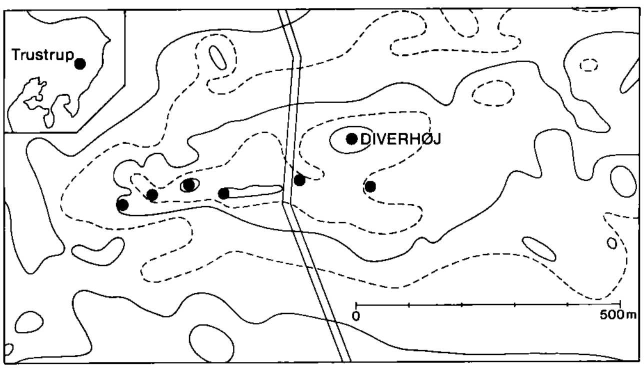

Fig. 1. Place of Diverhøj in Djursland and contour map showing the group of barrows.

It rapidly became clear that the monument was both complicated and well preserved and would require a large excavation budget. Indeed Diverhøj has been called the most expensive barrow in Denmark – but how can it be cheap to destroy a well-preserved grave mound?

There had been three main building phases (fig. 3). The latest was made up by a round-topped sod barrow. Under this lay a low disc barrow, also sod-built, containing an unusually well equipped man's grave from the Early Bronze Age. The oldest part of the monument was a partly round cairn covering the remains of a burnt structure built over a grave dating from an early part of the Late Neolithic. Under the barrow were found two distinct ard cultivation systems and three long houses with occupation layer from the Late Neolithic.

YOUNGEST PHASE

This consisted of a large dome-shaped barrow built of sloping overlapping sods (figs. 4 and 5). Its height had originally been over 3.5 m. Owing to damage at the margins of the monument it could not be decided whether it had completely encapsuled or merely surmounted the underlying disc barrow. All that can be said is that the diameter was roughly 22–26 m. Owing to the destruction of the southern part of the mound only the northern two thirds were intact, and here the maximum surviving height was 2.15 m. The disturbed southern part ended near the original centre.

The barrow is a classic example of a bronze age sod construction. The outline of the individual turves was perfectly clear in the section, which looked like a fretwork of dark humic layers separated by yellow clay. They were 10–45 cm long and 10–25 cm thick, with

Fig. 2. Diverhøj. The barrow from the south at the start of the investigation.

Fig. 3. Part of the barrow with the two sod-built phases in section and the cairn exposed from above. Seen from the south. The original centre was 4 m south of the section, where the southern baulk breaks off.

Fig. 4. Closeup picture of the section, fig. 3, dug to bottom.

large and small sods mixed together. Their dark upper sides lay downwards and the lighter root layer upwards.

The construction of this part of the barrow seems to have proceeded as domed layers of tilted turves starting in the middle of the underlying disc barrow. At the bottom was a core over ½ m thick and about 8 m in diameter of very light-coloured sods. Then followed about two courses of more humic sods. The diameter and height were gradualy increased in this way. Uppermost came a ca. ½ m thick layer of highly humic sod which had encased the entire construction. Similar caps of clay soil have been observed on other barrows, and may have been put there so that their denser root system could hold the slope together (Thorsen 1977, 94).

The differences in the humic and mineral content of the turves in different layers of the barrow suggests that they were brought from different places, and the uniformity within the individual layers suggests that these were cut from one place at a time. There was not the slightest sign of renewed vegetation growth between the layers, and it may be assumed that the barrow was built in one process without interruption.

No structural features or datable material were observed relating to this part of the barrow, but part of the head of a flat-headed fibula was found in an area disturbed by animal burrowing above the central grave of the underlying phase. It is possible that the object came from higher up, being from a grave of the final barrow phase that had been placed on the surface of or inserted into the intermediate barrow. Its central position supports such a suggestion.

The head of the pin is 1.2 cm long with flat underside and convex transversely-notched upper surface (4). The flat-headed fibula is dated to late period II of the Bronze Age (Lomborg 1969, 115), thereby giving a probable dating to the youngest barrow phase.

INTERMEDIATE PHASE

The intermediate barrow was represented by a flat sod-built disc barrow about 80 cm thick. Most of the northern part survived. It was recorded in the main N-S section for about 9 m, ending where it was cut off by the disturbance about 2 m north of the original centre (fig. 5).

The turves were rich in humus and 15–25 cm long by 10–20 cm thick, and were laid horizontally in horizontal layers with the vegetation surface downwards. Here the construction was distinct from that of the upper phase. It was difficult to distinguish the individual sods because of their uniform humic content, but in some places very thin lines of subsoil material could be seen between them.

Owing to disturbance caused by cultivation the disc barrow ended in a nearly 80 cm high almost vertical edge covered with slumped barrow fill. As the foot had not survived the diameter given as 24–26 m is only an estimate.

The uppermost of the horizontal layers of sods was sealed by a 6–15 cm thick turf line indicating the level surface of the barrow. This took the form of a dark brown strongly humic natural soil. No features were observed in the 65 m^2 surface that was exposed, apart from a small group of vertical sticks. The homogeneity of the sod structure suggests that the barrow was raised all at one time and with sod from a single locality.

Disc barrows occur occasionaly as sub-phases of larger mounds, e.g. at Krudhøj in Tyregod parish, where the disc barrow was primary (Thorsen 1977), and in a mound at Esbjerg, where two of the four building phases were composed by flat-topped barrows (Aner and Kersten 1986, cat. 4045). These were of small or intermediate size separated from the following phase by thin turf lines (5).

Disc barrows are also known without later additions. These are barrows of large diameter such as Bredhøj in Ringkøbing county, with a diameter of 49 m and a height of 2.5 m (Boye 1896, 24ff), and Fladhøj in Ribe county, with a diameter of 67 m and a height of 2 m (Brøndsted 1966, 34).

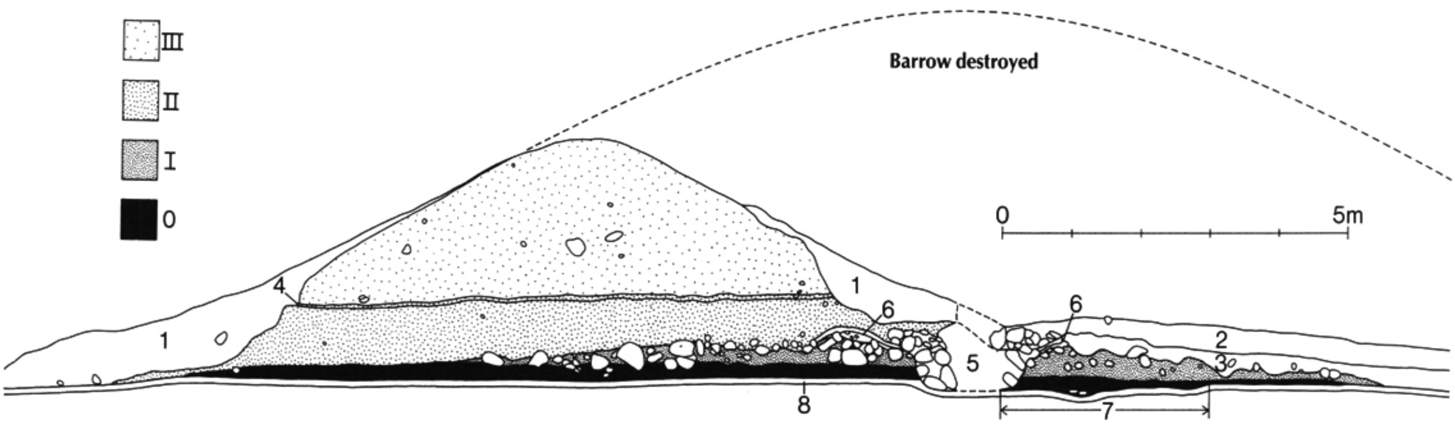

Fig. 5. The main N-S section from the west. 0–occupation layer; I – earliest phase of barrow; II – intermediate phase; III – youngest phase. 1 – slumped fill; 2 – plough layer; 3 – slumped barrow fill mixed with upper part of earliest barrow phase and somewhat disturbed by cultivation. 4 – turf line; 5 – Bronze Age grave of intermediate barrow phase; 6 – upcast from digging of Bronze Age grave; 7 – indicates the sunken part of the floor in house I; 8 – natural subsoil. Drawn by Orla Svendsen.

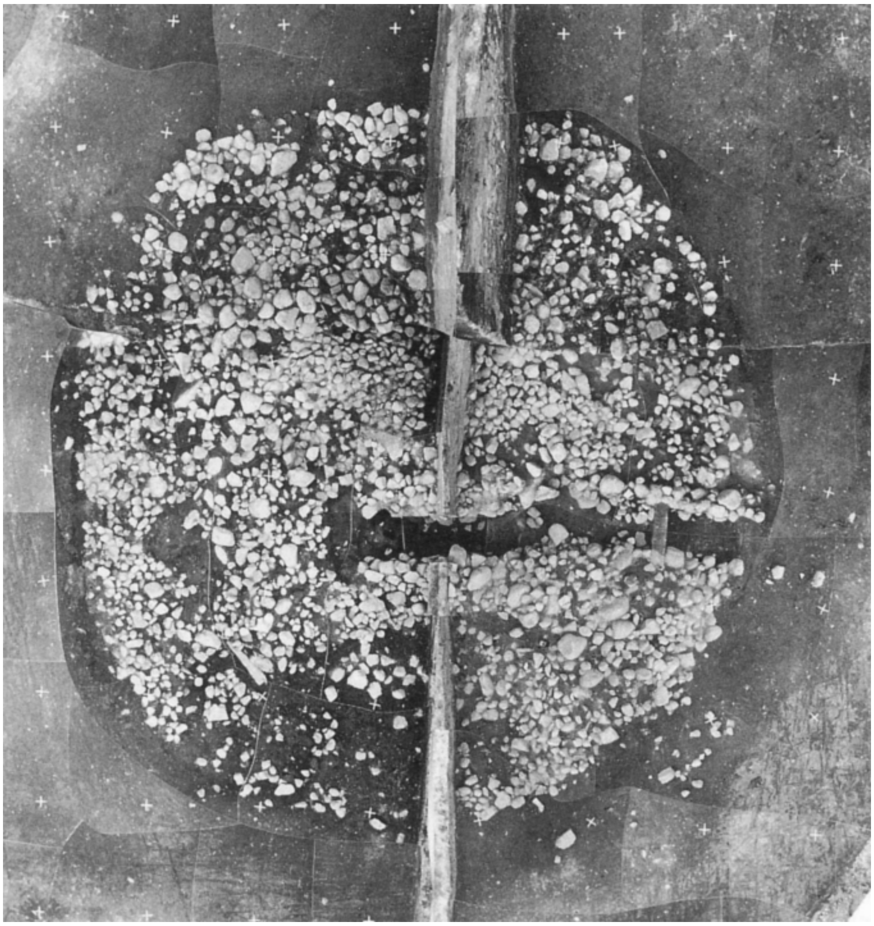

Fig. 6. General view of the cairn of the first phase and the Bronze Age grave. The Distance between the white crosses is 2 m. Vertical photo-mosaic by Erik Johansen and Jan Slot Carlsen. Photographic mounting by Søren Harboe Andersen.

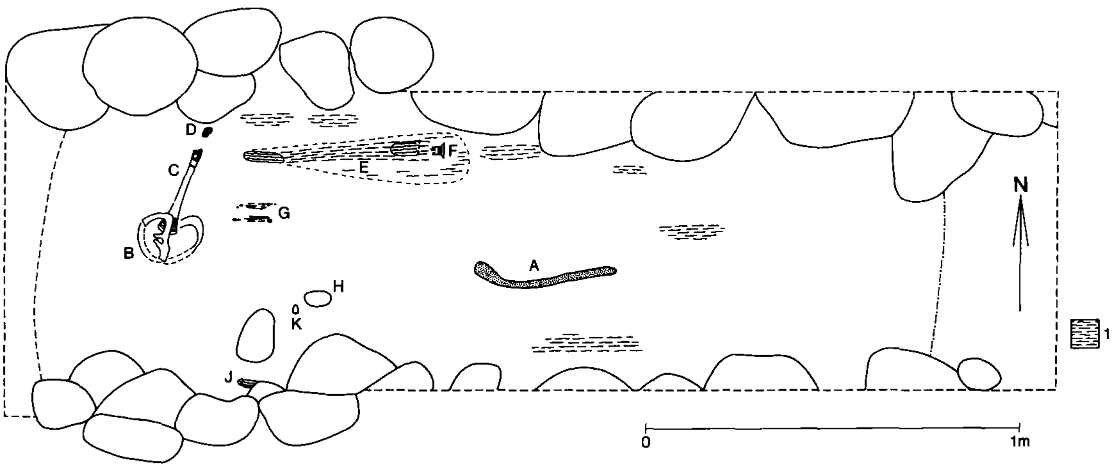

Fig. 7. The Bronze Age grave. 1 – traces of the coffin; A – traces of bone; B – remains of bark box; C – flanged axe; D – fragment of muff; E – traces of handle with pieces of bronze wire; F – ferrule; G – fibulae; H – iron pyrites; J – strike-a-light; K – indeterminate bronze fragment. Drawn by Orla Svendsen.

Sophus Müller described a disc barrow as "a normal round barrow, but without upper part, as the normal sloping sides terminate at a certain height in a horizontal plane". He interpreted them as uncompleted round barrows, pointing out that they covered a large area and would therefore require much work to finish (Müller 1914, 196f.).

With a diameter of 24–26 m the disc barrow in Diverhøj was large. The thick turf line covering it shows that unlike Krudhøj and the Esbjerg barrow it stood open as a disc barrow for a substantial time. The round barrow was constructed much later and cannot be regarded as its completion. The small or medium disc barrows separated from later phases at most by thin turf lines could perhaps be regarded as unfinished round barrows, but monuments with a diameter of from 25 right up to 65 m in diameter can only be finished monuments. They may have served some other purpose than round barrows. The name "Dansehøj" inspired Johannes Brøndsted to interpret disc barrows as places for ceremonies connected with burial cult (Brøndsted 1966, 34).

This barrow had been raised over an inhumation grave inserted into the underlying cairn (fig. 6). This grave appeared as a 3.4 × 2.8 m heap of stones orientated E-W and situated 0.8 m south of the centre of the cairn. Though originally at the centre of the disc barrow, when excavated it lay near the middle of the southern side of the surviving mound, where it was partly disturbed by cultivation.

The up to 50 cm thick covering layer of hand-to-head sized stones rose 10–25 cm above the surface of the cairn. Upcast fill from the digging of the grave lay directly on the cairn. A cupmark had been hewn into one of the uppermost stones, and there were 12 cup-marks in a stone in the surface of the cairn 3.5 m NE of the grave (fig. 14).

The burial itself was indicated under the covering layer by two regular parallel stone settings about 3 m long, with the loam filled space for the coffin between. The settings were laid in 2–3 courses of head-sized and slightly larger stones and enclosed the sides of the original coffin. The west end was probably destroyed during recent disturbance. The grave pit measured 3.30 × 1.75 m and was 0.6 m deep, with sloping sides except in the east, where it descended in two stages with a 30–40 cm wide ledge between.

The coffin had measured 2.70 × 0.65 m, but was only preserved in the approximately 8 cm thick basal find-bearing layer, where its outline was indicated by slight remains with the structure of wood (fig. 7).

The decayed bottom of the coffin, which survived in some places in the form of a cohesive sticky layer, was slightly concave, being about 5 cm lower along the middle than the edges. The underlying slabs on which the coffin had rested were similarly concave, so this was presumably a log coffin burial. In the interior space there were scattered crumbs of charcoal, perhaps indicative that the coffin had been superficially charred prior to burial.

All that remained of the corpse was a nearly 40 cm long decayed part of probably the right femur. Where the skull should according to the femur have been, i.e. at the west end of the coffin, was a milky white fungal vestige about 18 cm in diameter and 5 cm thick. This was found to contain highly decomposed remains of a bark box (6). Though no tooth enamel or other traces of the skull were found, the head of the deceased lay in all probability close to this box. In the Egtved coffin there was a bark box close beside the head of the corpse (Thomsen 1921, 183). The same could have been the case here, or the box, whose position in the coffin was approximately axial, could have stood at the neck. North of it, on the left side of the corpse, lay a flanged axe with spiral decoration. The last 6 cm of the blade lay under the fungus. Along the left side of the deceased's trunk and parallel with the north side of the coffin lay the almost completely decomposed remains of its shaft, which ended with a bronze ferrule, in the socket of which the end of the shaft was still preserved. The first 15 cm of the shaft had been destroyed by animal burrows. It ended with a more than 90° bend into which the butt of the axe had been wedged. Pieces of the shaft could still be seen on the butt, around which sat a fragment of the corrugated bronze muff that had secured it. Other fragments of the muff lay near by, and a piece 5 cm N of the butt still had wood in it. Three pieces of thin bronze wire lay across the axe shaft 5 cm from the ferrule.

Eight cm NE of the bark box two fibulae lay parallel to one another 3 cm apart. Judging from their position they had lain on the chest of the deceased and may have secured his clothing. Both were in a poor state of preservation. 35 cm SE of the bark box lay a lump of iron pyrites, and a further 30 cm to the SW a blade strike-a-light. The latter may have been moved by the agency of

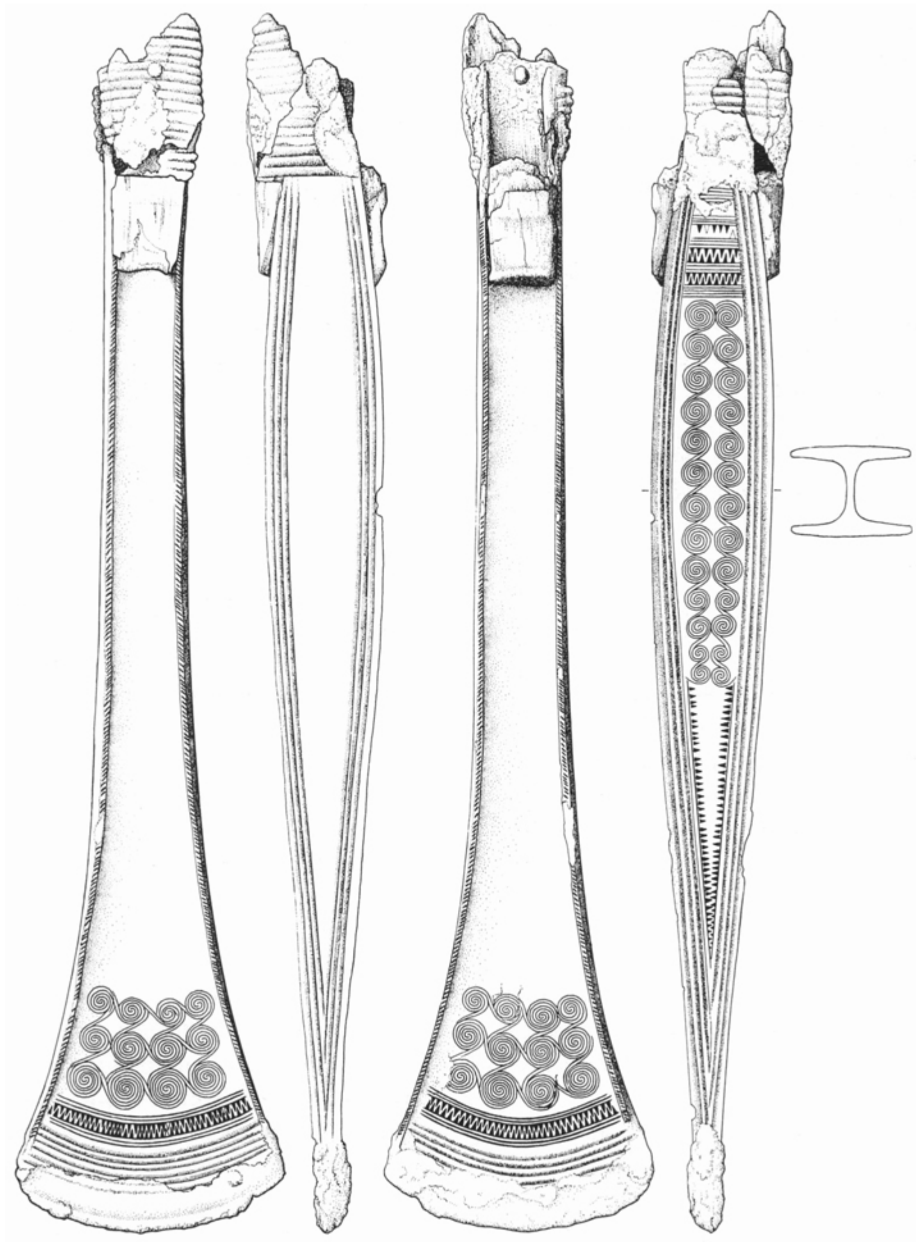

Fig. 8. Flanged axe. Drawn by Elsebeth Morville. 2:3.

animals in the grave from an original placing near the belt near the pyrites. Close to the pyrites was a small fragment of bronze.

Because of its condition most of the grave goods was taken up as blocks (7). At the laboratory two bits of textile were found on the axe (8). At the base of the find-bearing layer in the western half of the coffin were observed patches of a sticky red-brown fibrous material that may be the remains of clothing or of a cowhide the deceased had been laid to rest on (Thomsen 1921, 176; Brøndsted 1966, 46).

In the eastern part of the cairn was a 0.40 m deep sod-filled hollow measuring 2.40 × 0.55 m. It lay in approximate continuation of the grave with a southwards deflexion of 10°, and extended to the eastern edge of the cairn (fig. 6). Its sides were lined with the stones taken up when it was dug, and above a basal layer of water-lain sand it was filled with turves like those of the disc barrow. There were no further finds or structural information concerning this feature, but a connection with the grave is clear. Both were inserted into the cairn prior to the construction of the disc barrow, and the hollow must have been filled with sods at the same time as the barrow was erected over the grave.

There are several possible interpretations – a cenotaph, a burial without coffin or grave goods, preparation for a burial that was never carried out. Yet another possibility is that it was a practical feature, a "passage" for bearing the coffin to the grave. Here perhaps is also the explanation of the two "steps" at the east end of the grave.

The finds

Flanged axe, fig. 8. A narrow axe with high flanges, slightly splayed edge, surviving length 26 cm. Where the flanges end at the butt there is a break, showing that the axe was originally longer. The axe narrows from the 4.5 cm wide cutting edge, 10.5 cm from which it is 1.4 cm wide and parallel-sided. The flanges start at the corners of the blade and reach their maximum height ⅔ of the way towards the butt, where the implement is 2.4 cm thick from flange to flange. Two mm below the broken butt there is a hole 0.1 cm in diameter. The axe was originally wedged 4–5 cm into a shaft, parts of which still survived as two 2.3 cm long fragments of wood between the flanges. The butt was encircled by the remains of a tubular muff of ribbed bronze about 2 cm in diameter. It survived about ¾ of the way around the butt and had a maximum width of 3.3 cm. The loose fragments of it lying near by could not be joined together. The fragment lying 5 cm N of the axehead seems to have had a larger diameter, and the wood grain in it bent slightly (fig. 9). It probably came from near the bend of the shaft; it had been held in place by a bronze rivet. Inside the muff and the wood surviving in it remained parts of the bronze pin that secured axe and shaft more firmly together through the hole in the butt.

The blade is decorated with curved grooves running parallel with the cutting edge. Their outermost 4.5 cm is virtually obliterated by corrosion. Further up come 6 grooves followed by a zig-zag band bordered on each side by 3 lines. Then follow three rows of four running spirals joined by paired lines. The ornament is identical on both faces. On the narrow wides of the axes three marginal furrows follow the edge of each flange. One side has two zig-zag bands followed by two rows of 13 running spirals. The size of the spirals increases and decreases with the width of the space to be filled. Above follows a 2.5 cm wide field consisting of transverse zig-zags separated by groups of three transverse lines. The tops of all four flanges were decorated with closely-spaced oblique notches.

The cylindrical ferrule was 1.5 cm long with a flat annular collar (fig. 10). The collar is 4 cm in diameter and ⅓ of its edge is broken away. The central hole is 1.6 cm in diameter, and from it extends a 1.1 cm high tubular flange. The collar is decorated above with 2 concentric grooves along the margin and 2 around the central hole; along these grooves sit little triangles facing the reserved central zone. A furrow runs around the outside of the collar, and the socket is ribbed with 5 circumferential furrows.

In the socket remains a 2.2 cm long piece of the end of the wooden shaft, in which there are two crossing wooden wedges 0.1 cm wide and 0.7 cm long corresponding to the socket's diameter.

The axe may be dated to late period I, the Valsømagle horizon, of which it is a leading type (Lomborg 1969, 101). The position of the hole only 2 mm from the break shows that the butt was originally longer, and as the flanges end at the break, the butt must have ended in an extension without flanges, which is one of the characteristic traits of the Valsømagle type, as is also the only moderate splay of the cutting edge, and in a number of cases the groove ornament of the blade (9). Running

Fig. 9. Fragment of the bronze muff containing remains of the shaft. Drawn by Elsebeth Morville. 3:4.

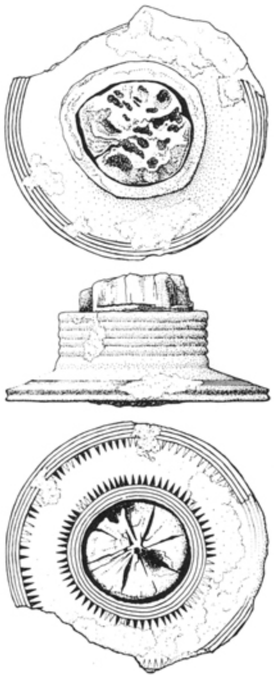

Fig. 10. Ferrule from the axe. a – from above: b – from side; c – from below. Drawn by Elsebeth Morville. 3:4.

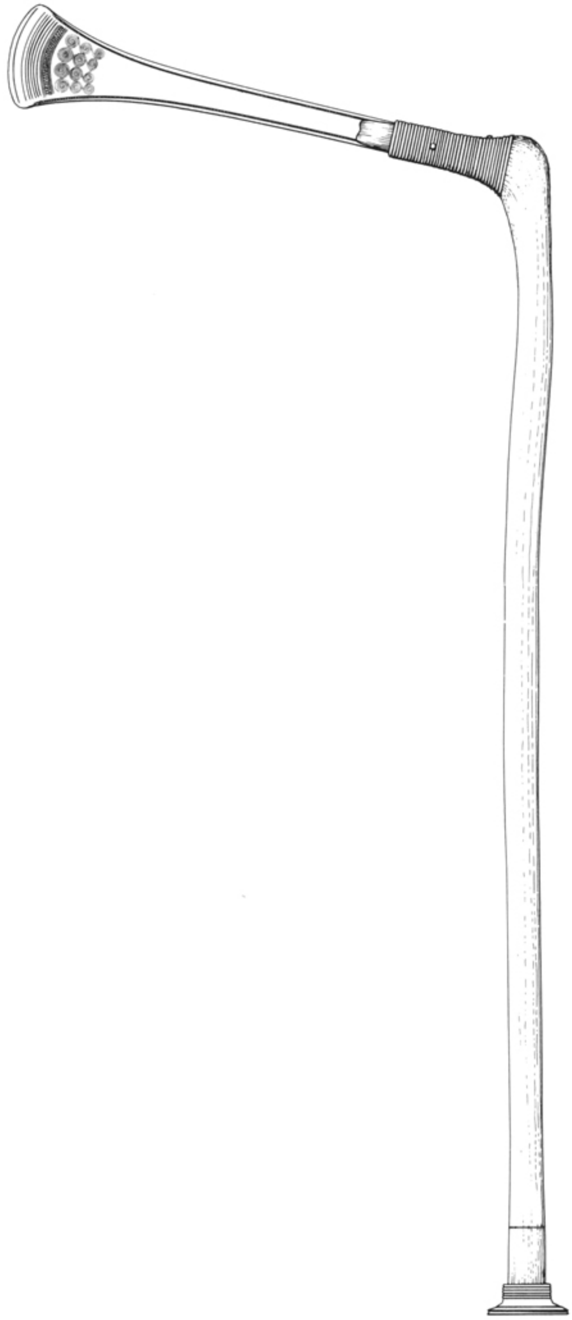

Fig. 11. Reconstruction of the hafted flanged axe, based on the position of the objects in the grave. Drawn by Elsebeth Morville. 1:4.

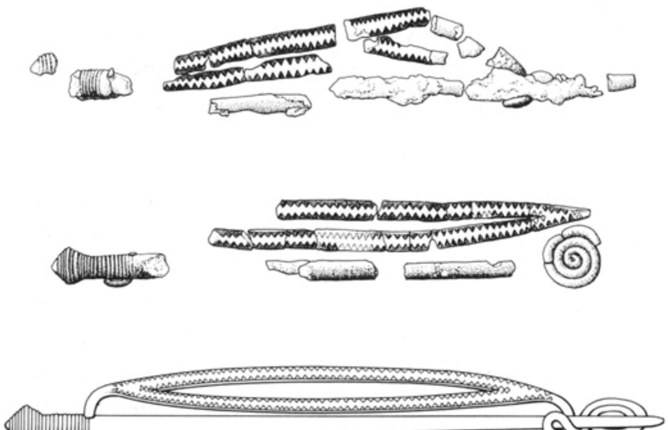

Fig. 12. The two fibulae (a-b) and a reconstruction of their original appearance (c). Drawn by Elsebeth Morville. 3:4.

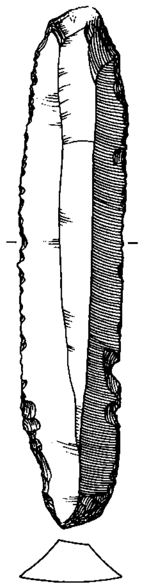

Fig. 13. Strike-a-light from the Bronze Age grave. Drawn by Orla Svendsen. 3:4.

spirals are a further typical element in the decoration of this phase. Ferrules with round terminal plate are especially connected with the flanged axes and do not follow the typology of the contemporary sword pommels (10).

A few examples of flanged axes with ferrule are known in finds from late period I and early period II (11). None of the others is properly excavated, and only one was found *in situ*, and even in this case the circumstances are unsure (Broholm 1943, vol. II, 46). It is an axe from Gislum herred, Ålborg county, where according to the finder the shaft continued in the same direction of the axehead (ibid. 33, grave 82). This led to the interpretation that these axes were hafted as thrusting weapons (12). Diverhøj shows that flanged axes were hafted as striking weapons (fig. 11). Hafting is by wedging into a knee-shaft and the mounting angle comes from a bend in the haft close to the head. This way of hafting resembles that of palstaves in period II (Broholm 1943, vol. II, 102 ff; Broholm 1966, vol. II, 51). There is however the important difference that the palstaves seem to have been hafted at an angle of less than 90°, which underlines their practical purpose compared with the Diverhøj axe, which seems to have been hafted at an angle of over 90°.

The bronze muff which secured the shaft is known both from flanged axes and from palstaves (13). The shaft itself could not be preserved. The three pieces of bronze wire which lay across the handle end must have been inlaid, probably as a small part of the decoration.

Only a few of these flanged axes are ornamented. That the axe from Diverhøj is decorated on the outside of the flanges on one side only is hardly accidental. When hafted only the two faces and one of the sides would have been seen directly. The axe from Hune is similarly decorated, while the "thrusting axe" from Gislum herred was decorated with spirals on all four sides (Broholm 1943, vol. I, 33, grave 82).

It is most unlikely that the Diverhøj axe was used as a working axe. There seems to be general agreement that so impressive a piece of workmanship had its function in the process of demonstrating power and status (Kristiansen 1983; Randsborg 1975). The angle of hafting by itself seems to preclude that the axe had practical uses; nor would it have been suitable as a weapon as supposed of Bronze Age swords and many of the axes, as indicated by the traditional expression "weapon axes".

Fibulae, fig. 12. The two fibulae of identical form were badly broken, but to judge from the lie of the fragments they had been 12 cm long. On the more complete of them 1.9 cm of the head was preserved. There was a perforation 1.4 cm from its end, in which there still remained part of the pin. The head was 0.4 cm in diameter and closely ribbed; at the end it widened to a carination and then came to a point. The bow was preserved for 6.6 cm, but its original length had been 7.5 cm. It was pointed oval and about 1 cm wide, with an open slit down the middle. The two strips into which the bow is divided were ornamented with a reserved zig-zags band. By the end of the bow, where the pin had originally come to a point, lay a coil of bronze wire 1 cm in diameter with four revolutions.

The remains of the other fibula include the end of the bow nearest the point of the pin. The damaged coil with only two revolutions lay broken off near by.

These fibulae are of the round-headed type representing the earliest Bronze Age pins (Broholm 1943, vol. 2, 124; Lomborg 1969, 115). The type is dated to period II and is present in its initial phase, the Løve horizon. The construction of the bow as two strips with slit between has to my knowledge no parallels in South Scandinavia (15). Pointed oval bows, however, occur regularly in period II, as does zig-zag ornament (Broholm, op.cit. 124). What is more unusual, however, on round-headed fibulae is the spiral coil, which at Diver-

Fig. 14. Stone with 12 cup-marks. From the north side of the cairn.

høj lay at the end of the bow nearest the point of the pin. Normally the pin of the round-headed fibula is held in a hook and only the later broad-headed type, dating to late period II, has terminal spirals to support the pin. Under the flat head is a second coil which works as a spring (ibid., 124ff.; Lomborg 1969, 115f.). The Diverhøj fibulae may perhaps be seen as a transitional form with only one coil. Only after the development of the flat head of the pin was there any purpose in placing a coil there.

Bronze fragment measuring 1.0 × 0.8 cm and 0.05 cm thick, possibly from a knife or razor.

Lump of iron pyrites with a dry weight of 72 g. The surface is yellow ochre in colour and uneven.

Strike-a-light, fig. 13, 9.3 cm long and 1.6 cm wide. Both ends are strongly worn.

Cup-marked stones. There were two of these. One had 12 cupmarks and measured 30 × 40 × 34 cm (fig. 14). The decorated side is sub-triangular, and near its top there are two nearly parallel rows with four and five cupmarks respectively. Over the fifth in the lower row is an extra one. These cupmarks are 2–3 cm in diameter and 3–4 cm deep. 12–24 cm below these come two slightly larger and less regular cupmarks 15 cm apart. The other smaller stone had a single 5 cm deep cupmark with a diameter of 3 cm. Its placing in the stone packing over the grave makes it reasonably sure that it was contemporary with the latter. There is less evidence in the case of the stone with 12 cupmarks, which had lain on the surface of the underlying cairn without being covered by the Bronze Age packing. As cup marks are also known from the Late Neolithic, these could theoretically have been made anywhere from Late Neolithic A (when the cairn was built) to period II of the Bronze Age (Glob 1969, 125; Thorsen 1977, 104; Rostholm 1972, 36).

Dating

It may be concluded that the disc barrow with its grave and adjacent cenotaph or passageway, together with one or perhaps both cup-marked stones, together date from period II of the Bronze Age. This dating is indicated by the fibulae from the grave, but the flanged axe points to an early part of the period. The few available Valsømagle and Løve flanged axes differ considerably in splay of the blade, and the butts also differ. Though our axe agrees best with the definition of the Valsømagle type, it should give no surprise that it occurs in a reliable period II context.

The decoration of the axe, the ferrule, and the fibulae have the same elements, for instance lines and triangle/zig-zag bands in very uniform execution. It is well known that bronzes from a single deposit often occur as sets (Asingh and Rasmussen 1987).

EARLIEST PHASE

The cairn, into which the Bronze Age grave had been inserted, comprised the earliest building phase of the monument. The cairn was slightly convex, and rounded-quadratic in plan with a diameter of 12.5 m and a maximum depth of 0.5 m. It consisted of 2–4 layers of stones varying from the size of a fist up to 75 cm (fig. 6), with very little earth between them. Many of the stones had been cloven, and many were missing after many years of cultivation of the area originally covered by the southern part of the monument.

Flat-flaked flint was found in the cairn, which strongly recalled the Late Neolithic barrow cairns, so its surface was thoroughly examined for possible features. In the central part were found parts of a stone setting of rounded quadratic shape measuring a little over 7 × 7 m. It was built of larger stones and rose 10 cm above the cairn surface. To the south the stones had been removed during cultivation but a curved nearly stone-free zone could be observed. The setting had two

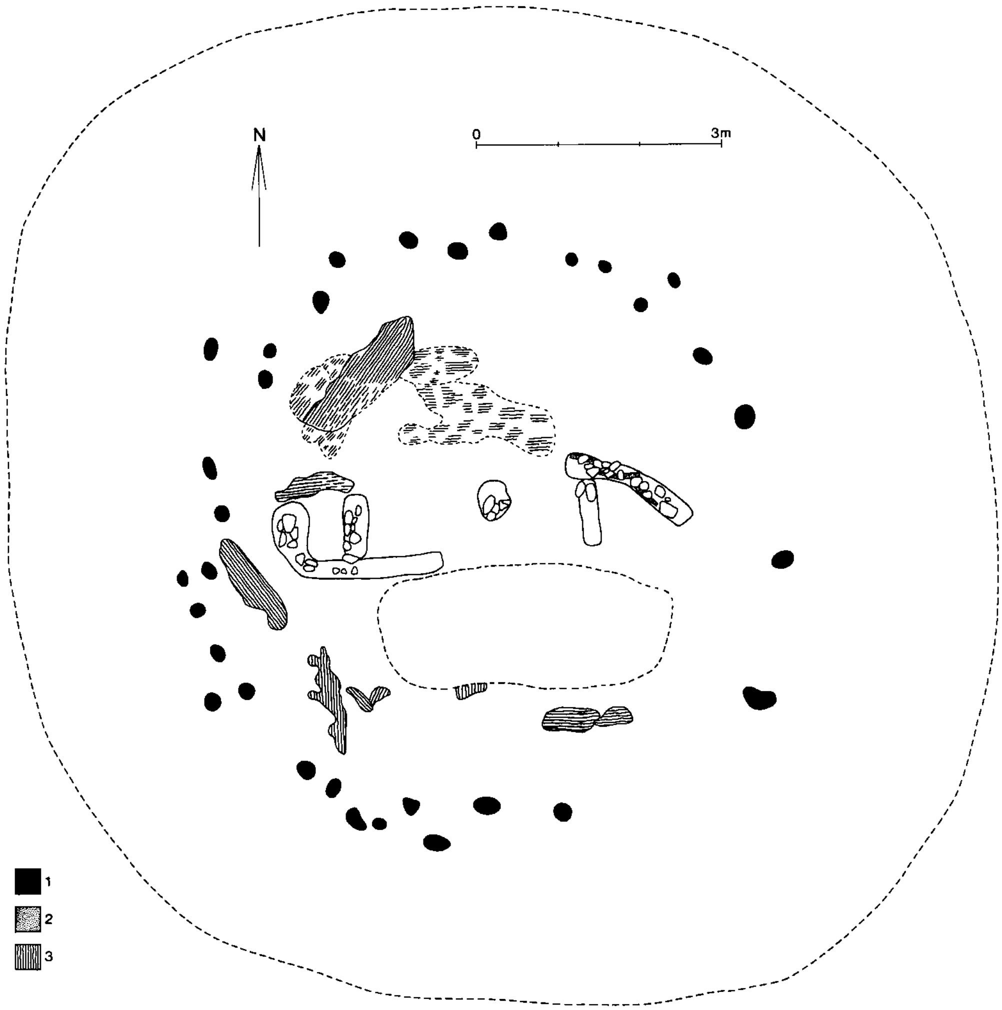

Fig. 15. Plan of the remains of the burnt wooden structure. 1 – posthole; 2 – marks of burnt wooden planks; 3 – carbonized plank. Drawn by Orla Svendsen.

to three courses of large stones, packed in some places with smaller ones, and could be followed through the cairn. Its lowest stones sank ca. 10 cm into an occupation layer, upon which the cairn rested.

Among and below the stones of the cairn was a strongly carbonaceous deposit, which turned out to be the remains of a burnt wooden structure. The layer was 5–15 cm thick and concentrated mainly inside the quadratic setting. Near the centre of the cairn was an area with loose humic material containing charcoal in smaller quantity. This 10 cm thick deposit was cut by the Bronze Age grave. Under the cairn it separated into four roughly rectangular slot-like features joined in pairs 2.6 m apart with a posthole midway between them at the centre of the cairn (fig. 15).

These features were 0.8 to 2.1 m long, 20–30 cm wide, and about 25 cm deep, and were joined in pairs as two U-shaped figures facing in opposite directions. They were all lined with stones, and in one of them there were marks of four vertical carbonised planks. At the base of the carbonaceous layer lay seven up to 0.8 m wide and 2–5 cm thick burnt oaken planks, of which the longest was 2 m. Partly overlying the planks was a 5 cm thick humic red-flecked layer with some subsoil in it.

Most of the way around under the stone setting were postholes (fig. 15). They were about 20 cm in diameter, and several were roughly oval and 5–10 cm deep with a little charcoal in them.

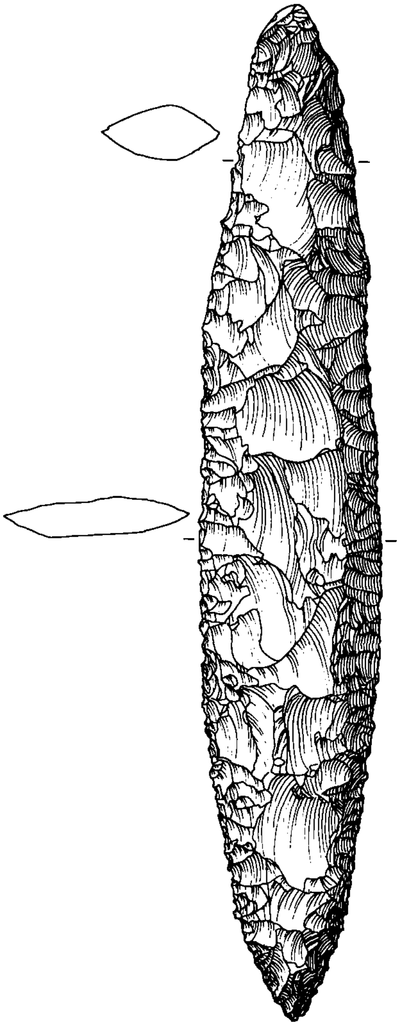

Fig. 16. Dagger from supposed grave accompanying the burnt wooden structure. Drawn by Orla Svendsen. 3:4.

Interpretation and dating

The relationship between the cairn and the cabonaceous deposit indicates that the cairn was erected in connection with a conflagration. The carbonised planks, the stone-lined slots with traces of vertical planks, and the postholes under the stone setting all indicate a wooden structure that had been destroyed by fire. The slots probably held planks which were a roof-bearing element to which the carbonised planks also belonged. The subquadratic stone setting, which antedated the cairn, no doubt supported the foot of smaller posts or rafters whose other end could have rested on a ridge-beam held up by the vertical planks and perhaps also by the central post. Thus the whole structure would have amounted to a tent-shaped sub-quadratic building. During the fire the structure collapsed. The lenses of subsoil clay and the humic material could be remains of wall or roof material that smothered the burning planks, whereas the rafters burned away.

The burnt remains covered by the cairn were probably erected in connection with a burial. About 2 m from the centre of the cairn were found a lanceolate flint dagger and fragments of amber beads (fig. 16) in fill thrown out when the Bronze Age grave was dug. The dagger (fig. 16) and fragments of amber beads in fill cm long. It derives in all probability from a Late Neolithic burial destroyed when the Bronze Age grave was dug.

The finds from the carbonaceous deposit included pottery, dagger and arrowhead roughouts, and broken type I daggers similar to material from the Late Neolithic A occupation layer below the cairn. As half the finds lay in the carbonaceous deposit it is possible that some of the flint-working took place after the end of the settlement and in connection with the fired structure. In all events no great time elapsed between the abandonment of the settlement and the construction of the cairn. The archaeological date of the cairn is Late Neolithic A. The radiometric dating of one of the carbonised planks to 1920 bc agrees with this, but the uncertainty is increased by the fact that the sample came from a large plank (16).

Several Late Neolithic burial cairns are known from Djursland (Boas 1986, 318ff; Madsen 1975), and similar discoveries from other area shows that they were a common form (Andersen and Kjærum 1968, 37ff; Aner and Kersten 1978, cat. 2294; Vorting 1977, 109ff.) There is often no indication of the grave itself in the cairn, and a stone perimeter would be hard to distinguish among the many stones. The graves are therefore often only noted when the grave goods appear (Andersen and Kjærum 1968, 44; Madsen 1975). Several of the cairns were the primary structures in Bronze Age barrows, while others were never covered over.

A cairn was the first stage of a Bronze Age barrow in Serridslev parish in Vendsyssel (Vorting 1977, 109ff.). It had been erected over a grave from Late Neolithic A containing two lanceolate flint daggers. The grave was inserted into the natural ground under the centre of the cairn. In Bronze Age II this was covered by a barrow, whose central grave lay on the cairn surface straight above the Neolithic grave. This provides a striking analogy to Diverhøj, where however the Bronze Age grave was inserted into the cairn, thereby probably destroying the Late Neolithic grave.

A cairn under the barrow, Marshøj, in northern Djursland contained an early Late Neolithic central grave and also two Late Neolithic flint axe hoards laid in its outer part (Madsen 1975). The central grave of the following phase from Bronze Age II was placed acentrally on top of the cairn.

Recently Late Neolithic wooden mortuary houses have begun turning up. At Løsning near Vejle the remains of a tent-shaped wooden structure were found over a grave with i.a. a lanceolate dagger (Ethelberg 1982, 10). The structure was rather different from the one at Diverhøj, and had not been burned down. In Ulkebøl parish, Haderslev county, were found remains of an apparently rather complicated wooden structure. A rectangular outline measuring ca. 3.5 × 2.0 m of steeply sloping posts and planks around a fill change with possible coffin traces was interpreted as the remains of a burnt tent-shaped structure over a Late Neolithic or Early Bronze Age grave (17).

These mortuary houses have an interesting resemblance to the tent-shaped mortuary houses of the Aunjetitz culture, but so far the latter are only known from a period corresponding to south Scandinavian Late Neolithic C (Piggott 1965, 127ff.; Harrison 1980, 40; Lomborg 1977, 35).

ARD MARKS

A pre-mound occupation layer covered the whole of the area excavated. Where not covered by the cairn it was cut by a system of ard furrows, and when the layer was excavated another set made its appearance (fig. 17).

The marks appeared first when the area around the cairn was being cleaned. Closer than 1.5 m from the cairn they mostly took the form of narrowly spaced lines, roughly parallel and 2–3 cm wide, following the edges of the cairn. The closer to the cairn the closer the lines, and right in at its foot they sometimes ran together as a belt. In several places it could be seen that the plough had "slipped" and struck a stone in the cairn, breaking off the furrow. At the corners only the innermost furrows followed the cairn, the outer ones crossing each other in different directions. At 1.5 m from the cairn the marks formed a criss-cross pattern. The furrows went down about 5 cm below the bottom of the occupation layer and were U-shaped in section (fig. 18).

As a whole it could be seen that the furrows resulted from ploughing a larger area. Cultivation was normally two-directional, but near the foot of the cairn furrows were deflected along its side before turning out again, and sometimes even continued around a bend. Cultivation may indeed have contributed to the somewhat rectangular surviving shape of the cairn. The many N-S and E-W furrows show, however, that the ard was not always brought in close to the cairn at all, whereby a rectangle was left with the cairn in the middle.

An earlier system covered the whole excavation with furrows in various directions. Outside the cairn these survived only as short lines clearly cut by the younger furrows, but under it they became increasingly clear as the excavation progressed, and in the end they showed up against the subsoil surface as 2–3 cm wide furrows a good 5 cm deep. The distance between parallel furrows varied from 5 to 15 cm, and at least 4 different ploughing directions could be distinguished. A few curved to avoid the stone setting of the funerary house, and may have been made immediately prior to the construction of the cairn.

Ard marks from the Stone and Bronze Ages have been found virtually only under barrows, etc., and their purpose has often been set in connection with these. The question is whether the ploughing systems were of ritual character (Pätzold 1960) or in some other way connected with the construction of the barrow (Wiell 1976), or whether they are preserved as a resulting of having been accidentally covered by these structures (Nielsen 1971; Thrane 1984).

With the older system under Diverhøj there are clearly several ploughings that cannot be separated stratigraphically. Therefore it is not possible to determine whether the last ploughing occurred when the cairn was constructed or not (Thrane 1984, 114), but as furrows are by no means confined to the area covered by the cairn, they must indicate normal agriculture. Admittedly there was no trace of a field boundary, but continuous ard traces over areas as large as 250 m^2 are not unusual (Thrane 1984, 116). As no renewed turf growth was observed below the cairn, this was probably erected soon after cultivation was brought to an end.

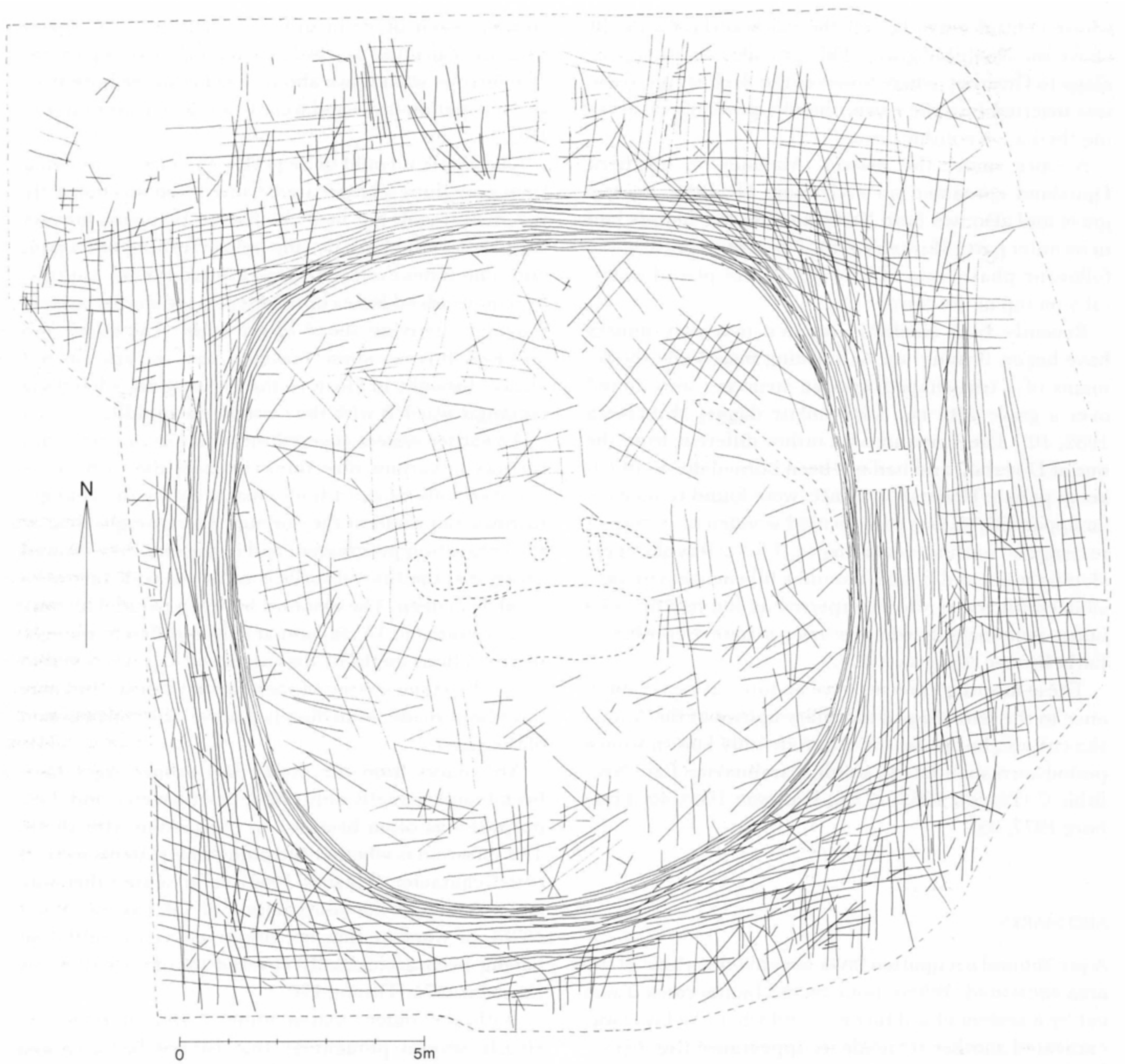

Fig. 17. Ard marks on subsoil surface under the occupation layer. Drawn from vertical photo-mosaic by Pauline Asingh.

Probably also the later system with cultivation around the cairn covered a considerable area, and though it cannot actually be shown to have extended outside the disc barrow, everything favours its being the result of ordinary cultivation.

Three barrows in German Schleswig show partial circular ploughing around the outside of a primary barrow (18). At all three sites earlier settlements had been ploughed over. At Süderschmedeby the primary structure was a cairn with a Late Neolithic grave. Just as at Diverhøj, there could outside the cairn seen parallel furrows, which belonged to a continuous criss-cross

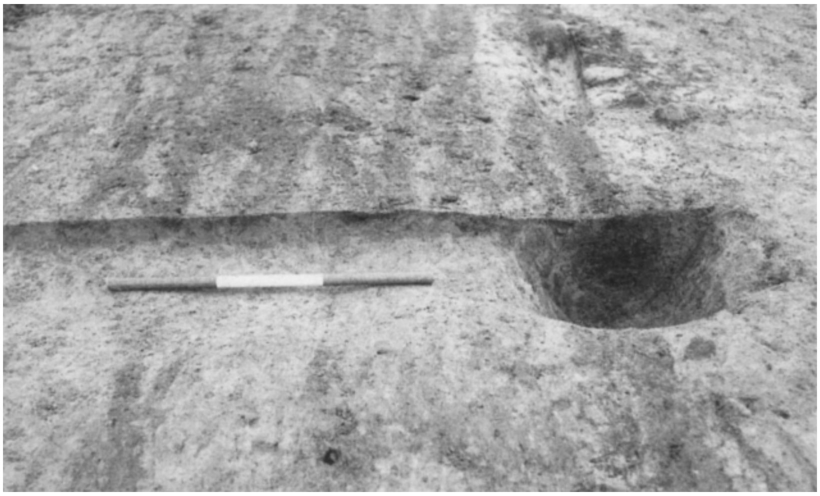

Fig. 18. Section through ard marks outside the cairn, seen from the south. On right section through posthole of a wall post in house I.

system in the surrounding area (Aner and Kersten 1978, cat. 2294).

In a cultivation system under Vesterlundshøj barrow near Give there were furrows going around a heap of field stones (Thrane 1968, 26).

In none of these cases is there any suggestion that the curved furrows had anything to do with the construction of the monument.

The situation is different in the case of complete circular ploughings. Here ploughing was carried out in a circle only, without covering a larger area. This kind of ploughing occurs always under the foot or kerb of a barrow, often directly under the ring of kerbstones (19), and is therefore interpreted as a practical device for marking out the circle on which a mound or stone ring was to be erected (Wiell 1976, 94f).

THE PRE-MOUND SETTLEMENT

Settlement layer

Under the cairn was found a homogenous, light grey-brown occupation layer up to 15 cm thick, containing scattered charcoal, much worked flint, and pottery (fig. 20–22). In a cleaned plane surface it looked homogeneous, and all that could be seen apart from features belonging to the earliest barrow were ard marks and indications of two vague rectangular depressions containing beating stones, etc. These became clearer as excavation progressed.

The layer was dug in squares with trowels and sometimes shovels, and most of the finds were planned in.

The houses

After excavation of two cultivation systems and an occupation layer we thought Diverhøj had been dug all the way to the bottom. But after removel of 5 cm of natural clay with ard marks about 50 postholes and pits appeared, and were found to belong to three longhouses with partly sunken floors (fig. 19). These were uniform in construction, parallel, and oriented E-W. The roof-bearing element was a row of large posts standing 3.5 to 4 m apart along the central line of each building. Along the course of the walls, which appeared to be straight, smaller posts had been set at intervals of 1–2 m. Rectangular soil changes indicated limited sunken parts of the floors. No house is known to be fully excavated, and no entrances were found.

House I. The southern house was recorded for a length of 18 m and was 6 m wide. its orientation was approximately ENE-WSW. The holes for five roof-bearing posts were recorded along the central axis. The closer spacing of the two western ones may indicate the end of the building. A tree pit had destroyed one of the eastern postholes. Parallel with the roof-bearing posts and 3 m from them came slighter and more closely spaced wall posts in straight lines. The traces of the northern wall had been partly disturbed by the burnt structure of the first barrow phase. About 8 m of the southern wall line remained. The eastern posts had lain outside the area protected by the cairn and were no doubt ploughed out already in prehistoric times.

A ca. 4 × 6 m roughly rectangular feature made its appearance at the top of the occupation layer, and is recorded in the main N-S section. In the north it was truncated by the Bronze Age grave (fig. 5). Ten cm below the top of the occupation layer it separated into five irregular pits about 20 cm deep. This feature lay axially between the rows of postholes in house I, and is interpreted as a sunken part of the floor. Further west, between two roof posts, was found a roughly oval patch of burnt natural clay measuring ca. 1.5 × 1 m. It was probably the bottom of a fireplace.

The hollow contained much settlement material, including the almost complete side of a decorated Bell Beaker (fig. 21). Some postholes contained waste flint and pottery.

House II. The middle house lay about 1 m north of house I, deviating from E-W by 10° in the direction of NE-SW. It was recorded over a length of 13.5 m and was 5 m wide. Five holes from roof-bearing posts lay in a line down the middle. The two eastern ones were less large than the others and stood only 1.5 m apart. The lines of wall posts ran parallel with the roof posts, and the 10 m long southern row continued eastwards into what may be a rounded house end. The postholes in the northern wall lay at irregular intervals, and a number had probably been ploughed out in the course of prehistoric cultivation around the cairn. A floor depression measuring 3 × 4 m could be seen as soon as the top of the occupation layer was reached. I was axially placed and 15 cm deep with an irregular bottom. Both this hollow and the postholes contained pottery and flint.

House III. Only the southwestern 13.5 m of the northern house was investigated. It lay 1 m north of house II with an approximately E-W orientation. There was a 10 m long line of posts belonging to the south wall. Of the two roof-bearing posts one lay 1 m south of its expected position. It is not known whether the row continued westwards or whether the eccentric post marked the end of the house. If the eastern roof-bearing post stood in the central line, the house was originally 6 m wide. The rest of the building lay outside the barrow, where modern ploughing furrows were visible in the subsoil. There were a few flint implements, and some flint waste and pottery in the postholes.

At various places there were shallow pits, which probably had some connection with the settlement.

All in all the features were not very distinct in a clean surface. Their fill was grey-brown, slightly humic, and contained a certain amount of charcoal and burnt granite.

The roof-bearing postholes were 30–50 cm in diameter and on the average 25 cm deep. The wall posts were about 25 cm in diameter and 10–25 cm deep. Remains of the posts themselves were not observed.

Considering the size and construction of the buildings, it may seem surprising that the postholes were so shallow, but apparently this was sufficient in the stiff clay. Several postholes were stone lined. Prehistoric cultivation has certainly caused some injury.

As will be shown below, the whole settlement can be dated to Late Neolithic A, and there is no difference in the archaeological ages of the three houses, as also shown by their uniform construction and orientation. The presumed eastern end of house II shows that regardless of length none of the houses can have overlapped. However considering that they were only one meter apart, it is hard to believe all three houses were in simultaneous use.

We are still not quite sure of their original lengths and how they relate to other excavated Late Neolithic houses.

Though the latter share a number of basic details they appear at first sight to fall into two groups. Characteristic of north Jutland houses are sunken floors, whose sizes range from 5×5 to 14×7 m (Jensen 1973, 1984; Simonsen 1983; Skov 1982). The placing of both roof and wall posts is somewhat irregular but in principle the same as at Diverhøj, which Myrhøj house GAB shows well (Jensen 1973, 72). None of the north Jutland houses have clear gable ends. All are dated to early in the Late Neolithic.

The regularly built houses from Limensgård on Bornholm stand in clear contrast to these. With length reaching over 40 m and widths of 6.5 to 7.5 m and in places double lines of wall posts, they were clearly larger and more substantial. In only one house (house S) was there a sunken area, which measured 4.5 × 5.5 m and was 10 cm deep, dividing at the bottom into smaller irregular pits (21). The date of these houses is Late Neolithic/Earliest Bronze Age (Nielsen and Nielsen 1985).

Of the north Jutland houses those from Diverhøj with their shallow sunken floor areas and regular post construction are the ones that most resemble those from Bornholm. Also the possible rounded end of house II recalls the end of Limensgård house AB (Nielsen and Nielsen 1985, 109). With their smaller proportions and single lines of wall posts the Diverhøj houses are un-

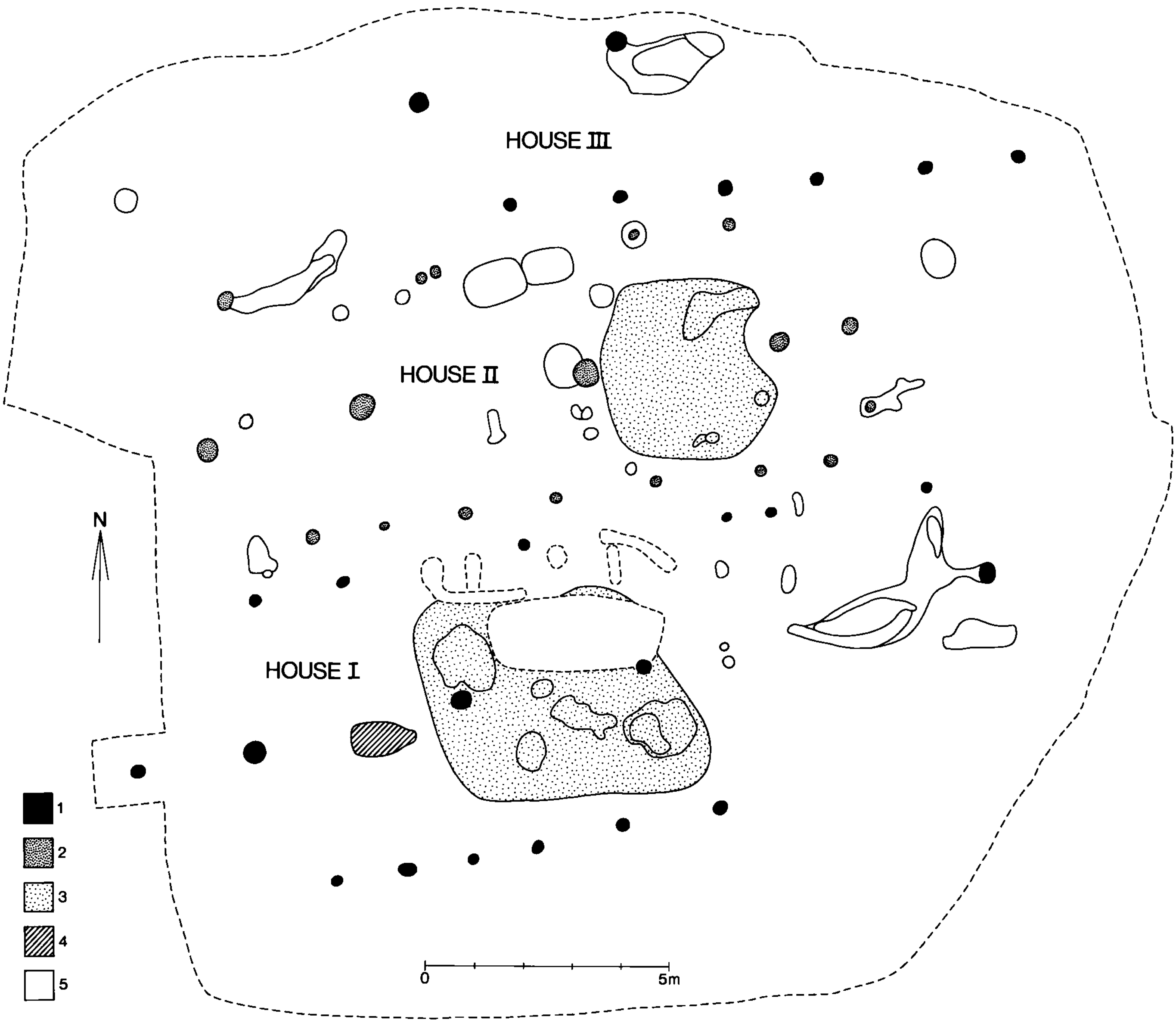

Fig. 19. Plan of houses under the barrow. 1 – posthole in house I or III; 2 – posthole in house II; 3 – sunken floor areas; 4 – base of hearth; 5 – other feature. Drawn by Orla Svendsen.

likely to have been as long as those from Bornholm, even if house II exceeded the 18 m that was recorded.

As the ends of none of the north Jutland houses have been reliably recorded, it is possible that they were longer than indicated by the sunken floors, and were sunken at one end only. They could have had a post construction corresponding to Diverhøj's at the other end, as already implied of house D at Myrhøj (Jensen 1973). Indeed they may all have been the same type, differing only in the size of the sunken part of the floor. The size and depth of the sunken floors varies considerably, and most have irregular sides and base. There is a positive correlation between area and depth (Simonsen 1983, 86), which suggests not that the hollows were dug before the houses were built, but that they resulted from activity in the houses and its duration.

It is tempting to see the hollows as the result of repeated clearing up of the habitation area with resultant deposition of settlement material elsewhere. Repeated clearance would increase the size and depth of the depressions and bring about the correlation observed. The depth of the floors varies from 0.25 to 0.60 m, deepest in Myrhøj house EAB, in which three central postholes were recorded. As the sunken floors seem to be a fixed practice, the roof construction and the depth of the postholes must have been designed accordingly.

This interpretation does not answer the questions whether the sunken floors were placed at only one end of the houses, and whether the irregular or deficient patterns of postholes often observed reflects a reality or is due only to poor preservation. Before this question is answered it will not be possible to come to a final conclusion whether all these Late Neolithic longhouses really were a single house type or not.

THE FINDS

As well as scattered cooking stones, charcoal, and a few quern fragments the 5–15 cm thick occupation layer produced a large quantity of flint and pottery, amounting in all to 16,991 objects (Table I). As there were no chronological distinctions in either the flint and pottery or the excavated features, the whole material will be treated together. About half the flint and a smaller proportion of the pottery came from the charcoal-rich part of the layer between and under the lowest stones of the cairn, and because of its similarity with the rest of the material is not treated separately.

	HOUSES AND FEATURES	OCCUPATION LAYER
FLINT		
flake with notch or denticulation	2	123
flake with edge retouch	1	29
burins		1
scrapers	2	72
borers		68
arrowheads	1	64
daggers, strike-a-lights	2	22
sickles		1
roughouts	1	11
axes		2
miscellaneous		93
hammerstones	6	24
total implements	15	510
cores	14	528
flakes	165	15,041
total flint	194	16,079
POTTERY		
rim sherds	22	21
body sherds	161	505
base sherds		9
total pottery	183	535

Table I

Flint

This was the largest category. The raw material consisted of shiny light grey to black flint and a smaller amount of grey calcareous flint. The flakes were generally longer than they are wide, and consisted of irregular flakes from roughing out and small thin flakes from flat working. Blades were irregular and few.

The cores were generally irregular and dominated by pieces with three or more striking platforms. These were so far as could be seen generally made on large thick flakes, but also round cores with scattered striking platforms occur, as did a single little conical core.

Flakes with notch or denticulation were usually irregular with one or more notches, sometimes retouched.

Flakes with edge retouch were generally irregular, large, often thick flakes with partly or completely retouched sides. A few are retouched across the end.

Of burins there was only a single irregular median burin.

The scrapers were mostly on irregular, often rather large flakes with or without lateral retouch. There is a single pear-shaped tanged scraper (fig. 20:g).

The borers were mainly on irregular flakes and occur both with and without shoulder. In addition there were a considerable number of slender borers on narrow blade-like flakes, several of them with propellor retouch (fig. 20:k). The conical cores could have provided blanks for such borers.

Nearly half the arrowheads were triangular or pointed oval with complete or partial edge and surface retouch. They occur with straight, convex, tanged base (fig. 20:a-f). Both short, wide, convex-sided and narrow,

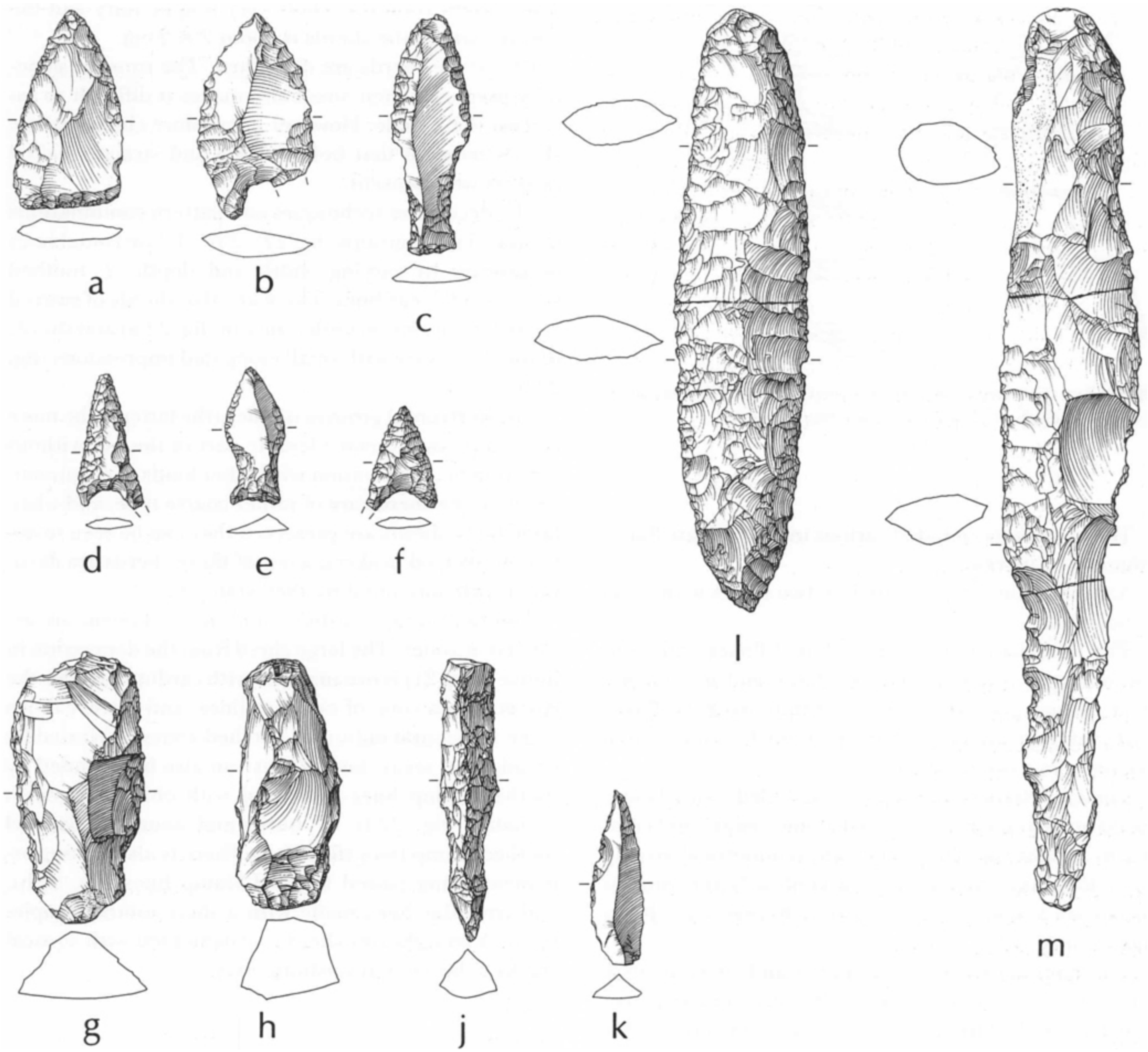

Fig. 20. Flint implements from the pre-mound settlement. a–f, arrowheads (c and e with tang and slightly narrowed base); g, tanged scraper; h, hammerstone; j, core struck from three sides; k, borer; l–m, daggers found separately. Drawn by Orla Svendsen. 3:4.

straight-sided arrowheads occur. Two have pairs of retouched lateral notches near the base (fig. 20:c and e). Over half are thin irregular or triangular flakes with partial edge or surface retouch and can be regarded as roughouts.

Daggers and dagger-shaped strike-a-lights were found only as fragments, but a few could be fitted together to make whole implements. These were lanceolate daggers of type I, and one was of type Ib (fig. 20:l) (Lomborg 1973, 38). There is an irregularly flaked strike-a-light (fig. 20:m). Most are roughouts and broken pieces, of which several had in all probability been lanceolate daggers.

Of sickles there is only a single fragment.

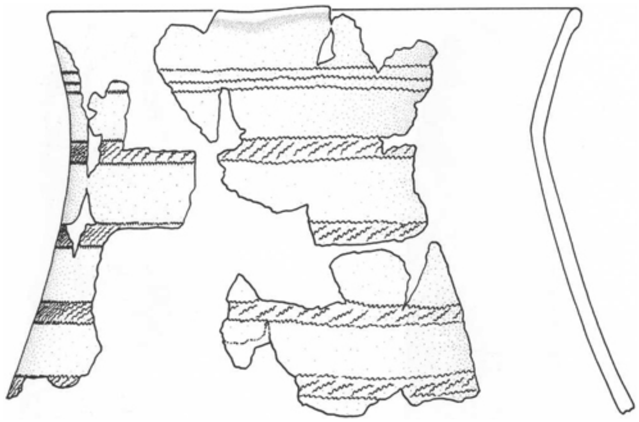

Fig. 21. Parts of a zoned vessel from the hollow in house I. The decoration is applied in cardium. Drawn by Elsebeth Morville. 1:3.

The roughouts included various indeterminate flat or edge flaked pieces.

Axes were only represented by two flakes with signs of polishing.

The miscellaneous group included flakes with continuous edge retouch. This is a large and unhomogeneous group, consisting largely of thin, irregular flakes with varying amounts of edge retouch, which often seems to be work-retouch.

The miscellaneous group also included 5 small elongated nuclear pieces retouched along 3 edges and coming to a point (fig. 20:j). They are symmetrical around their long axis, and may be a kind of borer. Similar pieces are known from the earliest Bronze Age (Jæger and Laursen 1983, 111).

The hammerstones are either round or elongated. The latter include three mutually very similar pieces which are flaked from 2 or 3 edges and converge at one end, where there are marks from striking (fig. 20:h). All are of grey calcareous flint like other similar pieces from Late Neolithic and Older Bronze Age contexts (Jensen 1973, 76; Jæger and Laursen 1983, 111).

Pottery

The majority of the sherds have an even and frequently smooth surface. The temper varies considerably and includes broken rock. The average thickness is 0.6 cm. A minority have an uneven surface, grits consisting of large stone fragments, and a thickness of around 1 cm. The pottery is on the whole very fragmentary and the average size of the sherds is about 2 × 2 cm.

19% of the sherds are decorated. The rims are generally plain and their small size makes it difficult to ascertain their angle. However a few more characteristic sherds indicate that both swayed and straight-walled beakers were present.

The decorative techniques and pattern combinations fall into 3 main groups (fig. 22) (20):– 1. horizontal lines or grooves of varying width and depth, 2. toothed stamp, and 3. cardium. There are also sherds of swayed beakers with cordon under the rim (fig. 22:a) and sherds of the thick ware with small elongated impressions (fig. 22:b).

The horizontal grooves or lines (the latter is the more common) cover a considerable part of the pot without zonation or combination with other kinds of ornament. Many of the sherds are of rather coarse type, and when large body sherds are preserved they can be seen to belong to swayed beakers; a few of these sherds are decorated with horizontal toothed stamp lines.

Toothed stamp, cardium, and line ornament are arranged in zones. The large sherd from the depression in house I (fig. 21) is ornamented with cardium. Under the rim is seen a zone of cardium lines, and further down come horizontal obliquely hatched zones separated by broad plain areas. Such zones can also be bounded by toothed-stamp lines and filled with oblique cardium hatching (fig. 22:f), or horizontal zones of parallel toothed stamp lines (fig. 22:g). There is also zig-zag ornament using paired toothed stamp lines (fig. 22:h), and irregular lines made with a three-toothed implement. A straight rim-sherd is ornamented with vertical stacks of horizontal cardium lines.

Dating

The material from the houses and occupation layer dates the settlement to the Late Neolithic, and the type I daggers point clearly to Late Neolithic A (Lomborg 1973, 68). This is reinforced by the zone-ornamented pottery, which is already dated by closed finds with these daggers to Late Neolithic A and is not known in later association (Lomborg 1977, 31). Horizontal groove ornament, which is present for example at Myrhøj, is dated to early in the Late Neolithic, (Ebbesen 1978, 60; Jensen 1973, 92ff.), while pots with cordon are dated to the Late Neolithic in general (Simonsen 1983, 84). A

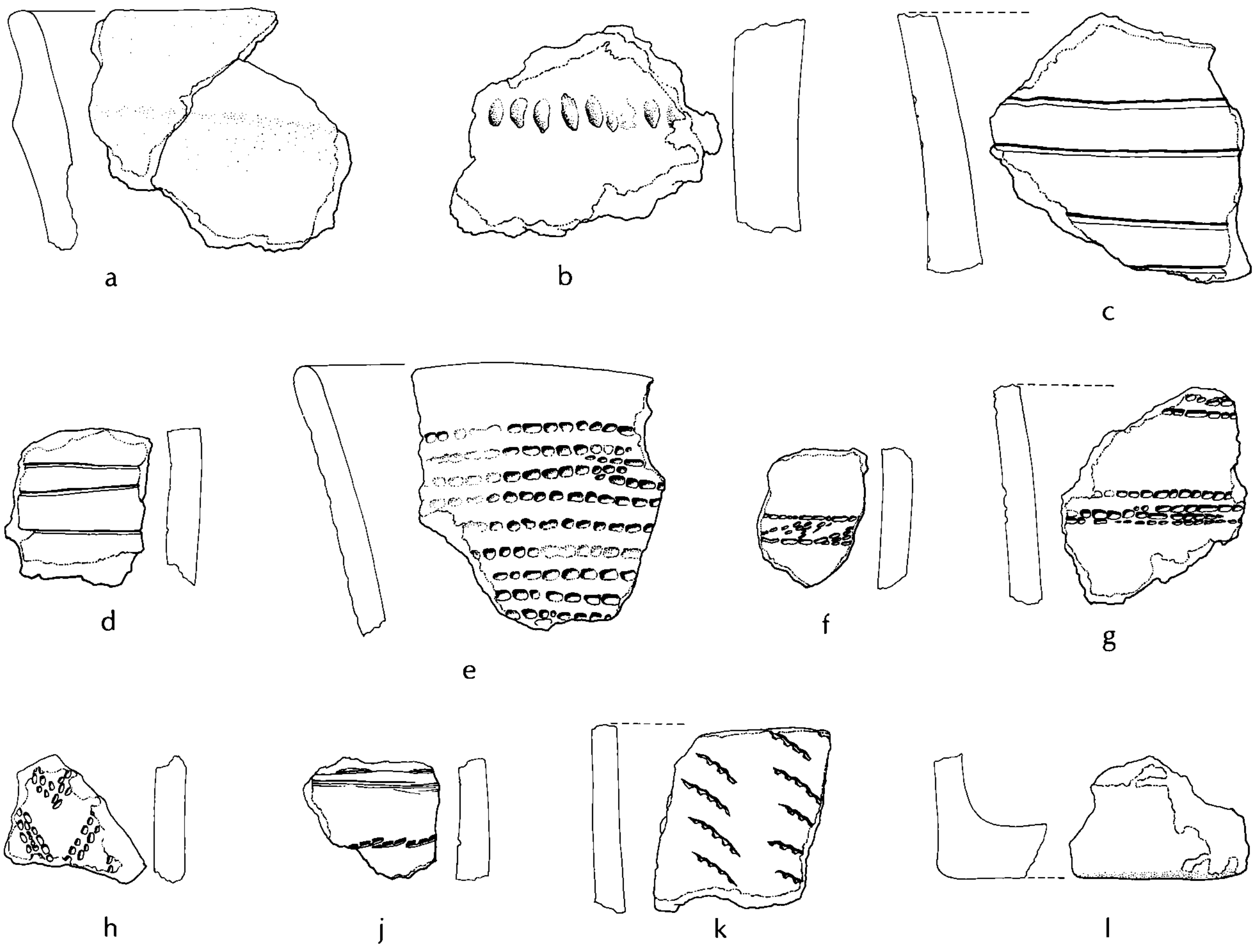

Fig. 22. Pottery from the pre-mound settlement. a – cordoned rim; b – sherds with impressed pits; c–d – horizontal grooves; e – rim with horizontal toothed stamp lines; f – zones outlined with toothed stamp and filled with oblique cardium impressions; g – zones of parallel toothed stamp lines; h – zig-zag decoration in toothed stamp; j – lines and three-toothed impressions; k – rim with vertical series of cardium impressions; l – base sherd from straight-walled beaker. Drawn by Elsebeth Morville. 3:4.

rim with vertical cardium lines is from a straight-walled beakers like Glob's group P, type 2–3 (Glob 1945, 103ff.). None of Glob's examples was found in dating context, but an early Late Neolithic dating was later proposed (Ebbesen 1978, 62; Hansen 1986, 82f.).

The material has striking similarities with Myrhøj (Jensen 1973). Though there is much less pottery, some of the forms and most of the decorative techniques and combinations are the same. Also the flint types are much the same, though no axes were found at Diverhøj, whose many borers and arrowheads are noteworthy. The difference also shows in the flint waste, in that the short and wide little flakes characteristic of axe production are nearly absent (Jensen 1973, 80).

A radiometric date of charcoal from the sunken part of house I is 1740 bc (uncalibrated), which is 200 years later than the datings from Myrhøj (Jensen 1973, 113). Two datings of 1610 and 1680 bc (uncalibrated) are from samples from the burnt wooden structure which is also dated archaeologicaly to Late Neolithic A. There remains the dating of 1920 bc of the plank from the burnt structure. In this case the wood could, as already said, be up to a couple of centuries older than the structure itself, so there need not be any conflict between the two datings (see note 16). A similar date of 1780 bc was obtained at Stendis, which is dated archaeologically to the Late Neolithic, and at the Barrel Site a layer containing Bell Beaker pottery is dated to 1770 bc (uncalibrated) (Skov 1982, 43f, Liversage & Singh 1985, 70). Although the close parallels to Myrhøj, then there is no reason to wonder about the late Diverhøj datings, and we may conclude that Diverhøj belongs to the late Late Neolithic A.

RESUMEE

We may end with a short summary of the history of the site: The first stage was a settlement with 3 longhouses and an occupation layer from Late Neolithic A. The area was brought under cultivation immediately after settlement ceased. Later in Late Neolithic A a wooden structure was erected. Probably it covered a grave with a lanceolate dagger among the grave goods. The structure was burned and an impressive cairn erected over its remains. Subsequently the area was again brought under cultivation. At the beginning of period II of the Bronze Age an opulent male burial was inserted into the centre of the cairn. A possible cenotaph and two cup-marked stones belonged in all probability with this burial. A flat topped barrow was thrown up over it. Subsequently, probably in late Bronze Age II, the disc barrow was surmounted by a round barrow built for yet another burial (22).

Translated by D. Liversage

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NOTES

1. Djurslands Museum jr. nr,. 1925. National Museum topographical register Homå parish sb. 18, Djurs Sønder herred, Århus amt.
2. Sb 16–17 and 19–22. Sb 19 is still under grass.
3. Excavated May to September 1985. Taking part were Peter Bertelsen, Niels Aksel Boas, Niels Oscar Boas, Gert Hougård Rasmussen, Ole Christian Sørensen, and the author.
   Samples for pedological examination were taken by Kristian Dalsgård and Per Nørnberg, Laboratory for Physical Geography, Geological Institute, Aarhus University (for method see Dalsgård and Nørnberg 1980, 135ff.).
4. The fragment is rather like the end of the head of D.O. no. 152 (Broholm 1952).
5. The disc barrow in Krudhøj was 3 m high and 18 m in diameter (Thorsen 1977, 92). The mounds of two out of four phases in the Esbjerg barrow were flat-topped. The oldest disc barrow was 1 m high and 9 m in diameter. It was enlarged in the following phase to 3 m high and 10 m in diameter (Aner and Kersten 1986, 100).
6. In the opinion of Ann Willemose, conservator at Kulturhistorisk Museum, Randers, the cause of the fungal growth was oxidation of the surviving organic material, probably as a consequence of the modern disturbance close west of the box.
7. The bronze objects were taken up by Ann Willemoes, conservator at Kulturhistorisk Museum. The condition of the objects is probably due to having been exposed to downward movement of water for a long time after the barrow was disturbed.
8. Lise Bender's appendix on the textile fragments.
9. Valsømagle axes are distinguishable from typologically and chronologically later axes, which are somewhat narrower with higher flanges and strongly splayed edge (Lomborg 1969, 113f.).
10. The pommels of the Valsømagle horizon are usually rounded pointed-oval (Lomborg 1969, 102).
11. Only 8 flanged axes of Valsømagle type are known: found in graves 72 and 83 of Broholm (1943) vol. 1 and cat. 66, 1098, 2237, 2182, 2343, 4216 of Aner and Kersten (unpublished). Information kindly provided by Helle Vandkilde.
12. In accordance with the finder's description, C. Neergaard suggested that the axe had been shafted as a thrusting weapon (Broholm 1943, vol. 2, 46). This was also accepted by Johannes Brøndsted (1966, vol. 2, 52).
13. Fragments of such muffs or bindings of bronze wire are known from other flanged axes and late palstaves (Broholm 1943, vol. 2, graves 72 and 82; Aner and Kersten 1973– , cat. 2713b).
14. It is a widely held opinion that Bronze Age swords and axes were intended as fighting weapons (Broholm 1943, vol. 2, 46; Brøndsted 1966, vol. 2, 51; Kristiansen 1982, 66ff.), but more peaceful ways of demonstrating power have also been suggested (Asingh and Rasmussen 1987a).
15. Fibulae with split leaf-shaped bow appear to be otherwise unknown in south Scandinavia (Aner and Kersten op. cit.; Broholm op. cit.; Oldeberg 1974; Johansen 1981).
16. The sample could be of old wood in a large tree, so the dating need not be so different from the others. The following ^{14}C dates are from Diverhøj:
    K-4717: 3630 ± 80 before 1950. 2140–1890 B.C. ca. ± 1 standard deviation. From stone-lined posthole between the two U-shaped features under the cairn.
    K-4718: 3870 ± 80 before 1950. 2470–2205 B.C. ca. ± 1 standard deviation. From carbonized plank under cairn.
    K-4719: 3560 ± 80 before 1950. 2030–1775 B.C. ca. ± 1 standard deviation. From charcoal-rich deposit under cairn.
    K-4720: 3690 ± 75 before 1950. 2200–1975 B.C. ca. ± 1 standard deviation. From the same deposit as K-4719.
17. Haderslev Museum jr. nr. 1712. Grundtvigs Allé, Ulkebøl parish, Haderslev amt. National Museum sb. 342. Information kindly provided by the excavator, Ole Grøn.
18. Aner and Kersten, op. cit. cat. 2188 (Flensborg), cat. 2251 (Weseby), cat. 2294 (Süderschmedeby). The last is the one described in the text.
19. Hjerpsted (Wiell 1976), Circular ploughing inside the kerb. Kokkedalsmark, Thorslev parish, National Museum sb. 19, circular ploughing under the kerbstones. Owschlag (Aner and Kersten cat. 2530), circular ploughing around the foot of the mound. Informa-

tion kindly supplied by Henrik Thrane and Erik Johansen, Fyns Stiftsmuseum and Ålborg Historiske Museum.

20. The groups correspond to 3 of the 4 groups distinguished for the Myrhøj pottery (Jensen 1973, 92).
21. Information kindly supplied by P. O. Nielsen, National Museum.
22. Queen Margrethe II's Archaeological Fund and the Prehistoric Institute, Moesgård, are to be thanked for supporting the preparation of manuscript and illustrations.

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Textile Remains from Diverhøj

by LISE BENDER JØRGENSEN

Two textile fragments were found in Diverhøj, preserved in the corrosion of a bronze axe in the burial from the intermediate phase (Early Bronze Age period II), as described by P. Asingh.

They measure 3.8×2 and 2.2×1 cm, and are felted together and caked with mud, but near the edges the structure is recognizable as textile. The weave is not determinable, but the yarn exhibits both S- and Z-spin; the count is approximately 4/5 threads per cm. The fibre is wool.

These features suggest that the Diverhøj textiles belong to the most common cloth type of the Danish Early Bronze Age: wool tabby with S-spun warp and Z-spun weft, and a count of 3–6 threads in both systems. This cloth type has been found in 51 other Scandinavian graves from period II, whereas other spin combinations such as S/S, Z/Z, S/Z, S or with plied yarn in one or both systems appear in 32 graves (Bender Jørgensen 1986, p. 17/290). In Period III, this picture has changed in that S/Z spin is now only found in 23 graves, against 29 graves with other types of spin. From Period I there is only a single Scandinavian grave with textile remains, a tabby with S/S-spun yarn.

Outside Scandinavia only a small number of Early Bronze Age textiles have been recorded. They comprise both woollens and linens, the former mainly in Northern Europe, the latter in Central Europe and in Britain. The wool fabrics of North Germany are generally S/Z tabby, whereas those of Central Europe are made of S/S spun yarn, those of Britain of Z/Z-spun (Bender Jørgensen forthcoming).

The oldest example of wool cloth in North Europe was found with a flint dagger of Lomborg's type I (Late Neolithic Phase A) at Wiepenkathen, Kr. Stade in Lower Saxony (von Stokar 1939, p. 103); the yarn is S-spun. Earlier European textile remains have all proved to be made of vegetable fibres, and the yarns are Z-spun, or plied Sz, i.e. from a basis of Z-spun yarn (Bennike, Ebbesen & Bender Jørgensen 1986, p. 204–05).

In both Scandinavia and on the European continent the wool fabrics of the Early Bronze Age show a preference for S-spin, either in one system (the warp) or both, contrary to the fabrics of vegetable fibres, both from the Stone Age and the Bronze Age, which employ Z-spin as the basic principle. This feature suggests that the two main types of fibres each had a separate technology, probably with different tools for the preparation of the fibres, for spinning, and maybe also for weaving.

The Diverhøj textile remains fit well into the Scandinavian and North European textile tradition of the Bronze Age, being samples of wool cloth with S-spun yarn in one system.

What sort of garment do the two small textile scraps derive from? They were found on the axe, which was situated close to and partly under the remains of a bark box, and supposedly close to the head and shoulder of the deceased.

The well-preserved Danish log coffins where complete Early Bronze Age costumes have been found indicate that several types of garments clothed the head and shoulders of the males: the cloak, which often covered most of the corpse; the gown, which was worn around the body and supposed to be fastened over one shoulder with a strap; and sometimes a blanket (Boye 1896, Broholm & Hald 1940). The Diverhøj textile remains may derive from any of these, although cloak or blanket must be considered the most likely.

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Bronze Age Research in Denmark 1970–1985

by JØRGEN JENSEN

The beginning of the 1970's was in many ways a turning-point in Danish archaeology. A new generation of archaeologists began to make its presence felt in Bronze Age studies, new archaeological methods and theoretical concepts were developed under the influence of English-language literature in particular, and at the same time archaeologists were faced with a rapidly growing number of excavation sites over the whole country, largely as a result of the growth of motorways, housing projects, pipe-lines and so on. The period as a whole has witnessed a veritable boom in Bronze Age studies which not even the economic cuts of recent years have been able to put significant limits to, and it is reasonable therefore to pick out certain major lines within the individual fields of the subject. In what follows will be found a survey of the last 15 years' Bronze Age research based upon the published literature, which is collected in appendix 1 at the end of this article.

The publication in 1975 of the book *Europæiske Forbindelser* (European Connections) (206) by Henrik Thrane clearly marked a watershed in Danish Bronze Age research. The book was the result of many years' study of foreign bronze objects from Bronze Age Denmark and in its way marked the end of an epoch in Danish archaeology. As a contemporary reviewer of the book remarked (68): "when Henrik Thrane began publishing, Danish Bronze Age research was just coming out of a period of isolation in which the international character of the Bronze Age had been almost totally overlooked. The dominant publication of the 1940's was H.C. Broholm's *Danmarks Bronzealder*, vol. I–IV, a work which almost entirely omitted the results of earlier diffusionist studies (by Sophus Müller amongst others). In the course of the 1950's, however, new tendencies were current in Danish archaeology. The dominant inspiration came from Gero von Merhart's school at Marburg, and one must understand Henrik Thrane's book in the light of the influence from this source. That it will be accepted nowadays in an academic environment which is again on the point of changing character and has turned itself to the economic and social aspects of prehistoric communities, ought not to obscure the contribution of the author and the influence his diffusionistic studies has exercised over Danish Bronze Age research".

The review reflected the departure from the diffusionist concept in European archaeology which set in at the beginning of the 1970's, finding expression, for instance, in Colin Renfrew's *Before Civilisation* of 1973, and which meant that attention was no longer directed to such a degree upon the diffusion of isolated culture elements rather than towards the multiplicity of processes which conditioned the changes in prehistoric social systems. Demographic, ecological, and sociological approaches became dominant, and the broad European perspective which, albeit with breaks, had dominated Bronze Age research since the 19th century was superseded by more local studies, as can be seen in the literature published in Danish since the beginning of the 1970's.

Quantitatively this literature clusters into three main areas: 1, systematic topographical publications of finds and excavations; 2, settlement studies, i.e. studies of Bronze Age settlements and their effect upon the surrounding landscape, subsuming the subsistence basis in its broadest sense; 3, studies of the organisation of Bronze Age society.

SYSTEMATIC, TOPOGRAPHIC PUBLICATIONS

The most significant work amongst the systematic topographical publications is *Die Funde der älteren Bronzezeit* (7) by E. Aner and K. Kersten. This work comprises a complete publication of one of the major sources of Bronze Age material, the grave and hoard finds of the early Bronze Age, periods I–III, together with stray finds connectable to these two categories. This publication has a uniquely high level of documentation: all find-places are visited by the authors and all data about the finds are based on original documents. The drawings are of a very high quality and in conjunction with the catalogue they present the archaeological record in a manner which is unique in Europe. In a time when steadily fewer archaeologists have the opportunity to study basic material in person, and when this material is growing to unmanageable proportions, publications of this sort are invaluable. This work, which has been in the course of publication since 1975, comprises at present 8 volumes which cover the islands east of the Lillebælt and southern Jutland. The rest of Danmark will be covered in 7 further volumes.

The annual *Arkæologiske udgravninger i Danmark*, (Archaeological Excavations in Denmark) which has appeared since 1984 is of great value for an overview of the rapidly growing data base. The book gives a complete account of all the archaeological excavations which are undertaken by the more than forty Danish archaeological institutions. A short summary of the most important results is given for every excavation, interpretation, dating and so on, and finally references are given to *The Central Cultural-Historical Archive* at the National Museum in Copenhagen where information about finds is collected and computerized (119). The archive holds information about prehistoric sites from more than 100,000 locations in Denmark, systematically collected since 1873.

With such tools archaeological research is coming to grips with the enormous increase in information which is currently taking place. At the same time, however, the need to define the problems to be tackled is also growing. An attempt will therefore follow to pick out some of the major lines which have dominated in Danish Bronze Age research during the past 15 years.

SETTLEMENT STUDIES: THE TWO- AND THREE-AISLED LONGHOUSES

From slender beginnings at the end of the 1950's, the study of Bronze Age settlements gathered speed through the 1970's. Only a few sites, however, have been the subject of large scale systematic excavations, and only in certain respects is the material known today representative for the whole country (207, 219, 221, 229, 237). The average number of excavations of Bronze Age settlement sites, from small rubbish pits up to large scale excavations with preserved building plots, at present lies between 30 and 50 a year.

Amongst the most important results within settlement-site studies is the excavation of a large number of buildings from the Bronze Age: see appendix 2. Quantitatively, the main thrust of excavations has been in Jutland although the volume is increasing on the islands of eastern Denmark, including Bornholm (130, 132). Although the dating of the sites often raises problems, one may discern the outlines of the development in Bronze Age building from one end of the period to the other, at least in Jutland.

The origins of the Bronze Age building clearly seem to lie in the Late Neolithic. Here excavations at Myrhøj (61), Stendis (184), Tastum (181), and Limensgård (140, 141), and at Fosie in Skåne (Sweden) (20), have gradually produced a picture of a building-form which, despite great variations, must provide the basis of the early Bronze Age building-type. This is a two-aisled longhouse with post-built walls. The length can vary considerably, from 15 metres to over 40, as observed at Limensgård on Bornholm. The houses normally lie in clusters but only a few of the buildings seem to have been standing at any one time.

In the earliest centuries of the Bronze Age, in period I, the late-Neolithic tradition was still alive, and the two-aisled longhouse was still in use. This is shown by excavations at Egehøj in Jutland (22, 23) where three partly overlapping buildings have been excavated (Fig. 1). At most two of the buildings seem to have stood at the same time.

The Egehøj houses were 21, 19 and 18 m long respectively, and all were 6 m wide. Each had 4 sets of roof-supporting posts and walls built of irregularly spaced posts. In two of the buildings there were signs of a partition wall in the middle and both had sunken floors, one in the east end and the other in the west.

At some point, as yet uncertainly dated, in the early Bronze Age, probably in period II, a major change takes place as the two-aisled longhouse develops into the three-aisled longhouse (Fig. 2). The new mode of construction makes a very wide building possible, sometimes exceeding 8 metres, as seen in the building at Trappendal, South Jutland (26, 27, 139). This building is dated to period III of the early Bronze Age, possibly earlier, as it is covered by a barrow the central grave of which belongs to period III. The Trappendal building is

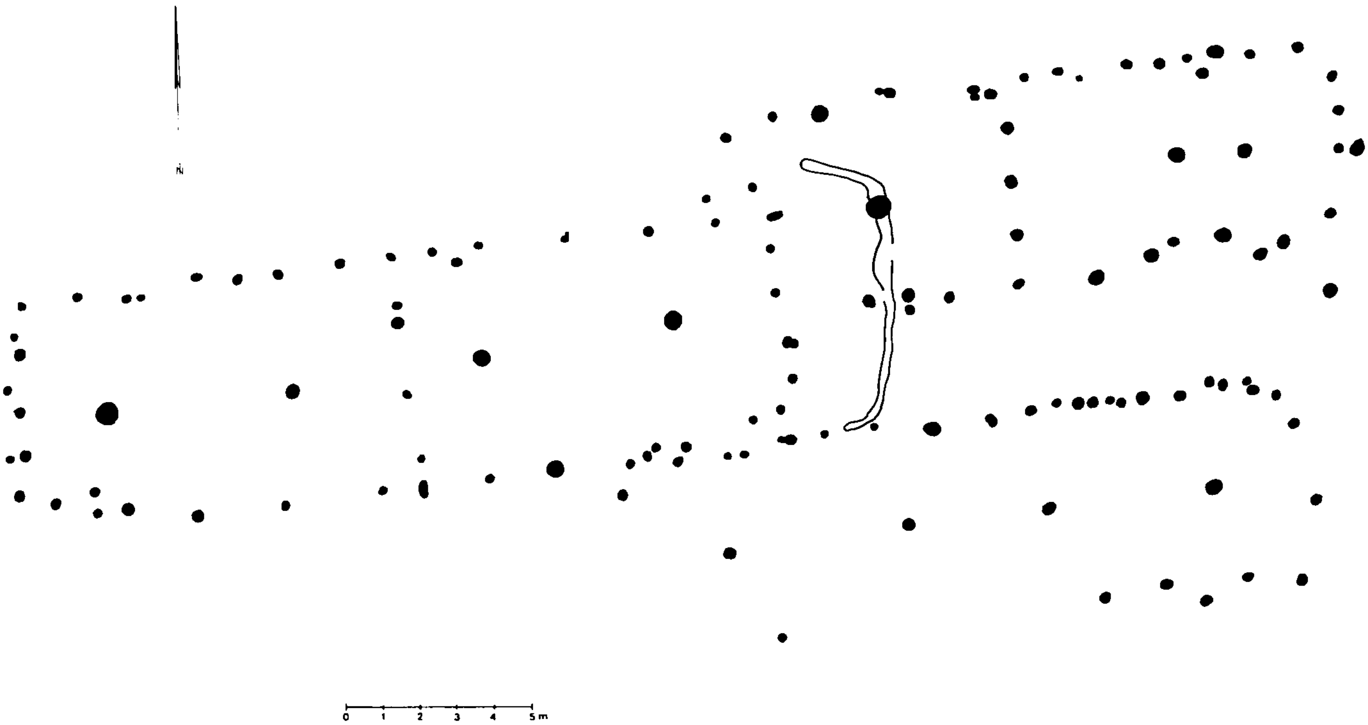

Fig. 1. Simplified plan of Early Bronze Age buildings at Egehøj, Jutland (23). The buildings were all of the same type: two-aisled longhouses with post-built walls.

a longhouse 23.5 m long, 8.7 m wide, with 5 pairs of roof-supporting posts at intervals of 3.4 to 4 m. Partition walls divide the building up into three rooms of different size. The ends are rounded and there are fireplaces in both ends of the building. Both long sides have entrances. The walls were constructed of closely spaced, slender posts.

The same building-type is known from immediately south of the Danish-German border at Handewitt near Flensburg (24) where, again beneath a barrow of period III, there was found a building 25.5 m long and 9.5 m wide, likewise divided into three rooms. Like Trappendal the walls were constructed of closely spaced posts although these were placed in a deep trench. The ends of the building were only slightly rounded.

Both of these buildings were covered by barrows after their first use. The same phenomenon has been observed at Hyllerup on Sjælland (appendix 2,9) and Horsager in North Jutland (appendix 2,17) but no immediate connection between house and barrow has yet been detectable. In some cases the building lies off-centre beneath the barrow (24) and in others a cultivation phase seems to separate the building and the construction of the barrow (appendix 2,9). The buildings may therefore be representative of the period's general building style: the available evidence does not support an interpretation as mortuary houses.

The three-aisled longhouse was thus developed as an established type in the Early Bronze Age: that is in the middle of the 2nd. millenium B.C. It is found at Vadgård by the Limfjord (126, 128, 132) and at other sites, and from the end of the period come a considerable number of buildings at Højgård, South Jutland (45, 46). The three-aisled longhouses excavated here are 20 to 22 m long and 6 m wide, although one is *circa* 30 m long and 8–9 m wide. The largest of the buildings has 7 pairs of roof-supporting posts and is internally divided by a partition wall between the second and third set of roof posts in the west end.

At Højgård the buildings' walls were constructed of heavy posts at relatively large intervals. This might indicate log construction, whereas the Trappendal build-

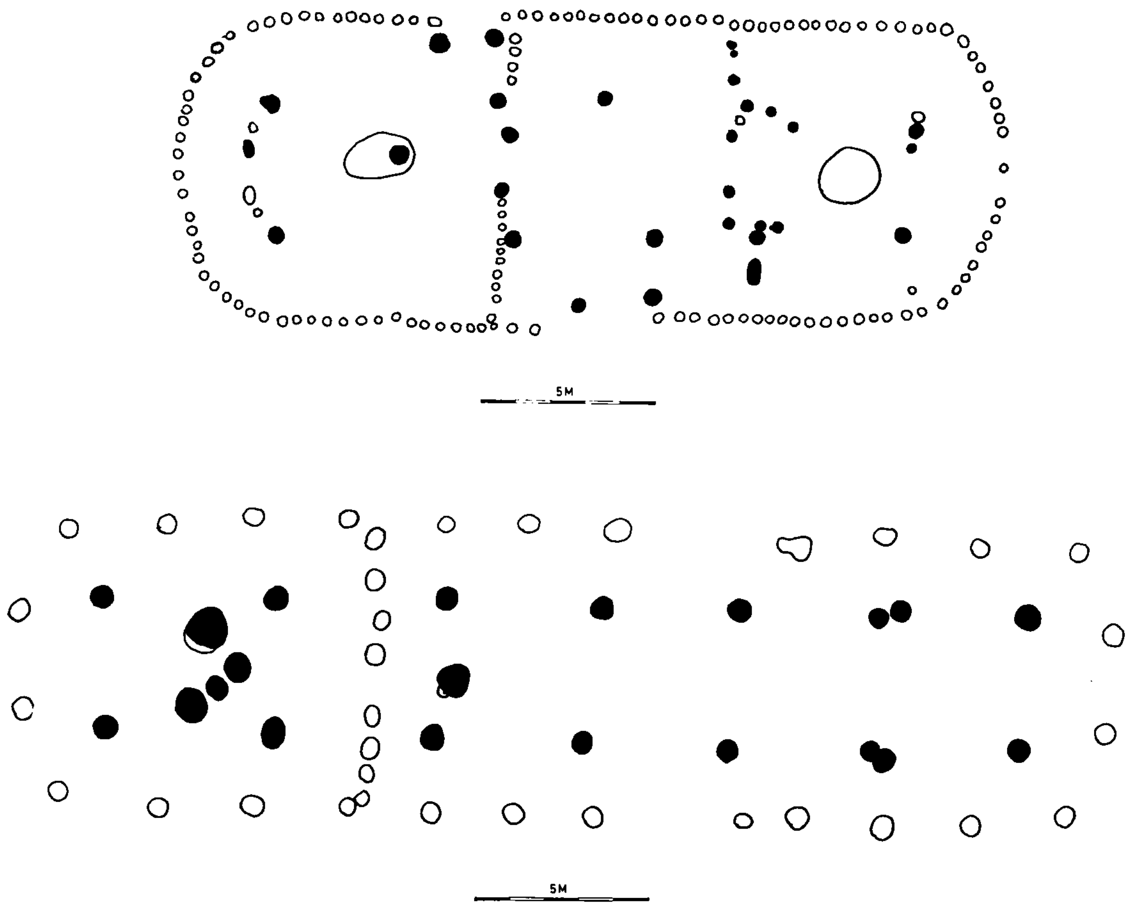

Fig. 2. Typical three-aisled longhouses from period II–III of the Early Bronze Age. Above: house site from Trappendal, Jutland (27). Below: house site from Højgård, Jutland (46).

ing seems to have had wattle walls. But there is no essential functional difference between the two building-forms.

In the late Bronze Age the development of three-aisled longhouses with rounded ends continues (Fig. 3). Buildings with widely spaced, sturdy wall posts apparently became less frequent. The walls are by preference built of more slender posts. This feature is found, for instance, at Jegstrup in North Jutland (34, 35), where three buildings were excavated, partly overlapping one another. At most two of the buildings could have stood at once. According to the pottery the dating must be to period V of the late Bronze Age.

The buildings were 24, 22.5 and 20.5 m long respectively, about 6 m wide. In two buildings entrances were found in both the north and south sides but the third had apparently only an entrance in the north side. The wall posts were in all cases slender, with a diameter of 15 to 20 cm and placed at relatively large intervals. The ends of the house were rounded.

At Fragtrup in North Jutland (37) two building plots aligned NW-SE were likewise excavated, 18 and 20 m long respectively and 7 m wide. They too can be dated to period V of the late Bronze Age. One building had 4 sets of roof-supporting posts, the other 5. It was noticeable that the easterly sets of roof posts stood at lesser intervals than the westerly, a feature that is frequently found in late Bronze Age buildings. The wall posts were very slender, less than 10 cm in diameter and relatively closely spaced. In one house the interval was 60 to 65 cm, in the other 70 to 80. Finds of daub indicate the presence of wattling. Both buildings had 10 to 15 cm thick

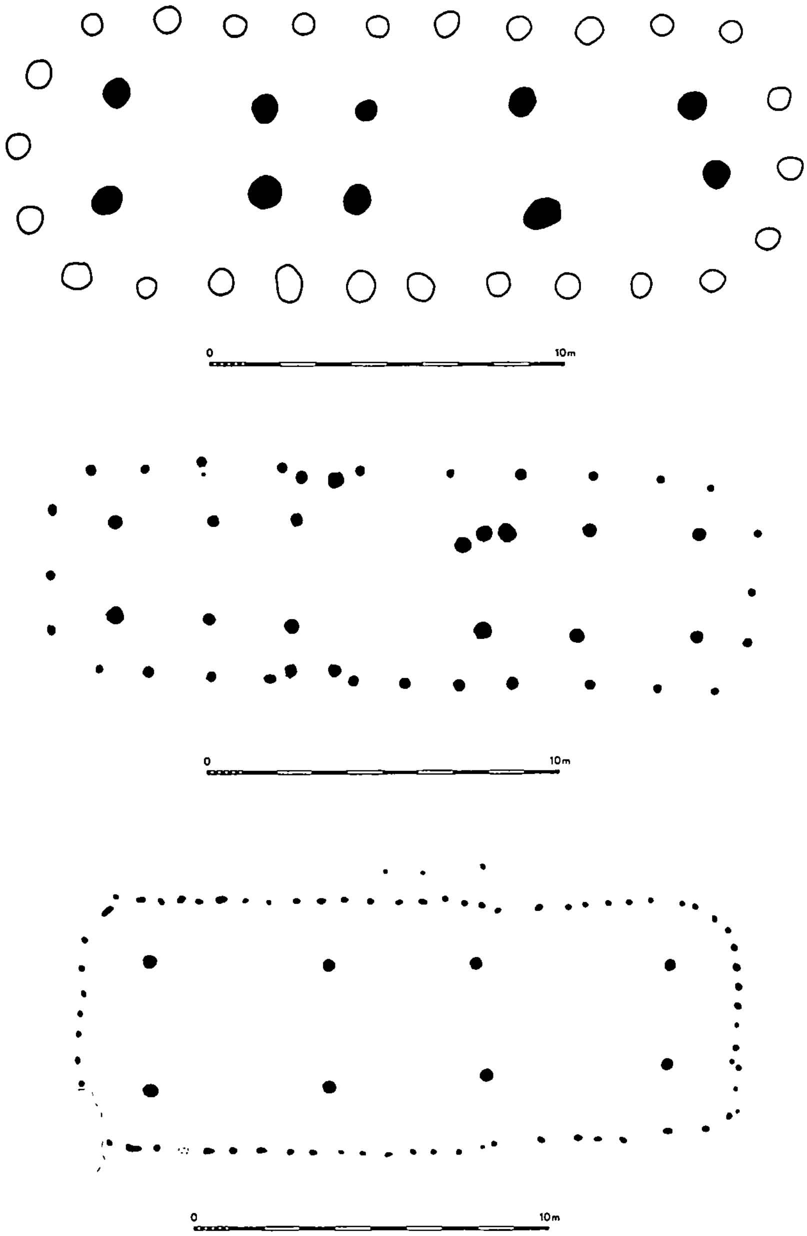

Fig. 3. House sites from the Late Bronze Age. Above: Bjerg, Western Jutland (13, 14, 15). Below: Ristoft, western Jutland (12). Bottom: Fragtrup, northern Jutland (37).

clay floor at the west end and one had traces of a partition wall, cutting off the eastern third of the house.

A further find, from Ristoft in West Jutland (12), dates to the end of the late Bronze Age, period VI. Three houses were excavated here, 17, 19.5 and 24 m long respectively and 6 m wide. In two cases there were probably several consecutive buildings. The wall posts were very slender and widely spaced. There were entrances in both the northern and southern sides, and the ends were rounded.

A number of houses from Nybro by Varde have the same, late dating (147), three of which were well preserved at about 20 m long. Two had 6, one 7 sets of roof-supporting posts. The wall construction was unusual, consisting of relatively slender posts set at approximately 40 cm intervals in double rows not observed in other cases. Two of the houses had partitioned-off stalls at the east end, in the wall of which there were further traces of an entrance. Enclosures were also found by the buildings, something which is only seen on a few other sites (64 and appendix 2,2).

An unbroken development of the three-aisled Bronze Age longhouse can thus be traced from the middle of the 2nd. millenium B.C. until the end of the period. Although there are changes in constructional details, the building-type is rather uniform. Orientation is nearly always W-E, with a bias towards NW-SE. Entrances are found both in the southern and northern sides, but may be supplemented by an entrance in the eastern end. The length normally lies between 18 and 24 metres but may reach over 30 in some cases. The largest house so far known measures 38 m (13). The width varies from 6 to 7 metres, but in the early Bronze Age it may exceed 8 m. The walls, which bore a considerable amount of the weight of the roof, may be composed either of closely spaced or more widely spaced posts at intervals of more than a metre. In some cases the wall posts are very substantial. This form of wall construction seems largely to occur around the middle of the Bronze Age, but apparently disappears in the course of the late Bronze Age in face of the type with widely spaced but slenderer wall posts. The ends are normally rounded, but there was at the same time a tendency in buildings with more closely spaced wall posts for the corners to be less rounded. The roof was of a somewhat different form from what came later in the Pre-Roman Iron Age.

The typological sequence can be extended from these Bronze Age houses down into the Pre-Roman Iron Age (15). At the beginning of the Iron Age the buildings become narrower, usually 5.5 m, a feature which seems to be related to the regular presence of stalls at the eastern end. In general the houses also shrink in length: there are buildings 17 to 18 m long, but the mean is lower.

At the beginning of the Pre-Roman Iron Age houses with rounded ends are still to be found, but this feature too quickly gives way to symmetrically angular gables. Sturdy corner posts and a strictly rectangular form become the rule. Wattled outer walls are now placed in trenches, and beyond these stand regularly placed, relatively large posts to support the roof. Formerly a roof-supporting element, the walls are moved in behind the outer frame of roof-supporting posts. A very well preserved example of this form of construction is known from Klegod, West Jutland (62). New developments follow: a more substantial outer wall is placed in a broad and deep trench, and the number of posts supporting the roof also increases.

A certain simplification of building practice is reached around the middle of the Pre-Roman Iron Age. The ground plan is still the same as earlier, two rows of roof-supporting posts, two entrances and symmetrically angled ends, but now the outer walls comprise just a single row of posts placed in a trench, without buttressing posts. At this point the building-type was created which would remain in use over most of the country through the following centuries into the period A.D.

THE FUNCTION OF THE BUILDINGS AND LAYOUT OF THE SETTLEMENT SITES

While the functional division of buildings from the Iron Age is nearly always reasonably clear there is frequent uncertainty concerning Bronze Age buildings, primarily because clay floors and culture layers are very rarely preserved. The presence of distinct byres in a small number of cases, however, at Hovergårde (64), Bjerg (13, 14, 15), Spjald (13, 14, 15) and Nybro (147) together with frequent wall-partitions, are indications that the three-aisled Bronze Age building was generally divided up functionally with a habitation area in the west and an east end which was used for maintaining animals.

Even more greatly differentiated division may also have existed. At Fragtrup (37), as yet the only excavation of a Bronze Age building plot with preserved clay floors, the distribution of the pottery showed, for example, that the finer wares belonged to the western end of the building while coarser pots were found in the central and eastern parts. This has been interpreted as evidence that the central part of the building was used as a workplace rather than for habitation. A similar tripartite functional division is indicated by the placing of partition walls in the buildings at Trappendal (26, 27, 139) and Handewitt (24). Traces of a tripartite division seem also to have existed at Kærholm, Sdr. Omme (12), where one of the buildings had two entrances in the southern wall.

The placement of the entrance in Bronze Age buildings otherwise indicates that the east and west ends were normally of equal size; the east end may be longer. The opposite was the case only at Fragtrup.

As yet an unanswered question is how many people the individual buildings housed. The placement of hearths, which sporadically occur at both the west and east ends, provides no clear picture, although interpretations on this basis have been made (151). Compared with the early Iron Age buildings, however, the complete Bronze Age household appears to have been larger. There is also little doubt that each building formed a complete production unit, whose material basis, however, could vary from area to area even within a single settlement.

It is not yet clear how these production units were internally organized, as only a very limited number of Bronze Age settlement sites are fully excavated. The usual experience so far is to see small group of buildings or production units without any clearly marked boundaries. The number of farmsteads on the individual settlement sites seem to have been very limited. It must, however, be borne in mind that most of the excavations have taken place within the poor sandy areas of Jutland which hardly formed a basis for intensive settlement. On the island of Fyn, at, for instance, Voldtofte (19), the extension and the thickness of the culture layers indicates that settlement must have been of quite significant dimensions.

In relatively few cases, such as Fragtrup (37), contemporaneity of more than one farmstead has been observed, so that in some cases it seems justifiable to talk of village communities composed of several farmsteads, although these do not have the same closed character as the later Pre-Roman villages. The possibility of explaining the grouping of houses within the Bronze Age settlements will probably be most enhanced after more comprehensive excavations at Fragtrup where the conditions of preservation are substantially better than at any other known Bronze Age settlement in Denmark.

Individual farm complexes often seem to have had a very long life, as traces of enlarging, rebuilding and repair can frequently be observed. On the other hand plough marks have indicated that some of the sites were ploughed over in the Bronze Age, or that they were constructed on previously ploughed land (37, 233). This shows a certain interchange between arable land and settlement, and it can also be observed how settlements can shift, for instance from higher to lower lying terrain (14). But a clear pattern does not yet present itself: the studies so far carried out are not comprehensive enough for this.

At the end of the period the settlement pattern changes radically, at least in the areas of Jutland where a continuous development from the Bronze Age to the Pre-Roman Iron Age has been traceable (14, 151). The size of the household apparently decreases, and a greater number of farmsteads are joined together, sometimes in regularly deliminated village communities which move around within the village territory at regular intervals (14, 15).

SUBSISTENCE ECONOMY

The last 15 years' researches have not brought much that is new concerning the subsistence economy which was practised in the Bronze Age settlements. Knowledge of the use of the plough has however been extended by a couple of important C 14 dates: the simple crook ard of the Hvorslev type has been dated to the early Bronze Age while the more composite bow ard of the Døstrup type has been dated to the late Bronze Age (188). The two ard types need not of course represent chronologically differentiated developments but could have had different, specialized functions (172).

As for the appearance of the fields, a series of new observations of ard marks from the Late Neolithic and Bronze Ages are available. This body of evidence comprises more than 90 cases, including both ritual ploughing and traces of day-to-day agricultural activity (228, 234). Together with field surfaces preserved under barrows, ard-marks form an important source of evidence which as yet has been used to far too limited a degree (156). It is only as yet possible to affirm that ploughing in Bronze Age fields was carried out in the same manner as later in the Iron Age, and that the traces indicate a moving field system whose field divisions stood only for a small number of years. Ditches and banks do not normally seem to have been formed by ploughing as is otherwise found on nearly all soil types from pure diluvial sand to heavy clay.

Little is known about the cereal crops cultivated in Bronze Age fields. Finds of grain from the beginning of the Bronze Age show the continuation of a development which began in the Neolithic whereby the cultivation of wheat was slowly being replaced by the cultivation of barley. In the early Bronze Age barley eventually became the dominant crop (175). This remained so for the coming millenium, although a tendency towards greater variation of plants can be seen in late Bronze Age agriculture (82, 176, 177, 225).

The balance between arable and pastoral farming is one of the unsolved problems of Bronze Age agriculture, which so far has only been discussed from a purely theoretical angle (161, 162). A large but mostly unexploited amount of bone material is available from early excavations of Bronze Age settlements. This includes, for example, Voldtofte (19), which gives, however, a very one-sided picture of cattle breeding in the late Bronze Age. More recent excavations of Bronze Age settlements have frequently been on sandy soils in Jutland where the conditions for the preservation of organic material are poor, and the literature of the last 15 years provides not a single example of osteological analysis of Bronze Age material. Material does however lie scattered in many Danish museums, which could illuminate, for example, the great importance of hunting and fishing on the coastal settlements and variations in the composition of herds of domesticated animals within particular parts of the land.

Amongst the other activities pursued on the settlement sites bronzecasting must be briefly mentioned, as traces of this are almost always found when only cultural layers are preserved (192, 193, 223). But apart from a series of minor studies of casting (90, 211) and decorative techniques (57, 179) this area of research has been little cultivated in Bronze Age studies of the last 15 years.

Rather more attention, by contrast, has been paid to textile working. This involves both the more technical aspects and the finished products of the craft (42, 43, 53, 135, 136, 178).

SETTLEMENT STUDIES: FURTHER PERSPECTIVES

Part of the picture of Bronze Age settlement sites is the system of trackways which joined the individual settlements together and ensured the exploitation of the surrounding landscape. Small plank roads over wetland have been found both from the early and late Bronze Age in recent years (86), and knowledge of Bronze Age fascine roads has also been substantially increased (142, 143, 144). The discussion of trackways formerly played a decisive role in Bronze Age settlement studies. The view that lines of burial mounds essentially reflected ancient trackways has been used to support very persistent theories about both Bronze Age settlement and trade. The problem, however, has been that it only rarely has been possible to date ancient stretches of trackways. It is only possible to get at relatively precise dating by scientific means when wood is preserved, for example, in the contexts of bridges, crossing places and other wet localities, or if a trackway lies sealed by a well-dated settlement layer or a burial mound.

More recent critical researches (6) have therefore noted that the barrows, even when situated in long rows, cannot be used for establishing routeways in the Bronze Age landscape, and that earlier researchers' supposition of a large scale network of roads, such as the existence of a major road up through Jutland, must be abandoned.

A more fruitful view of Bronze Age settlements and their exploitation of the surrounding landscape has been published by Kristian Kristiansen (99, 100). Through a topographical analysis he concludes that the general subsistence strategy common to Danish Bronze Age societies included a preference for light soils with a particular type of vegetation: thin, open woodland which is kept down by grazing and used for leafage. The general theory is that in the course of the Bronze Age agricultural intensification resulted in a transformation of the landscape in the settled areas, from open woodland interspersed with swathes of pasture to an open common landscape with scattered forest growth. And further, that through a crisis agricultural production was reorganized about the middle of the first millenium B.C., that is, the beginning of the Iron Age.

When published, this view was still a hypothesis. Several more recent studies have however shown that it corresponds well with results obtained from pollen analysis. A couple of pollen diagrams from Jutland and Sjælland may illustrate this (5, 246).

Pollan analysis from Abkær bog in southern Jutland, for example, was able to show how the face of the landscape was quite stable from the beginning of the Single Grave Period to the middle of the early Bronze Age. Beech invades about 1500 B.C., considerably earlier than previously thought, but does not, in this part of Jutland, achieve the extensive spread which is obtained in, for example, southern Sjælland (5). The reason is thought to be the intense human activity which marks the settled areas of South Jutland from the middle of the early Bronze Age. Upto this point hazel was widespread, but then becomes less common, which is taken to represent greater land use, i.e. a greater pressure of grazing. These changes precede increasing agricultural activity which is seriously effective at the beginning of the late Bronze Age when the landscape becomes much more open than before and is marked by open pasture and other unwooded agricultural areas interspersed with minor forests.

The pollen diagram thus demonstrates how in the second half of the early Bronze Age a gradual change of the landscape takes place. The result in the late Bronze Age is a landscape with extensive agricultural areas, a picture corresponding well with the postulated expansion of production which was delineated in the more hypothetical model of the development of Bronze Age agriculture.

Of course the sketch given here has many local nuances and raises many new questions. For example, was there a connection between the introduction of the three-aisled longhouse and the changes of the subsistence strategy in the middle of the second millenium B.C.? Furthermore, what was the background of the concentration of settlement during the late Bronze Age which apparently led to the rise of political centres manifesting themselves by the accumulation of wealth and at the same time indicating that the settlement pattern was hierarchically organized?

Settlement studies have also led to more detailed analyses of the representativity of archaeological remains from the Bronze Age (110, 111, 237). For example, E. Baudou (9, 10), by mapping the nearly 18,000 known Danish Bronze Age barrows, has shown how the destruction of large Bronze Age barrows is correlated with intensive cultivation, and how the connection between damage and increasing cultivation is particularly noticeable on the islands of eastern Denmark and in East Jutland during the 17th to the 19th centuries. His conclusion is that all interpretations which start from factors concerning spatial distribution will be precarious unless source-critical research has taken the influence of recent cultivation into consideration.

Interest in regional studies has also increased considerably during the last 15 years. One of the most important are surveys is Henrik Thrane's pioneering investigation of a 500 sq.km area of south-west Fyn (219, 221, 230, 232, 233). Bronze Age settlement here in general displays the same features as in the rest of Denmark. The sites are normally located on higher land, by preference in association with good pasture lands with a high water table, and also frequently in association with rich biotopes which permitted supplementary hunting and fishing. Of particular importance is that in the late Bronze Age the settlement pattern reflects a hierarchical structure. The centre of the settlements appears to have been the central village Kirkebjerget by Voldtofte (19, 220, 225). Around this were smaller settlements, which probably each formed independent production units or settlement cells (221).

This picture is drawn not only from the settlements but also from the graves of the region, amongst which the burial mound Lusehøj may be characterized as an emphatic monument, a grave of conspicuous construction with special furnishing and an unusual treatment of the body (200, 209, 215, 217, 233, 243). Besides this, the concentration of gold objects, imported goods and cult items also shows that there must have been a centre of wealth with a focus at Lusehøj-Kirkebjerget, primarily within period V of the late Bronze Age.

Comparable centres are known from other places in Denmark. In periods IV and V another concentration of wealth is observable in the district around Boeslunde in south-west Sjælland (73, 76, 240). The locality, by the placid waters of Skelskør Nor, and the land topography are very similar to the centre in south-west Fyn. The Boeslunde centre also manifests itself through a great accumulation of imported goods, cult items and gold. Almost 4 kg out of the total sum of 7 kg of Bronze Age gold from Sjælland comes from the Boeslunde area. As yet archaeological investigations of any great scope have not been undertaken in south-west Sjælland, and trial excavations in Boeslunde Banke, which was formerly considered a central religious site, proved negative (146, 147).

HOARDS AND GRAVES

Whilst up to the beginning of the 1970's Danish Bronze Age research was dominated by diffusionist studies, much of the last 15 years' literature shows different approaches which have increased the need for new studies of long-familiar find groups like hoards and graves.

On the subject of the hoards this has expressed itself in a systematic approach to source criticism. This, however, involves more than merely considering the closed nature of the finds, because a series of other factors influence the information-value of the data. Two important factors are the influence of the physical factors on the survival of the evidence and the influence of contemporary activities on the discovery and the distribution of finds. These factors have been examined in a valuable work from 1974 (93).

Analysis shows a close correlation between the volume of hoards and economic activities, especially peat digging (a majority of the hoards are found in bogs). Peat digging had, on the whole, the same effect all over Denmark, although the effects appear at different times. Generally speaking, Bronze Age layers in Danish bogs must be assumed to have been dug away by 1900. This, and other circumstances, are clearly reflected in the distribution of hoards. However, in contrast to the Bronze Age barrows the distribution of the hoard finds known to-day seems to be representative of the situation in the Bronze Age.

In another work from 1972 (66) it was argued that the very large amount of single finds from the Bronze Age which cannot be supposed to come from destroyed graves should be treated as one with the hoards. This involves individual swords, spears, axes, ornaments, etc. which, like the hoards, have often been deposited in wet areas: bogs, watercourses, lakes and so on – what is more, in the same regions of the country which have produced the bronze hoards. A large number of cult items belong to the group: lurs, helmets, hammered bronze vessels, statuettes (239) and processional axes, the latter a find-class which has increased dramatically in the past few years (70, 134) with some of the heaviest bronze objects from the whole period.

These numerous depositions are seen as an expression of ritual behaviour, with roots far back in the Neolithic, which continued throughout the Bronze Age. All of the early Bronze Age hoards will eventually be published in E. Aner and K. Kersten's *Die Funde der älteren Bronzezeit* (7), while for the late Bronze Age one must be referred to published catalogues without illustrations (66, 124). A selection of late Bronze Age hoards are, however, published in *Inventaria Archaeologica* (238), and in scattered special articles (49, 94, 101, 173, 174, 196, 198, 199).

The discussion of the interpretation of this large corpus of hoards, mostly of bronzes – male weapons and tools and female ornaments – has traditionally taken up a large part of the literature. There has in recent years been an increasing tendency to treat the hoards as an expression of ritual behaviour and at the same time a demonstration of social status (109). An important contribution to the discussion has come from Janet Levy (121, 122, 123, 124) who in a survey of the Danish Bronze Age hoards pointed out some striking tendencies: male depositions reveal a maximum diversity in periode II, then a decline, and again an optimum in period V (but lower than period II), followed by a steep decline in period VI. Female depositions, however, which are more numerous, steadily increase from period II to V, and then also decline. These observations have been used in more wideranging interpretations of socio-economic development in the Bronze Age of which an account is given below.

Traditionally, excavations of Bronze Age graves are a major part of the rescue digs carried out in Denmark (11, 17, 21, 47, 48, 78, 88, 152, 182, 183, 195). Unfortunately no clear formulated research strategy has been maintained and consequently relatively little new evidence about burial practices has been gleaned in the last 15 years. It is typical that the major publication on this topic is an unchanged reprint of Vilh. Boye's book about the oak-coffin graves of 1896 (25). One important study is however to be noted, Evert Baudou's already mentioned analysis of the representativity of the Early Bronze Age barrows (9, 10).

Significantly new material has, however, emerged concerning the later Bronze Age barrows, primarily in connection with the regional survey of south-west Fyn. The excavation of the great burial mound Lusehøj is particularly important (233). It came as something of a surprise that emphatic monuments of such dimensions were constructed in late Bronze Age Denmark, and the excavations have generally increased the attention paid to late Bronze Age burial practice, not just to the appearance of richly furnished graves but also to other grave-types. Secondary burials in earlier barrows are far from the only grave-form. Major barrows like Lusehøj form one extreme, while at the other end of the spectrum small barrows, as Lusehøj covered (233, 235), are found. At this site the conditions for preservation were especially fortunate. But despite the fact that small barrows are easily ploughed down it has been possible to show that this grave-type had a very wide distribution in southern Denmark (205, 233).

BORUM-ESHØJ	1290	1105
GULDHØJ I	1320	1370
GULDHØJ II	1320	1390
NØRAGERHØJ	1240	1210-1310
LILLE DRAGSHØJ	1310	1280-1345
TRINDHØJ I	1280	1285-1365
TRINDHØJ II	1300	1249-1305
STOREHØJ	1350	1340-1415

Fig. 4. Dendrochronological datings of some Danish oak-coffin graves (left) compared to calibrated C 14 dates (right). From A. Ljungberg (125).

CHRONOLOGY AND PROVENANCE STUDIES

The great number of objects from Bronze Age hoards and graves, mostly weapons, tools and ornaments, which have come to light in the last 200 years or so have long formed the primary basis for the modelling of Bronze Age cultural history. In no other period of Danish prehistory have diffusionist studies played so large a part. The foundation for this was laid in Denmark by Sophus Müller's pioneering works from the end of the 19th. century and there was a reflorescence under the influence of central European archaeology after World War II. Beyond being an explanatory cultural framework, the diffusionist studies aimed to connect the major European regions together in a network within which the provenance and date of every individual type could be established.

This purpose may be said to have been substantially fulfilled by the end of the 1960's and the early 1970's. In the case of the early Bronze Age this came through Ebbe Lomborg's studies of the late Neolithic and the beginning of the Bronze Age in Denmark (127). For periods II to V of the Bronze Age it came through the works of Henrik Thrane (197, 204, 206, 208, 212, 213, 218) and Klavs Randsborg (164), which particularly aimed at clarifying the relationship with Central Europe. For the end of the Bronze Age, period VI, it came through Jørgen Jensen's assessment of the importation of bronze objects from the earliest Iron Age cultures in Central Europe (66).

The result of these studies was that by about 1975 one could largely determine the relationship between Scandinavian Bronze Age chronology and the chronological scheme for Central Europe. However, simple comparison between the two systems has not proved possible because the period limits are not synchronized in Central Europe and Scandinavia (206). The only exception is the beginning of Ha C, which is contemporary with the beginning of period VI in Scandinavia (66). A series of observations further indicate that even within Scandinavia itself there may be more complicated lines of development, so that in certain regions one must reckon with "sub-periods" II and III which are contemporary with periods III and IV respectively in other regions (112, 164).

In the chronological studies ceramic chronology has not yet been subjected to analysis, although occasional approaches in this direction have been undertaken (37). Also of importance is the large number of C 14 dates of Danish Bronze Age finds. An account of these will not be given here because they will be presented in a future article in this journal. Likewise no additional account is given of the German dendrochronological project which includes the Danish oak-coffin graves. The results are not yet published, partly due to certain interpretative problems arising from the comparison of the West German and Irish series. However a small number of dates are now accessible in the literature (125). Out of eight Danish oak-coffins, seven show a good agreement between the dendrochronological and C 14 datings (Fig. 4).

Up to the early 1970's much research effort was concentrated on Southern Scandinavia's participation in the larger European network of bronze exchange. At the heart of these studies stood the works of Ebbe Lomborg (127), Henrik Thrane (206), Klaus Randsborg (164) and Jørgen Jensen (66) which emphasized the Danube region's decisive importance for the Scandinavian bronze industry. At the same time it could be shown how there were shifting centres for exchange in the broad contact zone in northern Germany and Poland. The general character of the exchange was also discussed (69, 72, 74, 75, 206), and during the later years there has been a tendency to see the diffusion of the metal objects as a combined result of regular contact between local settlement units in combination with more organized trading expeditions extending over long distances (115).

TOWARDS AN INTEGRATED APPROACH

All the way up to the 1960's Danish archaeology was profoundly marked by the positivist mode of thought which to a large extent regarded archaeological facts as self-explanatory. Diffusionism, with its vaguely formulated concepts concerning, for example, "cultural influence", was the dominant theoretical framework, which meant, for Bronze Age research, that the study of the chronology and provenance of the bronze objects was eventually treated as an end in itself.

New approaches were introduced in the 1970's, when an attempt was made, through the use of neo-evolutionary concepts, to correlate the stages of prehistoric development with certain levels of social organisation on an evolutionary scale involving bands, tribes, chiefdoms and states. An example of this was Jørgen Jensen's comprehensive synthesis in vol. 1 of *Dansk socialhistorie* (72) and *The Prehistory of Denmark* (74). Neo-evolutionary terms were above all considered of heuristic value, in that they functioned, in Max Weber's sense, as "Idealtypen", which should indicate the direction for further research. They thus had some renovatory influence on archaeological research and contributed to the development of new modes of analysis.

Around 1974 Klavs Randsborg had already published a series of works (165, 166, 167, 168) pointing new directions. Through a series of simple, quantitative analyses based upon the weighing of metal artefacts in early Bronze Age graves it was shown that great differences in both wealth and social status must have existed in the Bronze Age population. These major, but graduated differences in status expressed themselves in the grave goods, which for men were rich weapons, badges, folding stools and other objects of symbolic value. The number of women with high social status only seemed to have been half that of men, to judge by the number of identifiable women's graves with metal grave goods. Furthermore a clear correlation could be shown between the degree of social stratification and the supposed density of population in the early Bronze Age settlement areas. This was demonstrated by a comparison of the distribution of graves and an evaluation of the agricultural potential of the different regions of Denmark. The conclusion was that Bronze Age society was stratified by rank and that the graves known from the thousands of Bronze Age barrows only derived from a limited segment of the prehistoric population.

A related analysis dealing with the late Bronze Age was published by Henrik Thrane in 1981 (227). In this the number of bronze artefacts or amber in more than a thousand graves from periods IV to VI was used to show a strong prevalence of graves without metal objects, followed by graves with 1, 2, etc. metal objects. The distribution has a clearly pyramidal shape sharply pointed at the top where exceptional graves of the Lusehøj type lie.

Thus both from the early and late Bronze Age a picture emerges of a society which is interpreted as reflecting a hierarchical chiefdom structure, with unequal access to prestige goods, characterized by the intensive consumption of personal wealth in burials and hoards (108, 113, 114). The rank of the Bronze Age chiefs was expressed in sumptuous goods including both personal ornament and political symbols, such as horse gear, helmets and vessels. These objects were apparently used not only in daily life, but served important ritual functions as grave goods and offerings (124).

Through studies of traces of wear on the bronzes, especially on swords, it has also been suggested that there existed a more complex system of rank comprising chieftains with ritual functions at the top and below these a group of warriors without special ritual functions (56, 106, 107).

As yet it has proved possible only to a limited extent to give these observations a geographical dimension. The size of the postulated chiefdoms, for instance, which must have manifested themselves in a hierarchical settlement pattern, is still an unsolved problem. In some places however it has been possible to integrate the above viewpoints with topographical studies, for example through locating the centres of wealth which existed in the late Bronze Age on the Danish islands (72, 75, 230, 232, 233).

These centres of wealth have been interpreted as nodal points in the network of exchange connections which linked the individual chiefdoms together. In terms borrowed from social anthropology, it has been suggested that they represent a theocratic prestige goods system with religious/political dualism, status rivalry and competition between chiefs over trade, with powers of chieftainship based on the political monopolization of production, on alliances and on long-distance exchange (108, 115).

The use of a neo-evolutionary framework has served, as noted, important heuristic functions. But it is also clear that it has often resulted in rather static, generalizing models, which are not adequate for explaining variability or change in the archaeological record. This has become evident as the ideological manifestations of wealth and status do not only have a geographical dimension but also a chronological one, and a series of significant fluctuations appear through the Bronze Age. This has already been noted in connection with Janet Levy's studies of the Bronze Age hoards (121, 122, 123, 124).

An analysis of this variability is also found in a series of Kristian Kristiansen's works (98, 102, 104, 108) which deal with the development of ritual norms through Bronze Age periods I to VI as they are expressed in burial rites and the habit of depositing hoards. At the beginning of the early Bronze Age, period I, bronze objects are rarely deposited in graves. The major portion of the imported bronze is invested in deposits which generally belong to the male sphere. The picture is different in period II: wealth and social status are now shown through extensive barrow building, and both men and women are buried with rich grave goods. Hoards, mainly of men's weapons and tools, are also deposited although the share of women's ornaments is strongly on the increase.

In the succeeding period III the building of barrows wanes and cremation is introduced, but the deposition of sumptuous goods in both male and female graves continues. Metal, be it men's weapons and tools or women's ornaments, is relatively seldom deposited in hoards.

At the beginning of the late Bronze Age, period IV, the display of wealth and social status through burial rites dwindles. In general both male and female graves include only a few bronze objects, which are often of symbolic character such as miniature swords. The number of hoards by contrast increases and the volume of objects belonging to the female sphere is clearly increased. This development culminates in period V in which only few richly furnished graves are constructed. A majority of bronze objects are however still invested in hoards. The volume of women's goods is greater than ever previously. But besides these there appears a large group of objects, lurs, shields, helmets, hammered bronze vessels, horse gear and so on, which must be seen as attributes of a male, priestly role.

After the final flourishing of Scandinavian Bronze Age culture there is a break in the traditions of a thousand years. Both men's and women's effects disappear from the hoards, and eventually the deposits cease. The volume of bronze objects in the graves also diminishes further.

The pattern of variation sketched here is important for an understanding of the internal dynamic of Bronze Age culture and to overcome some of the explanatory limitations of the neo-evolutionary approach. Attempts have therefore been made to isolate some of the factors which influenced the variations. Kristian Kristiansen, for example, has pointed to fluctuations in bronze supply as they appear through the analyses of wear on prestige bronzes which indicates how long the bronze objects circulated before deposition (96, 98). Fluctuations may also be understood through independent evidence, for instance of the quantity of bronze invested in casting prestige objects. Bronze supplies seem to have increased up to period II and the beginning of period III, which represents a peak, before supplies begin to fall back. A second peak, not as high as in period II, comes in period V, but after that the importation of bronze declines drastically to virtually cease in period VI (98, 102).

Attempts have also been made to investigate the relationship with the subsistence economy. The picture here is as yet unclear, although increasing exploitation of the landscape is visible from period II, apparently culminating in the reorganization of the settlement pattern in period VI, at the same time as the southern imports end. It is as yet too early to draw extensive conclusions about the coincidence of these factors, but they may, eventually, lead to the understanding of some of the general conditions and developmental processes that govern the relationship between material function and cultural form in ranked and stratified societies (108).

Thus Bronze Age research in Denmark in the last 15 years has followed a pattern characteristic of a great deal of European archaeology. A diffusionist research tradition was replaced at the end of the 1960's and the beginning of the 1970's by a new trend closely associated with various forms of neo-evolutionism in social anthropology. In order to overcome some of the limitations in this explanatory framework, evolutionism has been further developed with theories which can explain the structure and internal dynamics of specific social systems. In Danish archaeology several Bronze Age researchers have aimed a showing how the interplay between the internal structural situation and adaption to external factors are the driving forces behind the development of prehistoric society. It has to some degree been possible to show that development at times goes in jumps which can bring either cultural flourishing or decline, crises or collapses. General evolutionism has thereby partly been abandoned for more concrete models of historical development.

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Appendix 1

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Appendix 2

Excavations of Bronze Age house sites

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National Museum j.nr. 4689/82, unpublished.

2. Gl. Køgegård vest, Køge parish, Copenhagen county.
Køge bys historie 1288–1988 (ed. Helge Nielsen) Køge 1985, p. 15.

3. Torstorp Nørreby, Høje Tåstrup parish, Copenhagen county.
Preben Rønne: Gård på vandring. *Skalk* 1986, 5.

4. Balderhøj, Ishøj parish, Copenhagen county.
Søllerød Museum 1986, unpublished.

5. Vesterled, Fløng parish, Copenhagen county.
Søllerød Museum 1986, unpublished.

6. Gundsøgård, Gundsømagle parish, Copenhagen county.
Roskilde Museum j.nr. 572/83, unpublished.

7. Jersie Strand, Jersie parish, Copenhagen county.
S.Å. Thornbjerg: Bronzealderboplads ved Jersie Strand, *Køge Museum* 1987–82, s. 85–92; *Køge bys historie* 1288–1988, ed. Helge Nielsen, Køge 1985, p. 16 fig. 11.

8. Skamlebæk radiostation, Fårevejle parish, Holbæk county.
E. Lomborg: Bronzealderbopladsen på Skamlebæk radiostation, *Antikvariske Studier*, 1, 1977, p. 127–30.

9. Byhøj ved Hyllerup, Slagelse St. Peders parish, Sorø county.
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Pre-Viking and Early Viking Age Ribe

Excavations at Nicolajgade 8, 1985–86

by LENE B. FRANDSEN and STIG JENSEN

Between 1970 and 1976 large-scale excavations were carried out in Ribe on the north side of the river at the *Kunstmuseum* and in *Dommerhaven* (Fig. 1:1 and 2). This was fundamentally a research project and the aim was to confirm the written sources' testimony of Ribe's great age and the town's important place in the Viking Period. The excavations confirmed that a rich trading place with international connections and diverse craft activities existed here – but long before the written sources' first reference to Ribe in *circa* 860.

A new opportunity to excavate in this intriguing area arose in 1985 when the construction of a cellar covering 90 sq.m. barely 30 metres from the *Kunstmuseum* was planned (Fig. 1:3). Since the building work would probably affect culture layers from the trading site, a trial excavation of some 5 sq.m. was undertaken in the summer of 1985. The results of this excavation tallied well with the data from the 1970's. The uppermost two metres or so consisted of recent topsoil and filled features from the Medieval and Renaissance periods. Below this were layers and finds of a different character. The finds appear principally to date from the end of the later Germanic Iron Age and the early Viking Period. The layers represented workplace activities: extremely find-rich, jumbled layers separated by thin sand or clay layers and spreads of charcoal, which altogether formed a picture of differentiated phases of activity and levelling layers (Figs. 2–3).

After the trial excavation there was no doubt that the whole area of the planned cellar should be dug. The excavation began on April 1st, 1986, and continued for 5 months. The results were no disappointment: several thousand finds and substantial new data and new ideas about the character of the foundation and subsequent development of Ribe.[1]

The purpose of this, strictly provisional article is primarily to throw some light upon the relative chronology and development of the site, and at the same time to report some of the artefact-material which has the greatest chronological significance. Thirty-four *sceattas*, moulds for decorated objects and pottery may be mentioned here.

The time dimension is a significant factor. How many years did it take to accumulate the series of layers we have looked at? Did the site have a long or a short functioning period? The upper part unfortunately was dug away, so the nature of the development on the site later in the Viking Period cannot be conclusively determined here (L.B. Frandsen & S. Jensen 1988).

The artefacts clearly reflect the primary importance of trade and craft on the site. Detailed analysis of the site's external connections and of the particular functions of the workplaces must wait for the time being until the whole material has been processed. It may however be mentioned here that wasters and detritus from bronzecasting, beadmaking, combmaking, amber working and more have been found.

THE EXCAVATION

The uppermost layers, from historical times, were removed by machine. The knowledge of the primary culture layer's colour and consistency we had obtained from the trial excavation in 1985 made it relatively easy to stop the excavation at the right level. From here the site was dug by trowel. To the north about one metre of the culture layer was preserved while the southern part – beside the river – was substantially dug away. Layers from historical periods reached the natural here.

As stated, the culture layer was composed of intermittent thin deposits which fortunately were only interrupted in certain places by major interventions such as some Medieval pits which reached the natural. The site therefore was mostly covered by primary culture deposits.

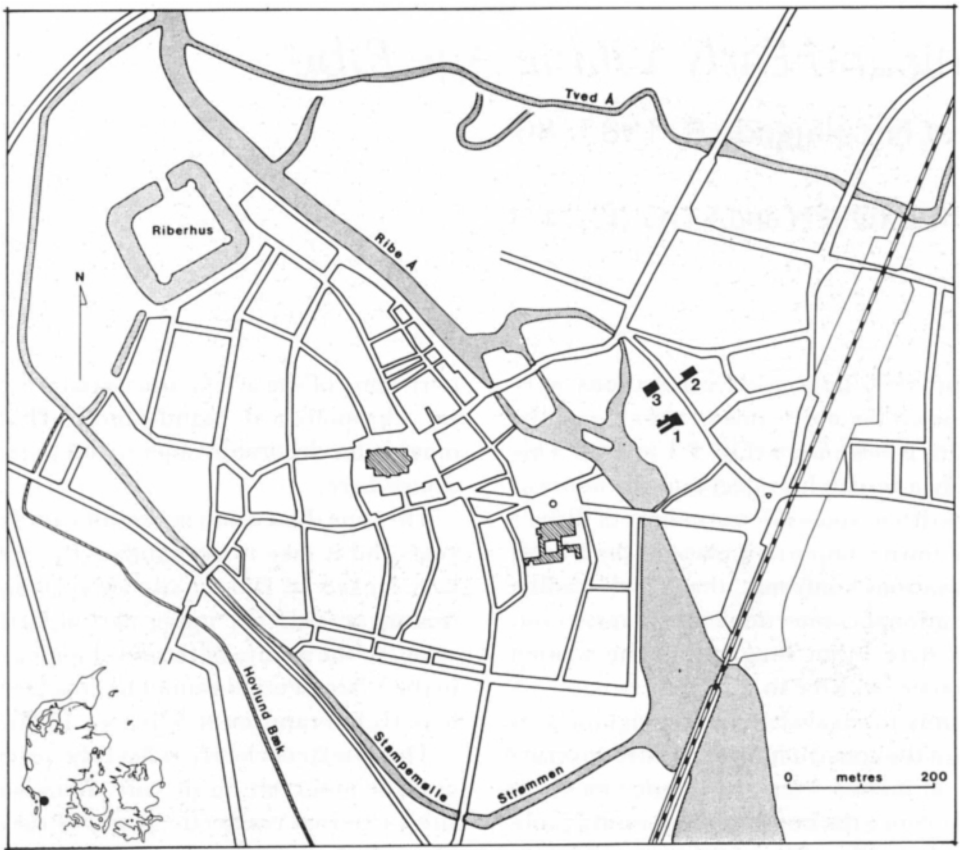

Fig. 1. Map of Ribe with the position of the excavated sites mentioned in the text: 1, the *Kunstmuseum*; 2, *Dommerhaven*; 3, *Nicolajgade* 8.

Our excavation technique was to follow, as far as possible, the natural layers, and we treated the description of the individual layers' internal relationships very carefully so that subsequently all layers could be placed within the relative chronology of the site. In practice the predominantly stratigraphic method of excavation resulted in a very uneven site, where the surface level of the same or contemporary layers could vary by up to half a metre (Fig. 3). This was the result of the means in which the culture deposits were built up. A recurrent sequence of hearths lay one above another around the middle of the site, and here the layers were thickest, diminishing towards the sides. In some places the stratigraphy was quite complicated, not least because some of the layers were narrowly confined, and not visible in the sections.

In order to form a clear picture of the stratigraphy of the site, it was necessary to work systematically and to take as a basis the direct relationship between just two layers at a time, which can only be expressed as one of four patterns (Fig. 4). It was then possible, step by step, to build up a picture of the interrelationship of all 283 layers. The result is presented as a sequence diagram or Harris matrix (C. Orton 1980). A minor segment of the diagram for Nicolajgade 8 is shown in Fig. 5.

The matrix provides the overview which is needed in order to group the sequence of layers. Firstly those layers are picked out which fall together in some interpretative unit, such as ditches, settlement layers, workshop layers, etc. Most of the layers can be categorized as workshop layers, which can further be divided into a series of workshop levels. The lines of demarcation between the individual workshop levels are put at natural breaks, for example where a sand or charcoal layer runs unbroken across the site.

Everything points to continuous deposits, and given that the functioning period of the site was long enough for typological development in the artefactual material, it should in principle be possible to show a series of development. Before we delve more deeply into the rela-

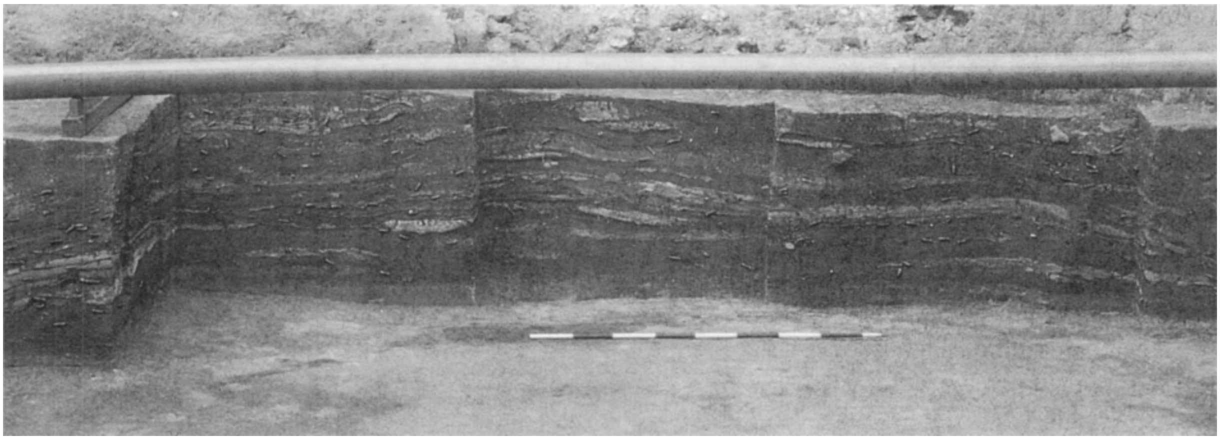

Fig. 2. The northern section of the excavation at Nicolajgade 8. Note how the layers decend on both sides of the middle part of the section. The view is somewhat disturbed by a drain running through the site. Photo by Stig Jensen.

Fig. 3. Photo showing the undulating surface appearing when the naturally deposited layers are uncovered – here a pale clearence layer sloping and disappearing towards the ditch (G2). In the foreground the trial ditch of 1985 is seen at the base of which the turf layer can be discerned. Photo by Lene B. Frandsen.

tive chronology of the finds and the absolute dating of the site we must describe the stratigraphy and development of the site.

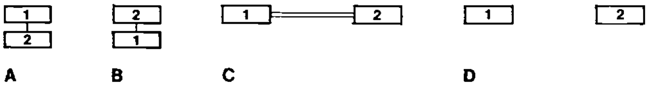

Fig. 4. Illustration of the four possible ways to describe the relationship between two layers: A, 1 is younger than 2. – B, 1 is older than 2. – C, 1 and 2 are contemporaneous. – D, no relation between 1 and 2 is established.

THE DEVELOPMENT OF THE SITE

On the basis of the schematic section-drawing, Fig. 6, which is the principal result of the stratigraphic analyses, our interpretation of the development of the site can be summarized as follows:

The Settlement Layer: Above the natural, which is composed of water-deposited sand, and on top of the old surface level, lies a dark brown, homogeneous culture layer which includes an amount of charcoal, pottery, bones and a few loomweights. This layer, which is de-

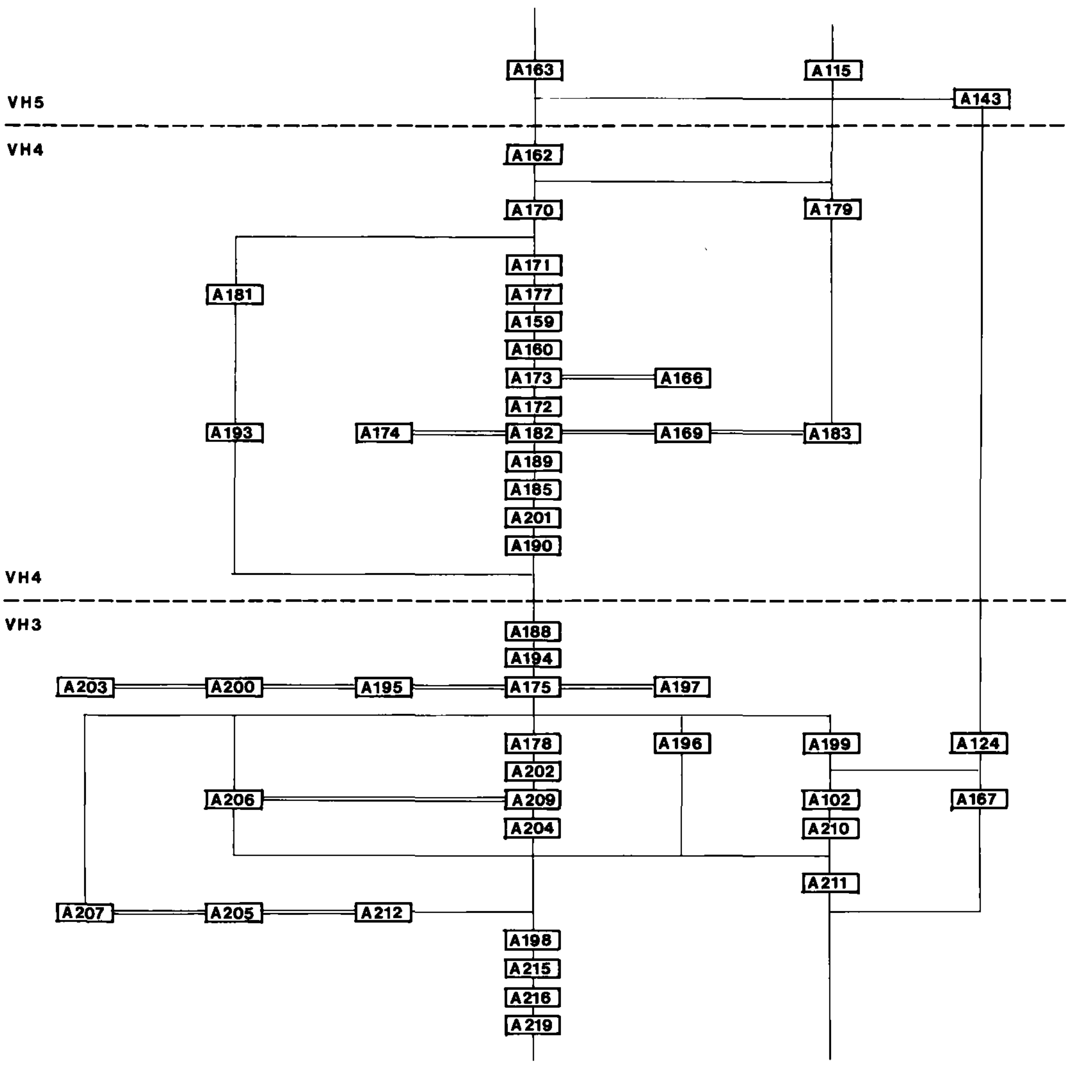

Fig. 5. Part of the sequence diagram for Nicolajgade 8. The limits between the individual phases are indicated by dotted lines. Framed numbers refer to layers and features.

void of finds associated with trade or industry, is interpreted as detritus from a village settlement which was situated here before the site developed into a trading place.

The Turf Layer: In the north-eastern part of the site the settlement layer is covered by a layer of inverted turves. The function of this is a little uncertain, but since the earliest workplace layer lies directly above the turves, which have a place in the delimitation of ditch 1, these turves must have been put in place in connection with the establishment of the trading place. Perhaps they simply reflect the clearance of the site, preparatory to its development. When we came across the turf layer in the trial trench of 1985 it was suggested that the turves could be a stage in a manuring process called *træk* (G. Lerche & S. Jensen 1986). After the 1986 excavation, however, the theory of a clearance layer seems more probable.

Ditch 1 (G1): As stated, the turf layer is placed so that the turves form the edges of the course of a ditch. This line is interpreted as the boundary of an early tenement-division of the trading place, as is corroborated by the subsequent development of the workshop levels.

The Workshop Levels (VH): Altogether the workshop

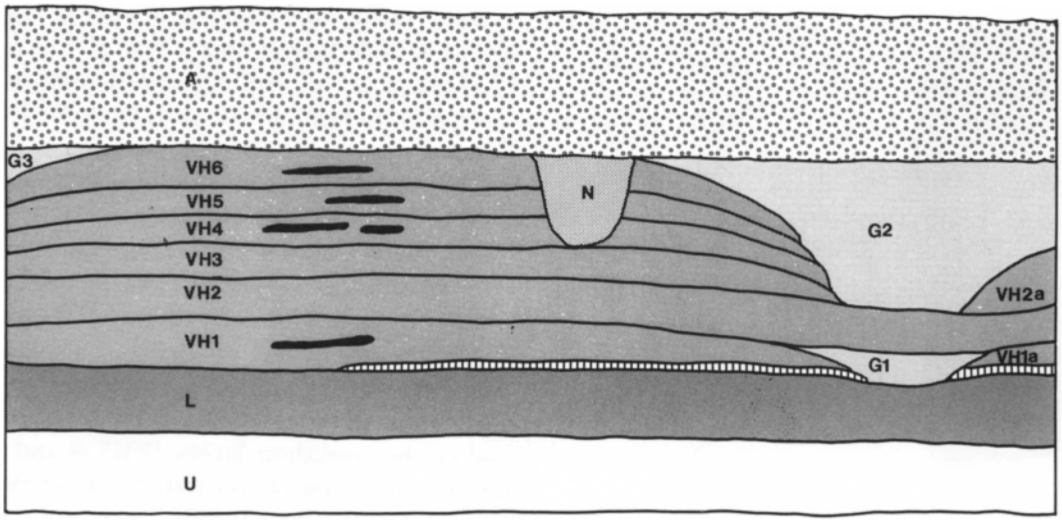

Fig. 6. Schematic section showing the principal stratigraphy of Nicolajgade 8, seen from the south. – U, subsoil consisting of water-deposited sand. – L, the settlement layer. – Vertical hatching: inverted turves. – VH1–6 and VH1a–2a: workshop levels. – G1, the oldest ditch. – G2, the youngest ditch. – N, disturbance. – A, layer representing the levelling of the site in later times.

levels form a culture layer about one metre thick, comprising workshop floors, hearths, levelling and rubbish layers from various workshop activities. The earliest levels, VH1 and VH1a lie directly on top of the turf and the settlement layers, to the west and east of ditch 1 respectively. After some time the ditch was filled up, and in the following phase, VH2, the layers run largely unbroken across the site. Any possible tenement-division at this stage has not left any trace of itself behind. It is difficult to say how long this period lasted, but the character of the site does not otherwise appear to change, in that there are uninterrupted traces of trade and industry in the finds.

Above VH2 the levels VH3–6 are built up. This follows the same pattern as before: the most substance in the centre, around the hearths, diminishing evenly towards the sides. At this phase the ditch is recommissioned. The question consequently arises of whether there were some form of visible boundary which the individual workplace areas respected, since the layers re-appear again and again so precisely on the same place. East of the ditch the workplace layers belonging to the neighbouring area are built up. These are situated so close into the limit of excavation that only the thin outermost layers were revealed. It was not therefore possible to group the workshop layers here, so that everything above VH2 in the eastern area is labelled VH2a.

Ditch 2 (G2): The cavity or ditch which is found between the two workplace areas is filled with collapsed detritus from higher-lying workplaces. Stratigraphically ditch 2 is clearly later than the workshop levels which encompass it. The finds however appear to show that the time between the latest workshop levels VH5–6 and the filling of ditch 2 was short.

Ditch 3 (G3): The course of a further ditch could be detected parallel to ditch 2 at the western side of the site.

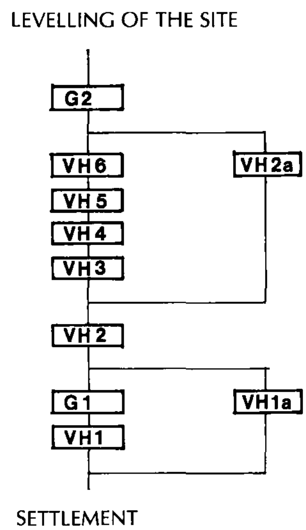

Fig. 7. Schematic stratigraphy of the site.

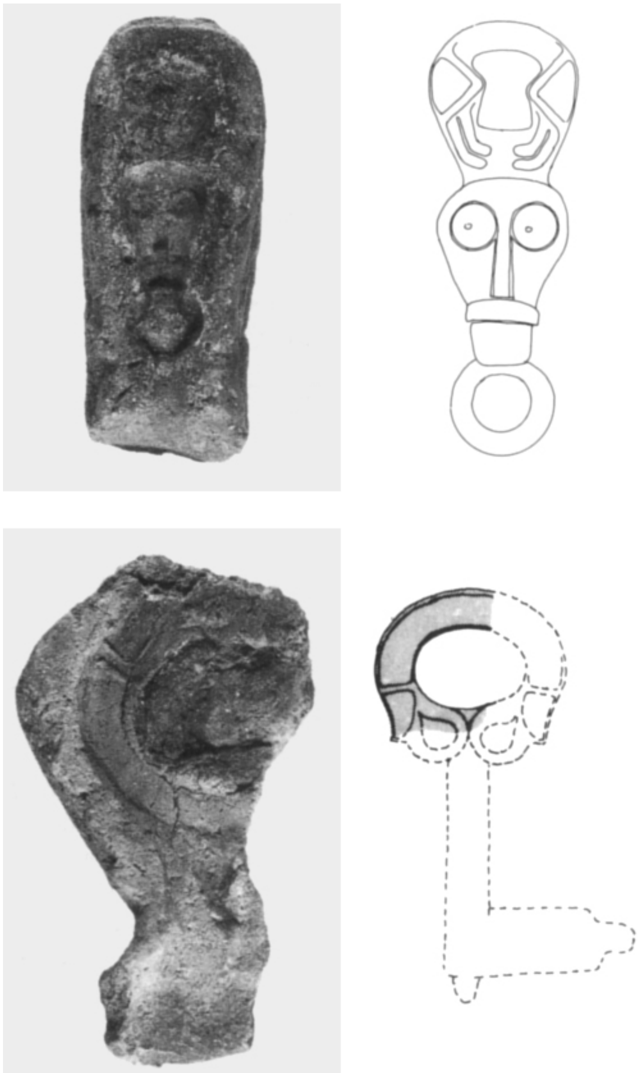

Fig. 8. Moulds for a mask and a key ornamented in style D. 1:1. The metal objects are reconstructed in drawing. Drawn by Jørgen Dich.

Since it was not possible to extend the site further in this direction we were only able to record the edge of this western ditch, G3, and unfortunately no finds came out of it. The distance between the two ditches is six metres.

The Cutting (A): The uppermost workshop level and the top of ditch 2 are sharply cut across. The intrusive layer's mixed contents of Renaissance-period, Medieval and Viking-age pottery renders an accurate dating of the intervention difficult.

Other Features (N): The later periods' activities have naturally left their mark. The site was, as has been stated, disturbed by individual features of the Middle Ages. Of considerable interest are a few pits in the top of the workshop layers with apparently unmixed Viking-age ceramic material, presumably from the late Viking Period.

In brief the following development took place on the site (Fig. 7). To start with there was an ordinary village settlement placed near the river bank. At some point the terrain was levelled out with turves, and the site divided up by a system of ditches (G1) into a series of working areas (VH1 and VH1a). The site was subsequently levelled again (VH2) and for a short time there are no boundaries between the working areas. Thereafter the workshop layers (VH3–6 and VH2a) again grow up separately on either side of the ditch (G2), which filled up after VH6 was deposited. The workshop detritus in G2 shows that industrial activities were continuing on the site, but for how long is unknown because of the removed section (A).

DATING

We have seen how it was possible to establish a relative chronology of development on the site by stratigraphic means. In what follows an attempt will be made to relate this chronology to the conventional period system. The datings will be based upon the style-forms which are represented in the mould material, after which the coin finds are brought in. Only a selection of the remaining material will be dealt with as we have only had time to analyze a little of it. Having thus established a chronological framework for the development of the site, the pottery is considered – primarily the rimsherds.

Most of the mould finds appear in the workshop layers, especially in VH2 and VH3. Two types are found within this group – keys and anthropomorphic masks – which are decorated in Style D (Fig. 8). This style is introduced towards the end of Phase 2 of the later Germanic Iron Age, but appears most frequently in Phase 3 (M. Ørsnes 1966: 224).

A number of mould fragments were also found in the uppermost, eastern ditch (G2). Amongst these were a few moulds for tortoise brooches of the Berdal type, which may be dated to the early Viking Period (O. Klindt-Jensen & D.M. Wilson 1965: 50). There were also two mould fragments with a virtually identical

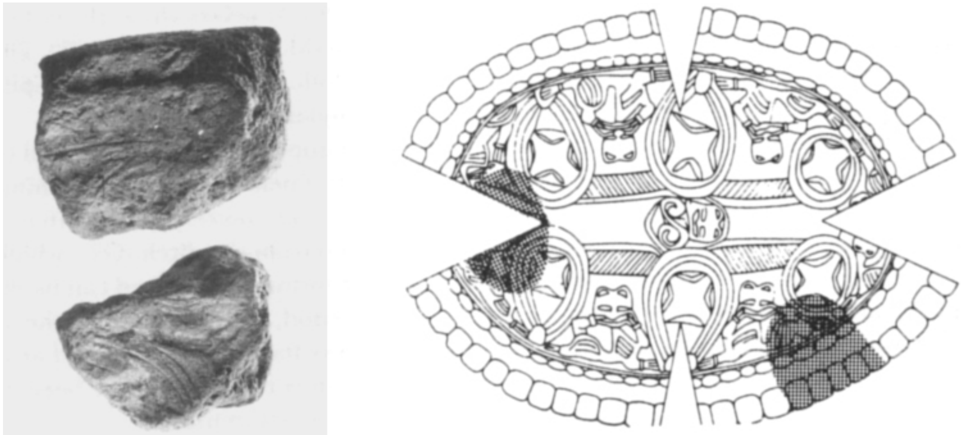

Fig. 9. Two fragments of moulds for brooches of the Berdal Type. 1:1. The position of the fragments is shown on the drawing. Photo by Rita Fredsgaard Nielsen.

form (Fig. 9). It has not yet been possible to determine what artefact-type was cast in these, but it seems that both of them included small mask-like animal heads in their decoration. These are similar to the heads on the gripping beasts of the Berdal brooches, but their long ears are more reminiscent of the Borre-style beasts. This style appears in the early Viking Period (O. Klindt-Jensen & D.M. Wilson 1965:62).

From the occurrence of stylistic characteristics, the workplace layers – at least the lower half – can be dated to Phase 3 of the later Germanic Iron Age and the ditch (G2) to the early Viking Period. As will be seen, this tallies well with the coins discovered, which are all *sceattas*.

Sceattas are small Frisian and English silver coins with a diameter of about 12 mm. A total of 34 of these coins were found in the excavations of 1986. These go to the Coin Collection of the National Museum, where they are analyzed by Kirsten Bendixen. At the time of writing only 30 of them have been cleaned, of which 29 are of the Wodan/monster type and one of the Maastricht type.[2]

Wodan/monster-type *sceattas* are thought to have been struck in the period from *circa* 720 until the currency reform of Pepin the Small in 755, when a larger and thinner coin-blank was introduced (K. Bendixen 1981). Finds in Frisia show no circulation of *sceattas* there after this date. It is however probable that Wodan/monster-type *sceattas* were in circulation for longer in Denmark as they seem to have served as models for the earliest Hedeby coins from *circa* 800 (K. Bendixen 1981; B. Malmer 1986: 70). One may therefore presume that most of the *sceattas* found in Ribe came into the ground within the period in which the type was produced, 720–755, while subsequently they circulated to a lesser and lesser degree towards 800.

Thirty-two of the thirty-four *sceattas* found in 1986 came from the workshop layers, while the two were within a disturbed layer. The thirty-two *sceattas* were distributed with 19 in the lowest third (Fig. 6, VH1–2 and G1), nine in the middle third (VH3–4) and four in the uppermost third (VH5–6). It is therefore reasonable to suppose that the production period of the coins, 720–755, falls within the period in which the lower two-thirds (VH1–4) of the workshop layers were formed, since twenty-eight of the *sceattas* found came from these. The uppermost workshops (VH5–6), where only four *sceattas* were found, may have been deposited in a period with a diminishing circulation of the coins.

The stratigraphy of Nicolajgade 8 in Ribe clearly shows that Pepin the Small's currency reform was not as obviously effective here as was the case in Frisia. If that had been the case one should expect the occurrence of *sceattas* to cease abruptly within a clearly restricted section of the sequence of layers and not, as was the case, to diminish gradually. Now one might argue that all the workshops layers were deposited over a small number of years within the period 720–755, within which the coins are thought to have been struck. The other finds, however, contradict this, especially the pottery. As appears below, a clear development from workshop level VH1 at the bottom to VH6 at the top can be demonstrated in this find-class. It appears that the pottery from VH1 is more closely associated with the pottery from the underlying settlement layer (L) than with the uppermost workshop levels. The pottery from these conversely carries great similarities to the material from the uppermost, eastern ditch (G2). The details of this ceramic development are given in the next section, and it simply may be declared here that it undoubtedly represents a period of time which is longer than the 35 years in which *sceattas* of the Wodan/monster type were struck.

As already stated, mould fragments carrying Style D appear a little below the middle of the workplace layers. These moulds can be placed in Phase 3 of the later Germanic Iron Age, which is usually dated 725–800 (M. Ørsnes 1966: 24). Since the moulds with Style D are all included in the series of layers which include the most *sceattas*, it is clear that the datings of the two groups of finds support one another as well as can be.

Amongst the moulds from the uppermost, eastern ditch (G2) appear Berdal-brooch forms, and two forms apparently decorated in the Borre Style. The filling of the ditch can thus be dated to the early Viking Period, the early 800's. It is significant in this context that *sceattas* were not found in this otherwise markedly find-rich fill.

One must be very wary of backing a relative chronology with absolute dates, since such absolute dates are often quoted all too definitely without the qualifications which were originally put to them. Despite this danger we shall try to place absolute dates on the development of the site, but it must however be emphasized that our analyses are still of a provisional character.

The lowest workshop level (VH1) contains no fewer than twelve *sceattas*. Bearing in mind that *sceattas* were not found in the very deepest workshop layers and that many *sceattas* appear in the higher workshop levels, it is reasonable to accept that workshop level VH1 was established in the first quarter of the 8th. century.

The underlying settlement layers do not contain data which lend themselves to a close dating, but it may be emphasized that the pottery from this context is closely linked to the material from VH1. A dating of the settlement deposits to the period around 700 is therefore probable. This dating is supported by the excavation in *Dommerhaven* of 1974 (Fig. 1:1 and 2). Here there was similarly evidence of activities within a rural settlement immediately before the earliest deposits from the trading site (M. Bencard 1979: 115). The timber from a well which belongs to this settlement phase was felled in 710 (V. Mejdal 1983: 31).

The uppermost workshop level (VH6), as stated, belongs to a period with a diminishing circulation of *sceattas*. Since the pottery from VH6 is closely linked to the material from the ditch (G2), which on the basis of the mould forms it contained can be dated to the early Viking Period, it is probable that the uppermost workshop level was formed in the period around 800. The fill of the ditch is thought to have been deposited in the first half of the 9th century.

The uppermost workshop levels are disturbed by a series of cuts (N) of the later Viking and Medieval Periods. The dating of these activities is dealt with elsewhere (L.B. Frandsen & S. Jensen 1988).

THE POTTERY

A considerable amount of pottery was recovered in the excavation. In this provisional publication we shall concern ourselves primarily with the local pottery and simply add certain comments on the imported ware. The material is in sherd form, and only in a few cases has it been possible to join these into larger pot fragments. We have chosen, therefore, to concentrate on the rimsherds, and have – with some exceptions – subgrouped them according to the same principles as were used for the more or less contemporary sherds from Südsiedlung at Hedeby (H. Steuer 1974).

In all, 189 rimsherds of local provenance which can be associated with a definite phase of the development of the site were found. They fall into three major groups, pots with inturned rims, pots with vertical rims and pots with lightly out-turned rims. There are also a few rimsherds from pots with strongly out-turned rims.

Fifty-five of the rimsherds are *inturned* (Fig. 14), and their distribution through the individual levels is seen in the diagram, Fig. 10. It is immediately apparent that these vessels do not appear in the earliest deposits, and that only one sherd of this type appears in VH2. They are more frequent in the following level, VH3, and subsequently form a greater and greater portion of the material up through the layers. In the uppermost ditch, (G2), 70% of the rimsherds are inturned.

If we look more closely at how the individual types of

	214-	114-	414-	414a	2131	1131	
G2	3	5	5	8	1		22
VH6	1	1					2
VH5	9	5			3	2	19
VH4	3		2				5
VH3	6						6
VH2	1						1
VH1a							
VH1							
L							
	23	11	7	8	4	2	55

Fig. 10. Inverted rims: Distribution and variation within the sequence.

inturned rims are distributed in the sequence of layers we find the following picture. The earliest inturned rims are all tapered (214–). From VH4 and 5 come also parallel-sided rims which can be either rounded-off (114–) or faceted (414–). All of these types also appear higher up, in G2. However a new form also occurs in this ditch – faceted and thickened rims (414–A) (Fig. 14: 3, 7). This type thus does not appear before the early Viking Period.

Six of the inturned rims are provided with a groove beneath the rim (1131 and 2131) (Fig. 14: 5). These types appear in VH5 and G2. As appears in Figs. 12 and 13, such characteristic grooves also appear on pots with vertical and lightly out-turned rims, likewise only in the upper half of the sequence of layers. It can also be stated that generally there are more variants of the inturned rims in the later levels than in the earlier ones.

Although it has not been possible to reconstruct complete profiles, there can be little doubt that many of the inturned rims come from hemispherical vessels. In a number of cases it has been possible to assemble sufficiently large body sherds to form a reasonable image of the profile.

The material also includes 57 sherds from *pots with a vertical rim* (Fig. 14: 1, 4). Their distribution through the individual layers is seen in Fig. 11. It transpires that the sherds represent a large number of Steuer's rim-forms. Some of these forms are dealt with in groups in what follows, in order to form a better overview. This also results in a reduction of the force of statistical uncertainties.

Pots with the rim continuing evenly into a vertical body (224– and 124–) are found in three examples, all in the lowest workshop level. Such virtually straight-sided vessels have also been found in a sunken hut at Karby on Mors which is dated by brooches to Phase 3 of the later Germanic Iron Age (S. Nielsen 1985: 275). On the

	224-	124-	1211	1213	1212	4211	2211	2213	1231	1233	3233	1232	2233	2231	
G2			1					1		1				1	4
VH6			3					1					1		5
VH5				2			1	1			1	1			6
VH4			2	3			1		1						7
VH3			1			1	2		2	1					7
VH2			1	1	1		1								4
VH1a	1	1	1				1								4
VH1	1		5	6		2	2								16
L			1	2		1		1							5
	2	1	15	14	1	4	8	4	3	2	1	1	1	1	58

Fig. 11. Vertical rims: Distribution and variation within the sequence.

	1313	4313	4311	2311	1311	2313	5311	2331	3311	4312	1312	
G2	1			1							1	3
VH6	4			1				1		1		7
VH5			1	1				1	1			4
VH4	1	2		2	2							7
VH3	3			3	2			1				9
VH2	2				2		1					5
VH1a	1		1		1	1						4
VH1	1		1	1	17							20
L	1	1	3	1								6
	14	3	6	10	24	1	1	3	1	1	1	65

Fig. 12. Slightly out-turned rims: Distribution and variation within the sequence.

	A	B	C	D	E	F	
G2		13	3	8		4	
VH6		2	2				
VH5		14	8			2	
VH4		5	1		1	3	
VH3		6	4		1	2	
VH2		1			2	2	
VH1a	2						
VH1	1				8		
L							
	3	41	18	8	12	13	

Fig. 13. Selection of chronologically significant pottery elements from Nicolajgade 8.

same site sherds from a similar pot were found in a layer which was cut by the sunken huts. The finds in Ribe indicate that there the type goes out of use in an early part of the 8th century. It is of interest here that pots with almost vertical sides are known from a late stage of the later Germanic Iron Age at Stengården, East Jutland and Darum, north-west of Ribe (S. Jensen 1982: fig. 1,5 and 1987).

Rimsherds from almost straight-sided pots can be hard to differentiate from the rims of hemispherical pots. The problem is the greater since the earliest hemispherical vessels, for example from Lindholm Høje, seem to be more straight-sided than the later ones (S. Jensen 1982: figs. 4 and 5). This development seems also to be traceable in the finds from Ribe.

Pots with a parallel-sided vertical rim (1211, 1213 and 1212) which goes over into the body with a slight curve form quite a large group, 29 pieces in all. Twenty-six of these appear in deposits below VH5 in which they form a characteristic element in the finds.

Short, faceted rims (4211) occur in four cases from the settlement layer up as far as VH3. Vertical, tapering rims (2211 and 2231) occur in twelve instances. These are evenly distributed through all the layers and do not appear to be chronologically significant.

Nine of the sherds are characterized by the provision of a groove below the rim. These are distributed amongst six different rim-forms (1231, 1233, 3233, 1232, 2233 and 2231), whereby an immediate impression of their diffuse occurrence is gained. If however the group is examined as a unit a clearer picture emerges in which it can be seen that these are found only in the upper half of the sequence of layers, from VH3 upwards.

Pots with a slightly out-turned rim are the largest group of ceramics from Nicolajgade 8. The group comprises 63 rimsherds divided amongst eleven different forms (Fig. 12). The group is very varied, and we shall refrain from commenting here upon the chronological distribution of the individual rim-forms. It may simply be pointed out that only two examples of the group occur in the ditch (G2) above the workshop levels, and thus the group is highly characteristic of that phase of the development of the site. It may also be noted that the group includes three sherds with a groove under the rim (2331). This feature appears, as with the other two principal groups, from VH3 and later in the sequence of layers.

The final major group, *pots with strongly out-turned rims*, is represented by eleven rimsherds. Since this group is both very diverse and evenly spread throughout the sequence of layers it will not be dealt with in any greater detail here.

It is quite evident that the 189 rimsherds certainly associable with particular levels from Nicolajgade 8 can be divided into a series of rimforms of which some occur only in a limited part of the sequence of layers. The distribution of some of the chronologically most significant of these is given in Fig. 13. It may be seen how the straight-sided pots (A) are associated with the earliest workshop level. In the next level (VH2) pots with inturned rims appear (B), a type which becomes increasingly common as the sequence progresses. A particular version of the inturned rim, with a thickened, faceted rim (D) is found only in G2. Rim-grooves (C) are found on pots with inturned, vertical and slightly out-turned rims. This feature appears in VH3 and subsequently is a characteristic element on the site.

The rim-forms in Fig. 13 represent 80 pots, or no less than 43% of all rimsherds. It is arresting that so great a proportion of this material is attributable to types which only occur in some part of the sequence of layers. The most obvious explanation of this must be that the development from the settlement level up to the uppermost ditch extended over a considerable number of years. The ceramic finds thus corroborate in the best possible manner the dating of the development of the site which was constructed above on the basis of coin finds and style-forms.

Twenty-five *bases* or *basal sherds* can be distinguished in the material. Twelve of these come from vessels with a plane base, and these occur primarily in the earliest deposits (Fig. 13E). In the second group we find round and unstable bases – pots with convex bases. This category can be difficult to distinguish in a collection of sherds since there naturally is no sharp boundary between the side and the base of the pot. It is therefore probable that a thorough sifting of the ceramic finds would increase the number of such bases. Thirteen rounded bases were found in the provisional sorting, and these appear from VH2 upwards through the sequence (Fig. 13F). It is reasonable to link the dominance of the round bases in the upper part of the sequence of layers with the increasing appearance of hemispherical vessels. One must not overlook, however, the point that some of the lightly rounded bases belong to pots with vertical or out-turned rims.

Handles of normal form do not appear at all in the ceramic remains from Nicolajgade 8. Two unusual forms however come from G2, a handle which sat on the inside of the rim and thus was protected from the flames of the fire, and a suspension hole through a lug pinched out of a rim. These two suspension devices are also known at Hedeby, a good chronological correspondence to their appearance in G2 at Ribe (W. Hübner 1959: Taf. 3 and 4).

Only a small percentage of the sherds are *ornamented*. Most common is stamped and simple linear ornament. The most frequent motif amongst the stamps is the cross-in-circle. There are also ring stamps, round latticed stamps and rhomboidal chequered stamps. Although loomweights are not to be dealt with here it should be noted that several of these are decorated, one with the impression of a key.

Imported pottery is as yet only very superficially studied. It appears in all the workshop levels and in G2 but not in the settlement layer. The imported wares divide

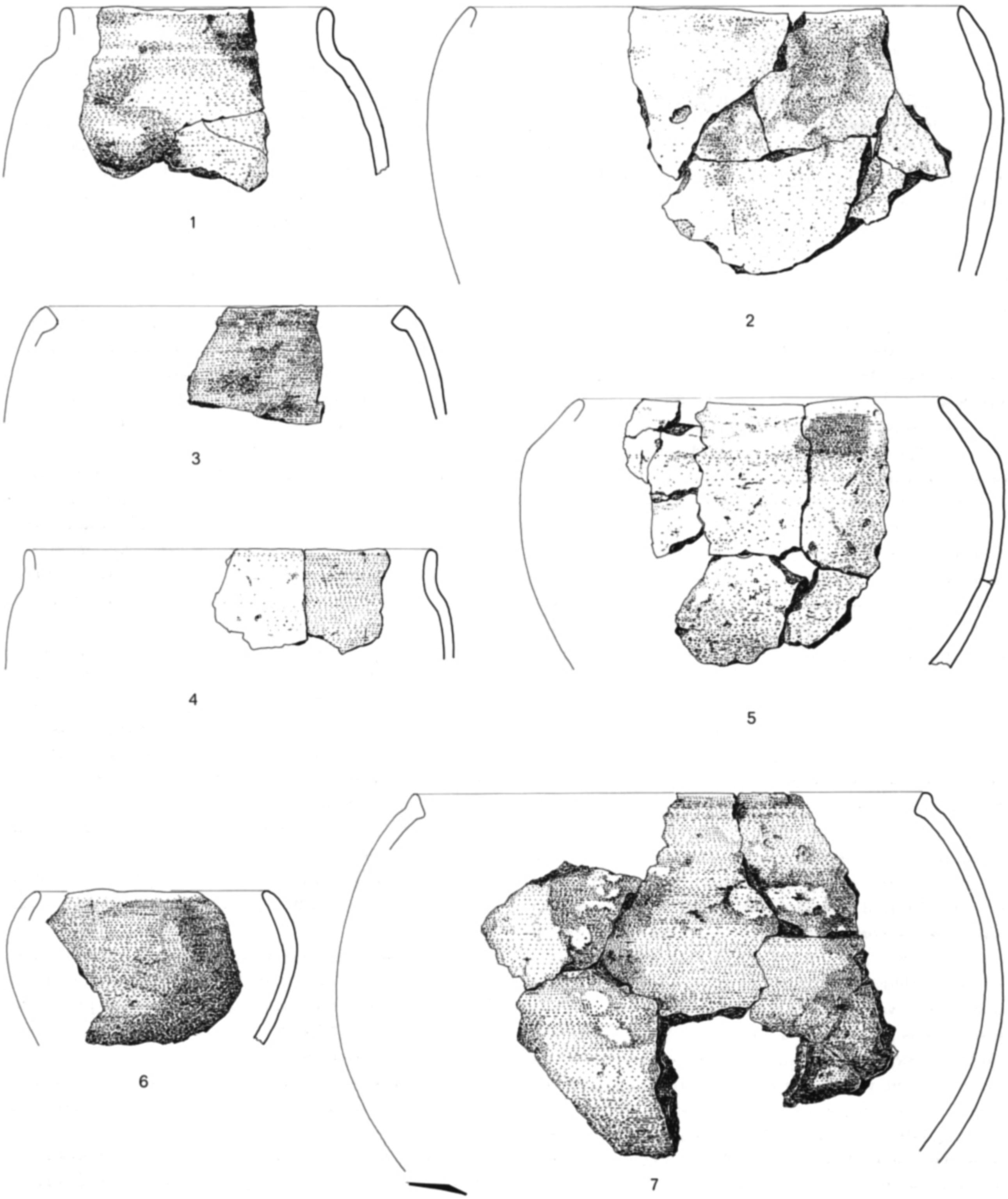

Fig. 14. Pottery from Nicolajgade 8. Drawn by Jørgen Dich. 2:5.

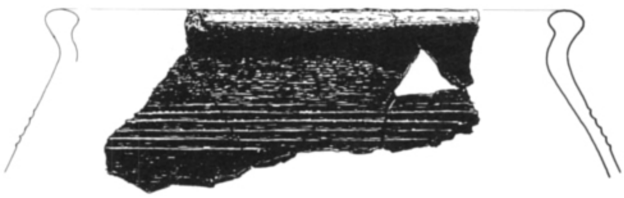

Fig. 15. Sherd of vessel of grey-brown fabric (imported). Drawn by Jørgen Dich. 2:5.

into several groups which are easily distinguishable from the domestic, handmade pottery. There are, *inter alia*, several types of grey and yellowish stoneware-like fabric, including the characteristic Badorf ware with rolled stamp. These occur only in VH6 and G2, which agrees perfectly with the conventional dating of the group to *circa* 780–880 (H. Steuer 1975: 107).

A grey-brown, tempered and medium- to hard-fired fabric was also found (Fig. 15). It occurs in all levels from VH1 upwards, apparently without any essential variation. The basal sherds are flat and carry traces of rotation-grooves, the rims signs of a ledge for a lid. Bands of incised grooves are also characteristic. The type, especially the rim section, has certain similarities with Medieval globular pots and one should in future take heed of the danger of confusion.

THE FUNCTION AND CHARACTER OF THE SITE

The character of the substantial culture deposits, and particularly the finds from them, clearly shows that, with the exception of the settlement layer at the bottom, we are not dealing with any common agrarian settlement. The craft production on the site had a character and range which far exceeds what an ordinary village could take on. The many imported objects similarly show that there has been lively trade on the site.

Most of the manufactured articles have a clearly luxurious character: glass beads, bronze jewels, amber beads, gaming pieces, etc. The glass goods render it quite possible to pursue the beadmaker's craft right from the imported raw material in the form of raw glass lumps and mosaic sticks to various fused, drawn glass claws and threads together with fully made glass beads of varied kinds (Fig. 16). Moulds, crucibles, furnace slag and various lumps of metal can be associated with bronzecasting. Great quantities of amber were also found. Most pieces are unworked, but pieces with drilled holes and faceted sides show that some dressing took place here. Besides these crafts there is also detritus from combmaking and ironworking.

A very great quantity of the finds can be linked to particular craftwork, and the remains of individual crafts often lie in concentrated groups. Unfortunately the levelling layers and the dynamic activity on the site have frequently blurred the picture of the size and situation of the individual workplace areas. In three cases it has however proved possible to show delimited workplace floors in the form of clay layers, one with an associated wall ditch (Fig. 17). Alongside these may be considered the many hearths which overlie one another approximately in the middle of the main area.

The good conditions for observation in the light levelling layers between the workshop ensure that we cannot have overlooked remains of substantial constructions such as sunken posts. The general impression is therefore that the workshop were not of a permanent character but were protected by light and simple structures. In some cases the craftsmen may have sat and worked in the open. The major excavations of the 1970's gave the same indications (M. Bencard 1979: 118).

It is therefore reasonable to propose that the workplace layers may have been deposited in connection with certain regularly recurring market situations, where many people have been collected on the site. In this case, the earliest Ribe must have been a seasonal trading place, which does not however exclude the possibility that it existed in association with a permanent settlement and/or a major estate. The phenomenon of the division into areas being maintained through approximately a hundred years is best explained through the presence of some permanent authority, which must also have been able to ensure the peace of the marketplace and access to and from the site. It is also reasonable to conceive that trade and craft activities might have spawned a permanent settlement which gradually evolved into a true Viking-period town.

Ribe is situated where the north-south traffic on the land crosses a water route, the Ribe river, directly connected with the tidal sea. Adam of Bremen describes Ribe as encompassed by a flood, by which ships could steer to Frisia, England and Saxony (I. Skovgaard-Petersen 1981: 51). Although this is a source of the end of the 11th century, it certainly also describes the situa-

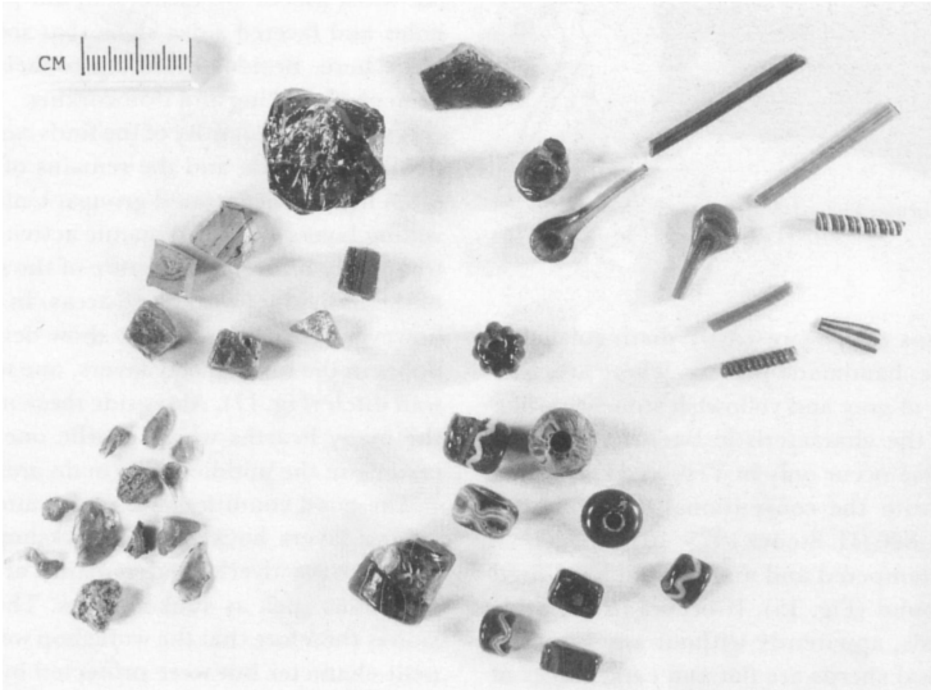

Fig. 16. Raw material, detritus, semi-manufactures, and finished products from the bead production at Nicolajgade 8. Photo by Rita Fredsgaard Nielsen.

tion of the earliest Ribe, a communications crossroad with international connections. The artefact material also reflects these southern contacts. From the Rhineland came glass beakers, pottery and basalt lava quernstones. From the same area we probably get the raw materials for the jewellers, such as raw glass for the beadmaker and bronze and precious metals for casting. On at least one crucible fragment traces of gold have certainly been identified.

The craftsmen seem to have produced their wares for the local market and not for the foreign merchants. Thus the bronzes belong to Scandinavian types. The beads are north-west European types but have local characteristics and are presumably not produced by craftsmen from the south. For whom the imported goods were meant we do not know. Some of the imported goods, especially the basalt quernstones, were traded further out in contemporary rural settlements of the region, but whether Ribe thus served as a transit point for the remainder of Scandinavia is as yet an open question.

The numerous *sceattas* found constitute the particular feature which best shows that Ribe is a most special site in the Scandinavian context. Adding in the *sceattas* from the earlier excavations there are now 66 *sceattas* found in Ribe. The earlier *sceatt* finds have already given numismatists the occasion for a lively debate (K. Bendixen 1981, B. Malmer & K. Jonsson 1986 and D.M. Metcalf 1986). On the one side, Metcalf has suggested that the marked appearance of Wodan/monster *sceattas* could be explained through the striking of these in Ribe. This is rejected by Malmer and Jonsson who believe that the frequency of Wodan/monster *sceattas* is because this type is later than other *sceattas*. Coin loss in Ribe would then only have taken place after the other *sceatt*-types had gone out of use.

We will not disguise the fact the many of the arguments which have been brought into this discussion lie on the fringes of our particular expertise. However we cannot deny that the situation in Nicolajgade 8 supports Metcalf's case. It is remarkable that there are no instances of Porcupine *sceattas* in the lowest layers or together with the earlist deposits of Wodan/ monster *sceattas*. If the *sceattas* found in Ribe came from Frisia one might expect that the currency reform of Pepin the Small in 755 would have a more marked influence here, or that at least some of the coins which replace the Frisian *sceattas* ought to appear. A better basis

Fig. 17. Nicolajgade 8. Clay floor during excavation. The floor continues beyond the eastern section where further examination was not possible. Photo by Lene B. Frandsen.

for the continuation of the discussion will undoubtedly result when the coin finds from 1986 are fully conserved, and the individual coins analyzed by Kirsten Bendixen.

Whether the king had coins struck in Ribe in the first half of the 8th century or not, a series of circumstances indicate that there must have been a central authority present. The tenement division shows that the trading place was a planned site from the first, and that it was possible to maintain the division through about a century. In this context it is reasonable to refer to two great and important constructions which were built in the same period, namely Danevirke, from 737, and the strategically important Kanhavekanal on Samsø from 726 (H.H. Andersen, H.J. Madsen & O. Voss 1976 and H.H. Andersen 1985). Could these be attributable to one and the same royal power?

Translated by John Hines

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NOTES

1. ASR journal no. 7. The excavation was led by Lene B. Frandsen with the assistance of the following students: Karen Magrethe Boe, Tine Engelund, Claus Feveile, Lene Lund and Ragna Stidsing, together with staff from *Den antikvariske Samling*. The project was carried through with resources from *Rigsantikvaren*. The excavation results were provisionally recorded in S. Jensen 1986.
2. Information kindly provided by Kirsten Bendixen.

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On the Dating of Medieval Pottery

– in the Light of Recent Finds from Ribe

by PER KRISTIAN MADSEN

This paper discusses some problems of dating medieval pottery, which are relevant not only to Ribe. I will begin by summarizing some main points in Danish research on medieval pottery. A more thorough review of the literature on this subject has been published elsewhere (Madsen 1987).

THE DATING OF LEAD-GLAZED WARE – A STANDARD QUESTION

A landmark in medieval studies – not only in pottery research – was the late Vilh. la Cour's publication of the totally excavated castle mound of Næsholm in North Zealand (la Cour 1961). Næsholm, which is not mentioned in any preserved written source, is only a small moated site, with the remains of a brick tower, which was uncovered by la Cour. The excavation technique did not entirely correspond to present-day methods, and lacks a stratigraphic basis for the dating of the mound and the finds. It is astonishing that la Cour claims that 90% of the 7000–8000 sherds of pottery on Næsholm were lead-glazed (la Cour 1961: 115, 136) (fig. 1). The dating of Næsholm, or its period of function, relies on the find of 302 coins, only 140 of which could be identified, and which were scattered in the layers. The identified coins were struck within the period 1241–c. 1332, and accordingly la Cour dates the occupation of the site to ca. 1240–1340 (la Cour 1961: 118). This proposed dating of Næsholm may have seemed convincing, since it fits almost precisely the so-called "standard dating" of lead-glazed pottery in northwestern Europe – 1250–1350 – which can be traced through the literature back to the works of G.C. Dunning (cf. Hurst 1964; Lüdtke 1985: 56). This dating, however, has mainly to do with the distinctive group of lead-glazed pottery that is termed "highly decorated", a group that consists mostly of elaborated jugs, and which spread from the coastal zones of the North Sea and the English Channel. The standard dating does not allude either to the dating of medieval lead-glazed wares as such, or to the occurrence of glaze in the area bordering the North Sea (cf. Hurst ed. 1971; Verhaeghe 1982).

This was already clear when the term "standard dating" and the whole problem of dating medieval pottery were introduced to Danish medieval archaeologists by Mogens Bencard in his paper on the anthropomorphic glazed jugs of Southern Scandinavia (Bencard 1973). These jugs may themselves be considered examples of the highly decorated wares, and later research has shown a rather differentiated development and dating of this special kind of pottery decoration (Bencard 1979; Madsen 1980; Broberg & Hasselmo 1981; Erdmann 1982). In his conclusion to the paper in 1973 Bencard is aware of the fact that lead-glazed jugs are not limited to the period 1250–1350, although he accepts this frame as a temporary working hypothesis (Bencard 1973: 170). This well-considered conclusion became for the coming years the standard reference for Danish publishers of medieval pottery, whenever glazed pottery occurred in an excavation (cf. Madsen 1982 and 1986 with references). In a paper on a few finds of pottery from Ribe, I tried to demonstrate that this too uncritical use of the standard dating – and of the more or less tentative datings of various sorts of imported pottery – will be seriously misleading, especially when it comes to the interpretation of find complexes (Madsen 1982). That the standard dating really constituted a problematic restriction became clear from excavations in Ribe, the results of which have by now been confirmed by later excavations (Madsen 1988a), cf. below, and could furthermore be demonstrated in a correlation between the standard dating of glazed pottery and the results of the excavation "Århus Søndervold" in Århus (Andersen, Crabb & Madsen 1971).

Fig. 1. Three of the best-preserved, lead-glazed and decorated jugs from Næsholm. After la Cour 1961. Scale 1:4.

In Århus only a few pieces of imported lead glazed pottery were found. Glazed sherds, however, do occur rather early in the layers, as the detailed schemes in the publication show. Although the excavators tend to believe that some glazed sherds have been mixed into older finds by accident (Andersen, Crabb & Madsen 1971: 96), it seems clear that the use of the standard dating on the material as a whole would have increased the dating of the layers and finds from the 13th and 14th century by at least 25 or 50 years (Madsen 1982: 88).

THE GREY-FIRED WARES

This postponement would also include the change from soft-fired greywares to hard-fired wares, which is dated to the beginning of the 13th century (Andersen, Crabb & Madsen 1971: 263). In my 1982 paper, I recommended that pottery dating be based on the mass-produced, dominant and probably mostly local greywares, in order that various locally founded chronological and typological schemes could be constructed, independent of such fixations as the standard dating of glazed pottery and the accidental occurrence of imports (Madsen 1982: 88). In the following, I shall try to apply these points of view to some finds from Ribe, which were either not known in 1982 or were not yet ready for study. A full account awaits publishing (Madsen 1988a).

The grey-fired sherds are separated into two groups according to fig. 2. The system also includes other main sorts of pottery (cf. the "Rahmen-Terminologie" by a group of North German archaeologists: Erdmann *et al.* 1984; Lüdtke 1984), and if necessary it may be extended by a further group, which could be called "A0", corresponding to the "godstype I" (Viking Age and Early Middle Ages) of Århus Søndervold (Andersen, Crabb & Madsen 1971: 76). A1 is an intermediate group, in firing and tempering, and a forerunner of A2. Group A2 consists of hard-fired, well-tempered and often thin-walled

A		B		C		D		E	number	weigth grams	museum number
1	2	1	2	1	2	1	2				

Fig. 2. Classification of pottery finds. The following groups are used: A1 reduced, rather soft wares. A2 reduced, hard fired wares. B1 lead-glazed wares, red- and/or grey-fired. B2 as B1, but with applied slip or decoration in pipeclay. C1 sherds of unglazed and partly glazed pipeclay. C2 glazed pipeclay. D1 Pingsdorf wares. D2 near stoneware, including Paffrath ware. E stoneware.

Phases	Pottery groups A 1	A 2	B 1	B 2	C 1	C 2	D 1	D 2	E	number	weight
X	41	26	11	22		13	3	7		123	1750
IX	9	2	1			4				16	127
VIII	2	4	1			2				9	60
VII	7	3	1			8	1	4		24	170
VI	4	2						3		9	50
V	81	98	2	6		16	5	7		215	2250
IV[1)]	65	71		1	1	6	6	11		161	3065
III	79			2		2	3	5		91	845
II[2)]	59				3		3	1		66	1550
I	29				2	2	2	4		39	525
Total	376	206	16	31	6	53	23	42		753	10392

1) House with wall post (with sapwood and bark), felled in the autumn of 1179.
2) Refuse container of wooden planks, from trees, which were felled not earlier than the year 1144.

Fig. 3a. All pottery finds from all phases of the excavation at Sct. Catharine's Square in Ribe. The datings of the various phases rely partly on dendrochronological evidence.

Phases	B		C					Total
			Andenne		North France (Rouen)			
	B1	B2	partly glazed/ glazed	glazed, rouletted	bichrom.	green glazed	Others	
V –*c.* 1225	2	6	3		4	4	5	24
IV 1179/80 –		1	3	1		2	1	8
III Before 1179/80		2					2	4
II after 1144			3					3
I *c.* 1150			4					4
Total	2	9	13	1	4	6	8	43
	B: 11 sherds		C: 32 sherds					

Fig. 3b. The glazed pottery including both groups B and C from phases I–V in the excavation on Sct. Catharine's Square. After Madsen 1986.

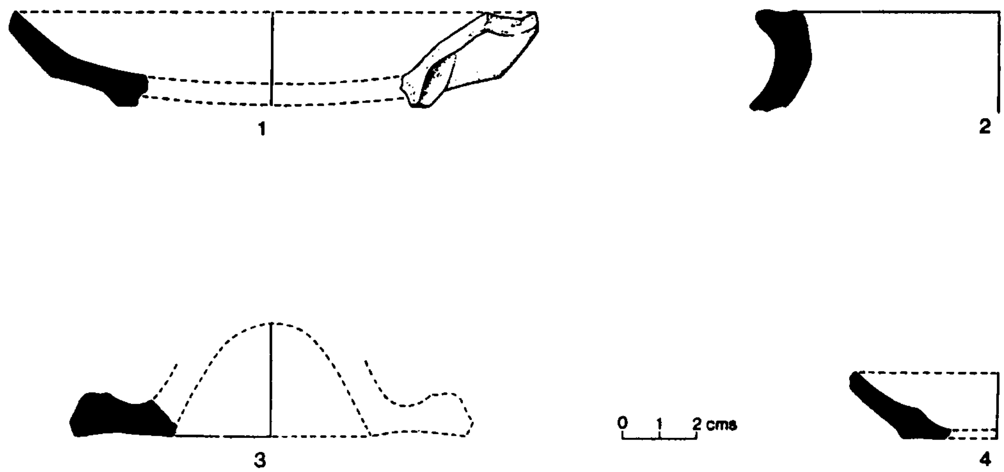

Fig. 4. Sherds of Andenne pottery from Sct. Catharine's Square, belonging to the second part of the 12th century. 1: base sherd from a partly glazed jug, phase I. 2: rim sherd, probably from a partly glazed pot or bowl, phase II. 3: base sherd from a candlestick, phase II. 4: base sherd from a partly glazed jug, phase IV. After Madsen 1986 (with further references). Drawing Aage Andersen.

greywares of the High Middle Ages, corresponding to "*godstype II*" in Århus.

Fig. 3a–b gives the total number of sherds along with further separations of the glazed pottery from the five oldest phases of an excavation near Sct. Catharine's Church in Ribe. This excavation revealed the remains of several houses, one on top of the other. The best-preserved house was a wooden building (phase IV), whose erection was dated by dendrochronological analysis. This proved that the house was built at the end of the year 1179 or in 1180. Underneath this house was in phase II a wooden construction, probably a refuse container, which was dated to the time after 1144 (Madsen & Mikkelsen 1985). The glazed pottery in fig. 3b belongs to 21 separate layers, which are all related to the various phases. The number of glazed sherds – 43, which corresponds almost to the number of vessels represented – comprises 7.5% of all sherds in phases I–V, and it appears that lead-glazed pottery was used in Ribe before 1200 (Madsen 1986).

Even so it still has to be discussed where this glazed pottery was made – 32 of the glazed sherds have a fabric of pipeclay, which means that they are probably all imported. This is, for instance, the case with the pieces of Andenne pottery that could be recognized (fig. 4). Of course pipeclay as a raw material could have been imported to Ribe, as it probably was in the early 12th century for the covering of unglazed floor tiles in the church of Sct. Laurentius in Roskilde (Møller 1968).

It needs mentioning that Hartwig Lüdtke, in his book on the large pottery find from "Schild" in Slesvig, suggests that some distinctive, small jugs or flacons with a blackish lead glaze might have been made in Slesvig from imported pipeclay (Lüdtke 1985: 55). The dating of these vessels in Slesvig is somewhat imprecise (c. 1200), but recently two similar miniature jugs have been recognized in Lübeck and in Alt Lübeck, which are both dated by dendrochronology: Lübeck before 1173 and Alt Lübeck c. 1100 (before 1138) (Andersen in print, personal communication from H.H. Andersen, Moesgaard and W. Erdmann, Lübeck, cf. Erdmann

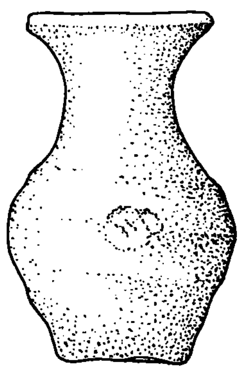

Fig. 5. Miniature jug or flacon with blackish lead glaze. Inside the jug is a small ball of fired clay, which may have helped to keep the contents fluid, when shaking the jug. After Petersen 1985. Drawing Aage Andersen. 1:1.

Trench B Layer	A		B		C		D		number	weight	ASR 1 no. X
	1	2	1	2	1	2	1	2			
BC	1	21	3	2			4	3	34	740	14
BC		38	20	5		5	4		72	1200	15
BE ●		38	226	7		4	1	9	285	2760	16
BF ● ●		4	7						11	200	17
BG		180	4	4		2	7	7	204	2221	18
BH			1	1		1			3	20	19
BT		150	18	14		26	1		209	1750	20
BAN		25				3			28	147	21
BAR		4							4	357	22
BK	21	229	7	12	3	17	4	20	313	2646	23
BN		7							7	46	24
BAO		20						1	21	95	25
BAS	2	4	1					2	9	60	59
BL	17	22				1		7	47	685	26
BM	152	1	4	19		13	2		191	988	27
BP	180					4	10	18	212	1530	28
BAP	210				1	8	3	15	237	947	29
BAU	25						3	15	43	219	30
BQ=BAQ (BAÅ)	202					1	14	31	248	2263	31
BBA	4							4	8	82	32
BAV	1	6			1		1	13	22	257	33
BAW	19					1			20	321	34
BBB	4								4	33	35
BR	29			2		1			32	540	36
BR_1	244						8	80	332	1667	37
BS								1	1	5	38
BT	87						19	24	130	1059	39
BU	8							1	9	50	40
BV	35							3	38	200	41
BX	134					1	6	21	162		42
BAH	1								1	10	43
BAI	9								9	160	44
BW	6					1	7		14	80	45
BW II	70		1			2	4	18	95	650	46
BY + BZ	81	(5)			8	2	25	26	147	1230	47
BAA	45					2	8	36	91	940	49
BAB	16	2				2	5	1	26	210	51
BAC	27					1	2	3	33	240	52
BAD	11						1		12	160	53
BBG	1								1	10	54
BAE ? BK	19						2	1	22	275	55
BAE	77						2	5	84	1030	56
BAG	58			1	1		1	9	70	560	57
BAK	10				1			1	12	230	58
Total	1806	756	292	67	15	98	144	375	3553	28873	

Fig. 6. All pottery finds from the excavation at Riberhus which could be related to the main section. A drawing of the section was published in JDA vol 2, 1983, p. 164. Only those layers that contained pottery finds are shown to the left. Brickbats occur only in layers BC to BAN, however not in BH and BT. ● indicates coin finds, see fig. 7. A code for the groups of pottery is given in fig. 2.

1984: 108). Such miniature vessels are also found in Ribe, but unfortunately none of them can be firmly dated (fig. 5) (Petersen 1985: 106; Madsen 1988 (b)).

The remaining 8 sherds are all from red-fired vessels, and only scientific analysis could show, whether the raw material for these sherds is Danish or foreign. It is a fact that green lead glaze is used on a decorative frieze of slender columns and arches which forms the upper parts of the side walls of the brick church in N. Løgum some 40 km south of Ribe (*Danmarks Kirker, Tønder Amt*: 1525). A dendrochronological dating of the timber from the original, preserved roof of the church indicates that the roof was constructed 1188 ± 1 year (Madsen 1986: 62). Lead glaze on probably locally made floor tiles, which were laid at the end of the 12th century in the Cistercian abbey church of Sorø, central Zealand, also indicates that knowledge of glazing was at hand in Denmark before 1200 – and probably not only among brick- and tile-makers (Als Hansen 1982). This seems all the more convincing, since red-fired, lead-glazed pottery is also present in Lübeck at the same time, dendrochronologically dated before 1173 (Erdmann 1985; 1986).

Fig. 3a also shows that the change from A1 to A2 is gradual, as it runs through the phases. IV–V. This means that this transition starts in the last decades of the 12th century, and that it takes place in the same period as the forerunnes of the glazed jugs arrive in Ribe, at a time before such imports as Pingsdorf- and Paffrath-wares begin to leave the market (cf. Bencard 1973: 173; Madsen 1982: 80). These tendencies from a rather limited but well dated excavation can be further illustrated by other finds from Ribe (cf. Madsen 1988a).

In 1980 a trial excavation was carried out in the centre of the massive earthwork of the castle of Riberhus. The topographical results were briefly mentioned in JDA (Jensen, Madsen & Schiørring 1983), when all the finds had not yet been investigated. The scheme (fig. 6) shows all pottery sherds which could be related to the main section. No relevant dendrochronological dates are at hand, and the few coins found all belong to the uppermost zone of layers (fig. 7). They testify that deposition did not cease earlier than after 1300 – although at a time when no real stoneware had yet reached Riberhus.

All layers from the bottom and including BAR were devoid of traces of bricks. The estimated dating of the beginning of brickbuilding in Ribe Cathedral is c. 1200 (*Danmarks Kirker, Ribe Amt*: 188ff., 242; *Sønderjyllands Amt*: 2657, 2664), whereas the earliest known use of bricks in medieval Denmark takes place c. 1160 in Ringsted on Zealand. Still, we know of the great brick wall at Dannevirke in Southern Slesvig, built by Valdemar I before his death 1182, almost contemporary with the church in N. Løgum (*Danmarks Kirker, Sønderjyllands Amt*: 2640, 2664, 2740). In Lübeck the first traces of bricks being used for the construction of town houses are recognized in the 1170s (Erdmann 1986: 375). All this could mean that bricks might have been in use in Ribe some decades before 1200, since their presence in the cathedral does not need to be their primary introduction in the town (cf. I. Nielsen 1985: 54).

Layer	*Coins*			
BE	Erik Glipping	(1259–1286),	Ribe,	(MB 214 or 219)
	Erik Menved	(1286–1319),	Ribe,	(MB 471)
	Duke Valdemar	(1283–1312),	Slesvig,	(MB 492 var.)
	1 coin with no stamp			
BF	1 coin, not identifiable			

Fig. 7. Five coins were found in the layers of Riberhus – four of them are from BE, the last one from BF. The coins have been identified by the Royal Collection of Coins and Medals, The National Museum. The abbreviation MB refers to Mansfeld-Büllner 1887.

Whatever the case, the scheme fig. 6 shows that the relative development of wares is the same at Riberhus as in the excavation on Sct. Catharine's Square. It indicates the presence of glazed pottery at Riberhus as in the town before 1200, although this does not mean that this or any other ware was in common use or known to the same degree all over Ribe. Most of the glazed pottery is foreign (C1 and C2), but we are still left with the problem of the origin of the red-fired sherds (B1, B2). Predominant among the early imports are Paffrath and Pingsdorf wares, which are both frequently met with in Early medieval contexts in Ribe (Bencard 1972; Madsen 1982). In this respect it should be noted that sherds of near stoneware are found already from layer BT, and although their amount is only small, their relative part is clearly growing – as the Pingsdorf and Paffrath wares gradually disappear. This points to a rather early date for the incipient transistion from Pingsdorf and Paffrath to near stoneware, a good deal earlier than suggested from the coin hoard from Obbekær some 8 km east of Ribe, where a near stoneware "Kugelbecher" with splashes of red iron wash or "Sinterengobe" was buried in c. 1240–50 (Liebgott 1978a: cat.no 15; Madsen 1988c).

If we return to the largest part of the sherds, the groups A1 and A2, we can observe a gradual change between these two groups, which starts before the occurrence of bricks. According to this, the change seems to be fulfilled before 1200 or even earlier. In Århus, the bottom zone of that series of layers which are dominated by the hard-fired greywares (*godstype II*, corresponding to group A2 in Ribe), did not contain any traces of bricks, and the first bricks occur c. 1200, followed by lead-glazed bricks by the middle of the 13th century (Andersen, Crabb & Madsen 1971: 225). The relative development in Århus and Ribe seems to be synchronous, whereas there might be some differences in the exact datings. In Århus, the change between the two groups of greywares, which are discussed here, is dated to the beginning of the 13th century. The finds from Sct. Catharine's Square and from Riberhus point to a somewhat earlier dating, but it is important to notice that an intermediate group similar to Ribe's A1 also exists in Århus, where it is dated to the 12th century (*ibid.*: 81–83 (Ic–e); 263). These rim shapes have been paralleled by those finds from Ribe that were published in 1982 (Madsen 1982), and although there may have existed some real chronological and formal differences between the pottery from the two towns, a somewhat earlier dating of the change of the Århus-finds could be considered.

In the town of Slesvig it seems through the work of H. Lüdtke that a change in the 12th century grey-fired wares runs almost parallel to that in Ribe. Lüdtke does not establish a separate group as A1, but in his general remarks there are several indications showing that this would probably have been possible (Lüdtke 1985: 43). The existence of a group like A1 is also indicated by some North German finds (Schindler 1952: 120; Erdmann 1984: 103), especially the pottery from the dendrochronologically dated well in the castle of Lübeck from the second part of the 12th century. The well itself was built in 1155 and used only during that century (Fehring 1979). Pottery like A1 has also been distinguished in Ålborg, Viborg and probably Randers (Kock & Vegger 1982; Krongaard Kristensen 1982; Stürup 1977). Further probable parallels are from the later phases of the settlements Omgård, Vorbasse and Sædding in Jutland (L.C. Nielsen 1980: 205, fig. 32, 4–7; Hvass 1980: 171, fig. 34,2,4 & 6–7; Stoumann 1980: 117, fig. 28).

It appears that the separation of the grey-fired pottery from larger finds into three different groups, as described here, may help to distinguish the pottery of the Early Middle Ages (A1) from that of the following period (A2). The dating of the period of change between these two groups of pottery can be indicated to some degree, although some real geographic differences may exist. It must also be possible to distinguish wares of group A1 from Viking Age pottery (A0). The occurrence of A1-wares and shapes (*exclusively* globular pots with everted rims) in Viborg in circumstances that are clearly datable to the decades immediately around the year 1000 (Krongaard Kristensen 1982) indicate that this somewhat harder-fired type of pottery, which was formerly considered to be purely medieval, was also present in the late Viking Age. I am here dealing only with the western part of Denmark, leaving out the Early medieval Baltic wares, which dominated Eastern Denmark until c. 1200 (Liebgott 1978b: 10).

Those tendencies which the finds from Ribe allow us to discuss and compare with results from abroad point to a pronounced need for thorough publication of stratigraphic excavations from various parts of Denmark. This work has to include the Baltic wares, and it ought to establish series of local chronologies, which can in turn be compared with oneanother. All ways of ordering pottery are subjective, at least to some degree, and so is this one. I nevertheless believe that the main criteria have to be based on as many features as possible: that is on the tempering, firing and general appearance of the pottery, and not merely on rim forms or vessel shapes, which are only secondary indications of date. On the other hand, I do not agree that this prevents us from dating pottery more precisely than within periods of a hundred years (Lüdtke 1985: 138).

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NOTE

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Svendborg in the Middle Ages

– an Interdisciplinary Investigation

by HENRIK M. JANSEN
with contributions by TOVE HATTING and INGRID SØRENSEN

Since 1972 a team of about 30 specialists, archaeologists, historians, medical researchers and natural scientists, have taken part in the archaeological investigations of Medieval Svendborg and of Ørkild, the royal stronghold to the northeast of the town. A wide range of scientific techniques have been used to augment the information about contemporary life which the scattered written sources and traditional archaeological methods can provide. Some examples of these will be discussed in the following paper. The purely archaeological evidence will only be outlined in brief and further information can be had from the sources listed in the bibliography.

THE EARLIEST SVENDBORG AND THE TOWN IN THE MIDDLE AGES

Written sources tell us nothing about how and when the town came to be founded. Evidence from archaeological and pollen analytical investigations suggests that it took place in the second half of the 11th century. Ingrid Sørensen's pollen analyses (see later) show that it was at this time that a valley to the north of the town called *Dronningmaen* was dammed, doubtlessly in connection with the creation of a mill pond and the establishment of an associated water-mill. Furthermore the particular form of the graves excavated in the graveyard to the south of the Franciscan Monastery suggest that the graveyard had been used for some time before the Franciscans took over in 1236. There are hazel rods in the graves, a feature which in Lund, Sweden, amongst other places, can be dated at the latest to the first decade of the 12th century. Usually this heathen practice is seen in graves of the 11th century. The phenomenon is known from Viking burial rites, being the symbol of the tree of life, and it was allowed to continue into the earliest Christian period.

It was purely by chance that Svendborg entered the written sources as late as 1229. By this time Svendborg was already a thriving town which had been granted royal charters and which possibly had two brick-built churches, St Nicholas's church and the church down at the shore which the Franciscan monks took over in 1236. Svendborg's entrance into the pages of history took place in very romantic circumstances. In a letter of 23 June 1229, to Valdemar the Young's wife, Princess Eleonora, daughter of Queen Berengarias brother, King Alfonso II of Portugal, concerning her morning gift, Valdemar II confirms the handing over to her of the southern part of Funen with the three 'castra' (translated as 'castles'): Swineburgh, Wordburgh and Foburgh, plus half of the income from the mint on Funen as well as that from the whole of the town of Odense. When Eleonora died in childbirth less than 2 years later, everything in the gift reverted to the king.

The interpretation of the name 'Swineburgh' has occupied historians and place-name researchers for centuries, but there is now agreement that it is not the man's name Svend to which the first part refers but to *svin* (= pig). Whether this is *vildsvin* (wild boar), *oldensvin* (domesticated pigs fed on mast) or *marsvin* (porpoise) is still not clear. In the 12th century there were several royal castles with animal names for example Flynderborg (*flynder* = flounder) and Kalundborg (*kalund* = jackdaw).

There have been attempts to locate Swineburgh at various sites in and around Svendborg. It is most probable, however, that it lay near where the later Skattertårn, which has much in common with other fortified towers from the 12th century, came to be built.

The large royal castle of Ørkild, which lies to the northeast of the town in the parish of Tved, was the subject of small trial excavations in 1979 and 1980 in connection with an extensive tidying-up operation on the site which had fallen into disrepair. The collection of

THE SVENDBORG PROJECT 1972 – DIRECTOR: Henrik M. Jansen

Field work
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Jens-Aage Pedersen
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Hans Mikkelsen
Søren Diinhoff Pedersen

Leather
W. Groenman-van Waateringe

Textiles
Lise Bender Jørgensen

Coins
Jørgen Steen Jensen

The Medieval Town Project
Knud Hornbeck
Helle Reinholdt

Hans Mikkelsen
Søren Diinhoff Pedersen

Diatom analysis
Niels Foged †

Pollen
Ingrid Sørensen

Plant macrofossils
Hans Arne Jensen
Grethe Jørgensen
Jan van Dijk

Consultant
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Wood identification
Thomas Bartholin
Kjeld Christensen

Dendrochronology
Thomas Bartholin
Niels Bonde

Quaternary zoology: mammals, birds, and fish
Tove Hatting
Kim Aaris-Sørensen
Knud Rosenlund
Lars Serritslev

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Parasitology
Peter Nansen

Anthropology
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Søren Floris
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Geology
Kaj Strand Petersen

Metallurgy
Sidsel Fregerslev
P. Solgaard

Archaeological chemistry
Hans Toftlund Nielsen
B. Funder Schmidt

Radiocarbon dating
Søren Håkanson
Henrik Tauber

Carbon-13 analyses
Henrik Tauber

Table 1. Project organization.

finds from Ørkild showed that life there was very different in many ways from the picture we have of daily life in the medieval town, something clearly illustrated by Tove Hattings's analyses of the zoological material, for example.

It is obvious from the oldest surviving charter granted by King Christopher I (1252–59) on the 25th February 1253, that Svendborg had the status of a provincial town under Valdemar II (1202–41). In this document it is stated among other things that 'all the laws and priveleges that they (the inhabitants of Svendborg) had in our father's time – in blessed remembrance – are confirmed'. With regard to further details of the topographical development of the town reference is made to the bibliography; only a short account of the monastery investigations carried out between 1975 and 1980 will be entered into here.

Svendborg's Franciscan Monastery was established on the initiative of Valdemar II's castle baliff (castellanus), the grand-seneschal Astrad Fracki in 1236. This was 4 years after the first Scandinavian monastery of the order had been founded in Ribe and only 10 years after the death of St Francis in Assisi. The fact that Svendborg was among one of the first places in Scandinavia that made provision for the Franciscans supports the idea that as early as the beginning of the 13th century, Svendborg was a community of sufficient economic might to make it attractive to the holy fathers, who despite their vows of poverty were conscious of the alms they would recieve from the community amongst whom

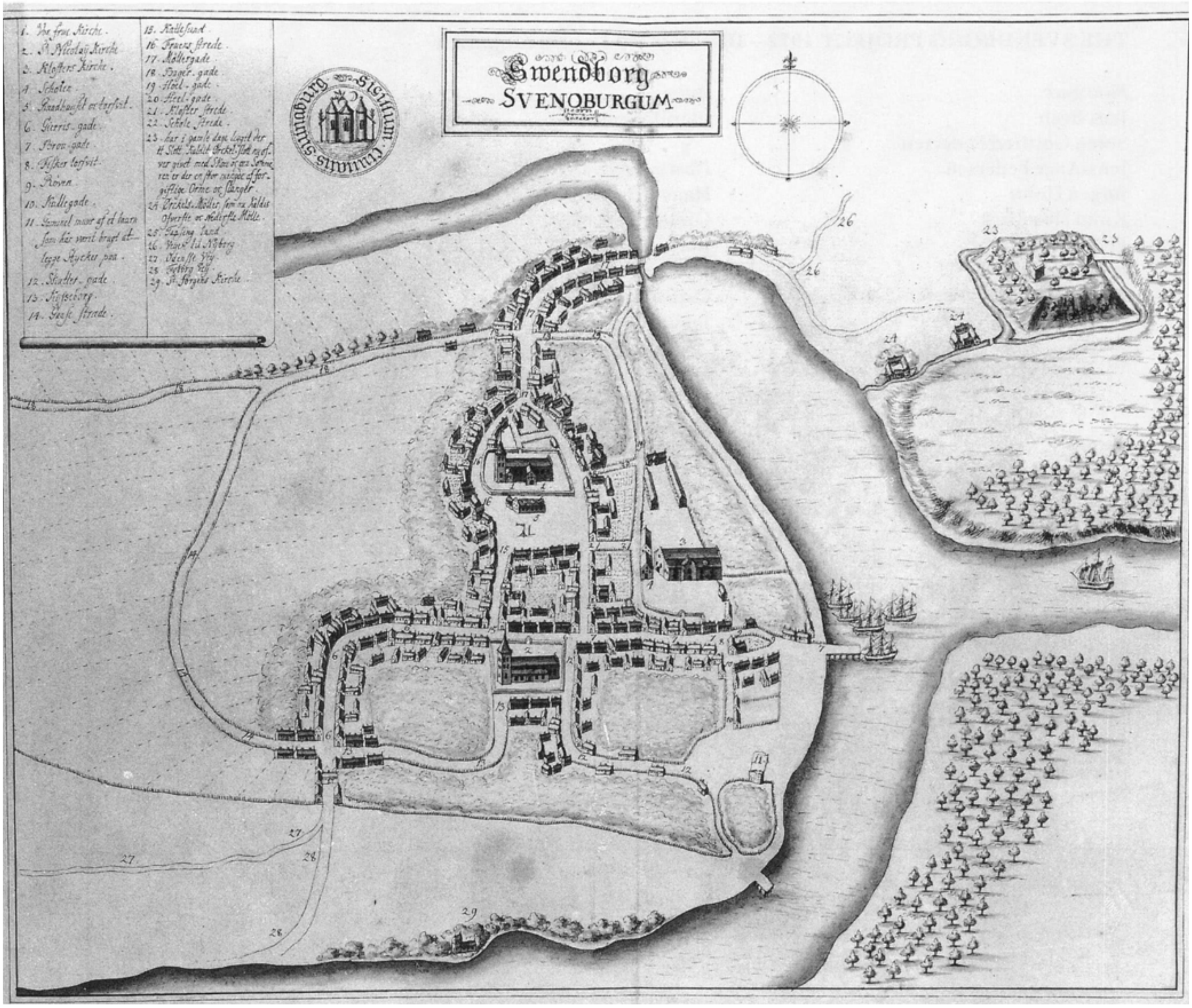
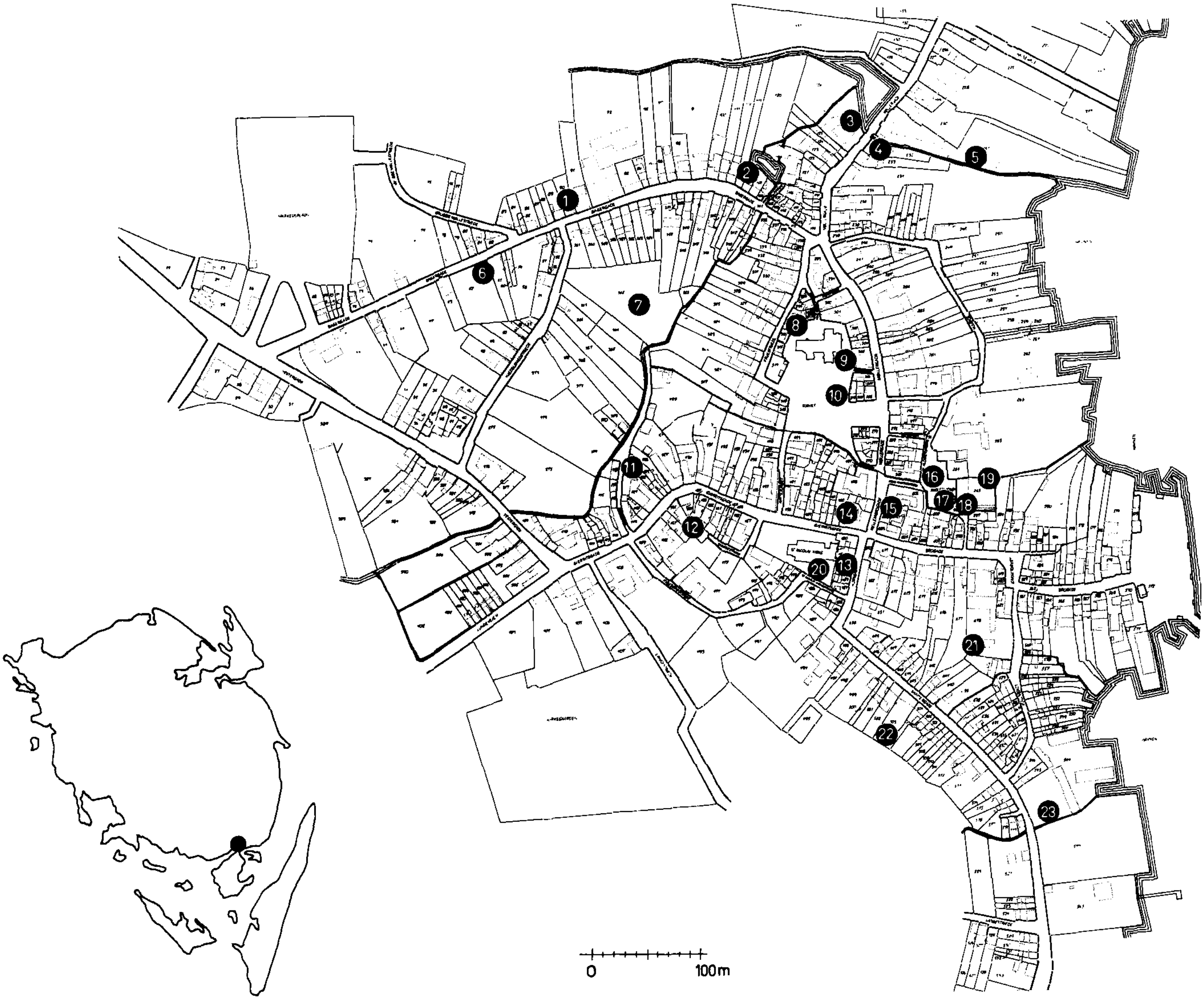


Fig. 1. Svendborg. Illustration from P.H. Resen: *Atlas Danicus*, 1667.

they were assigned to work. Svendborg doubtlessly enjoyed the prosperity that came with Baltic trade when the Valdemars became established in the second half of the 12th century. Even after the north German towns took over this trade during the course of the 13th century, Svendborg continued to flourish unabated. At the end of the medieval period, the town defences enclosed a built-up area of about 18 ha, and in addition there was the small suburb of Kongens Mølle (the Kings Mill) which lay outside the defences to the north.

Information about the monastery complex itself is sparse. Astrad Fracki arranged for the handing over to the monks of a large area of ground in the north-east part of the town, down at the shore, which possibly extended all the way up to the town defences. As outlined above the excavations in the monastery church and in the cemetery revealed that there was already a church and churchyard on the site in 1236 when the monastery was founded (fig. 3).

The establishment of the leper hospital, later St George's, west of Svendborg, similarly took place in connection with the activities of the Franciscans in the town. The present St George's church is the only one remaining of 37 churches and chapels performing a simi-



	Land Reg. No.	
1. Bagergade 42a	91a	1985
2. Bagergade 20–22	102–103	1981
3. Møllergade 55	126a	1983
4. Møllergade 62	232	1984
5. Toldbodvej	231	1986
6. Krøyers Have	362	1973
7. Bagergade	62	1974
8. Fruestræde 8	296	1985
9. Vor Frue/Our Lady's church		1972
10. Market Square		1972
11. Gåsestræde 4	421	1985
12. Badstuestræde/Gerritsgade	466	1980
13. Korsgade 4	482	1972–73
14. Møllergade 1	449a	1972–73
15. Møllergade 6	607a	1976–77
16. Monastery V-VI		1979–80
17. Monastery II		1977
18. Monastery III-IV		1978
19. Monastery I	263	1975–76
20. The church of St. Nicholas		1972–73
21. Brogade	618a	1973
22. Skattergade	503	1981
23. Kullinggade	544a	1974

Fig. 2. Map of Svendborg, 1863, with sites excavated since 1972.

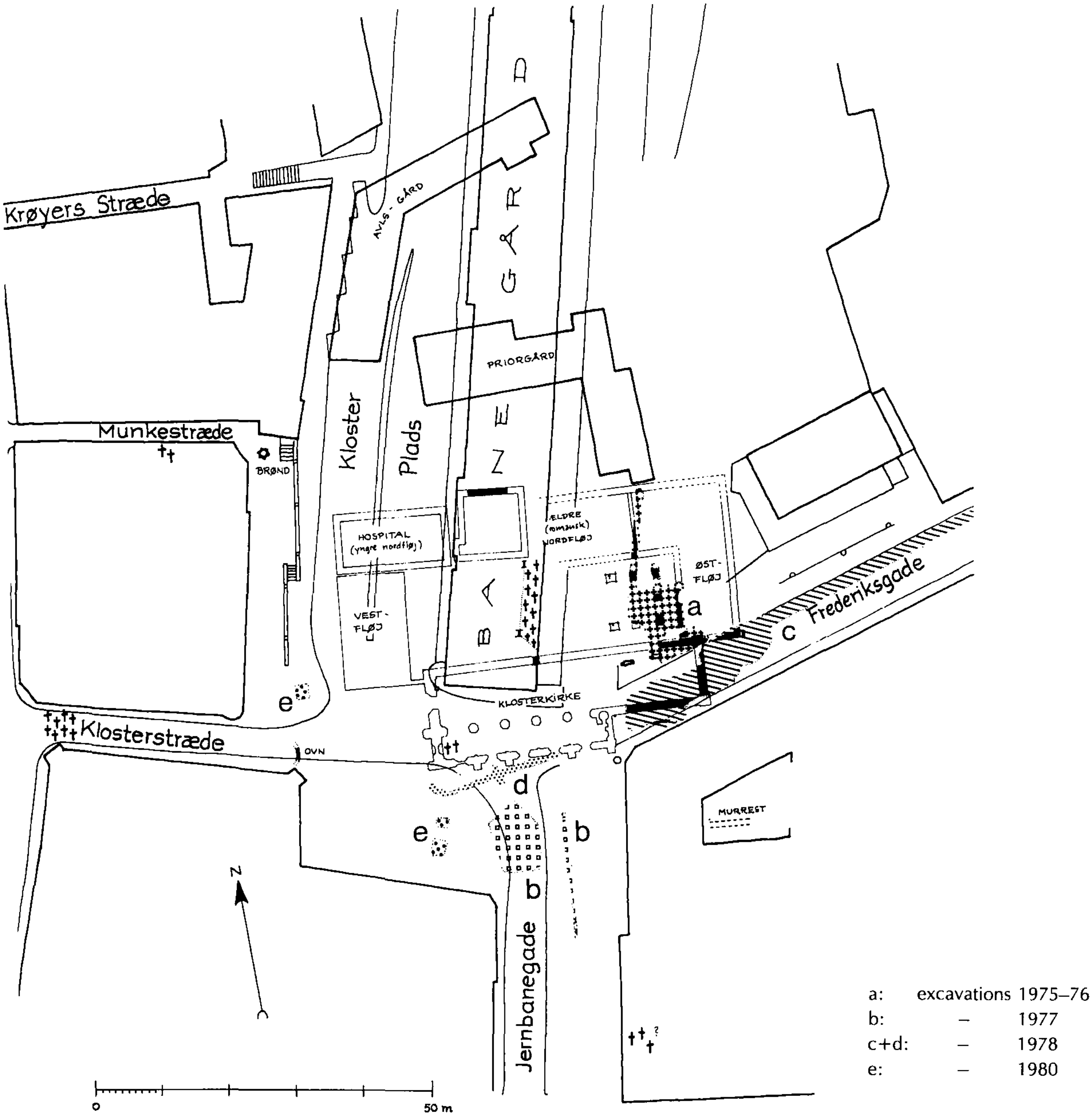


Fig. 3. Map of excavations in the central part of Svendborg showing a plan of the Franciscan Monastery based on excavations 1975–80 and previous evidence. Black indicates remains documented during recent investigations. Other parts of the complex of monastery buildings are reconstructed from Land Register maps.

lar function, which were abolished in 1541 'as leprosy is not as common in the land as she was in the past'.

In 1975, when it first became possible to undertake archaeological investigations on the site, there was not one visible sign above ground of the Franciscan monastery's existence. Everything had been razed to the ground in the sacred name of progress. Luckily the conditions for preservation of organic material were particularily good in this part of the town due to the extremely waterlogged nature of the Medieval refuse layers. Excavation was concentrated on the monastery chapel and those parts of the churchyard which were in use un-

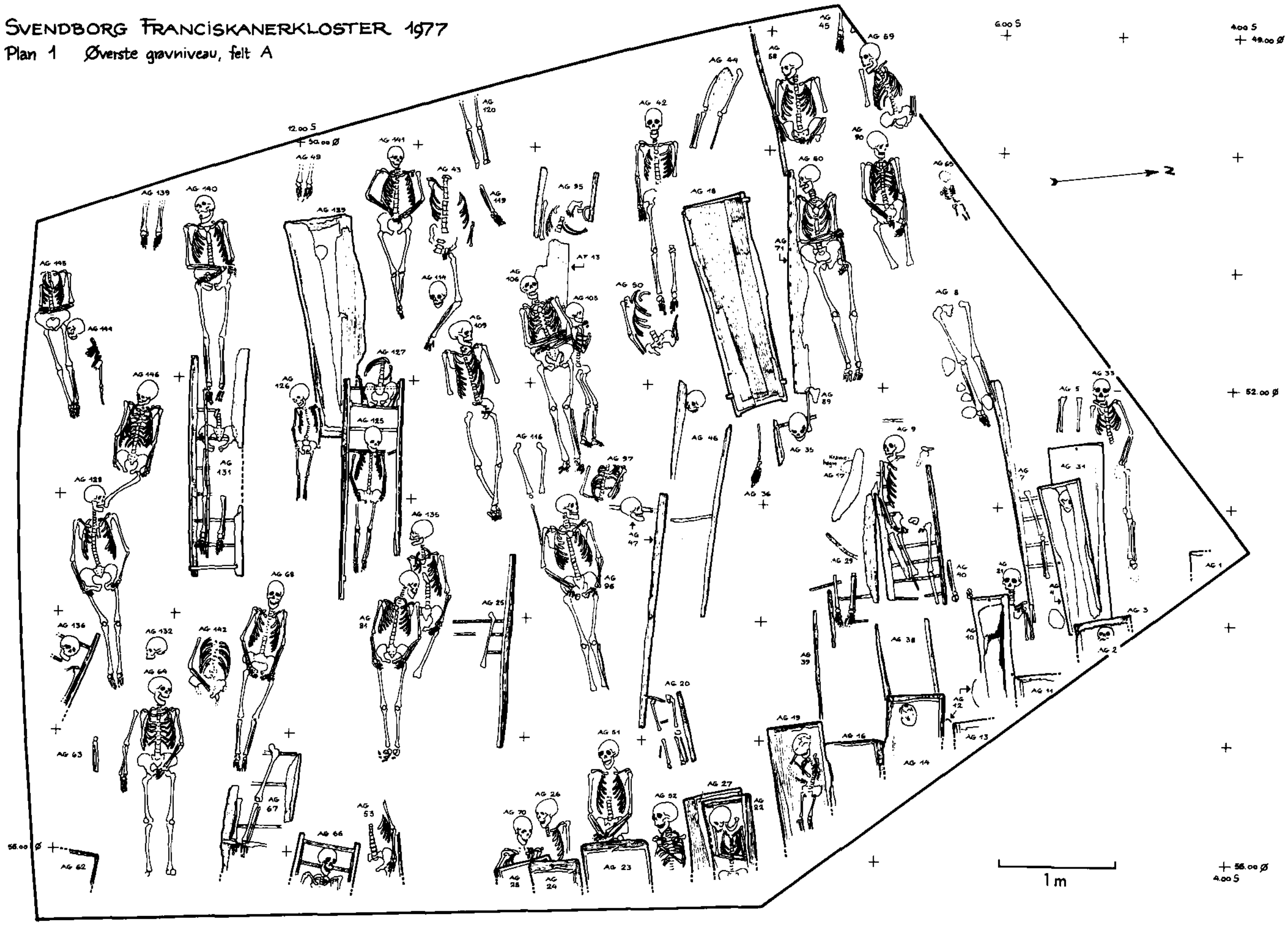


Fig. 4. The excavated part of the churchyard south of the Franciscan Monastery church, showing the uppermost level of graves. Jens Bech *del.*

til immediately after the beginning of the Reformation, *i.e.* c. 1550.

THE MEDIEVAL POPULATION OF SVENDBORG

The following is a short account of the results of the medical and anthropological analyses carried out by Izabella Tkocz, Niels Brøndum and their co-workers which are presented in full in volume 3 of *The Archaeology of Svendborg*. From the examination of about 200 individuals, partly from the monastery's cloister and partly from the churchyard (fig. 4), there is not thought to be any doubt that those buried in the churchyard can be taken as representative of Svendborg's population as a whole and therefore the following can be said of the average Medieval inhabitant.

As was the case over the whole of Europe at this time, the level of child mortality was high and children and adolescents made up 25% of the material collected. Nevertheless this is a lower total than that known from Viborg for example, which leads the researchers to suppose that the excavated skeletons represent a population with a lower than average mortality rate for the time. The average age at death was around 33 for men and 28 for women. Of course these figures reflect the high child mortality rate but also destroy the myth that it was men who went out and sacrificed themselves for women. It appears to have been much more dangerous to stay at home and give birth to children than to fight

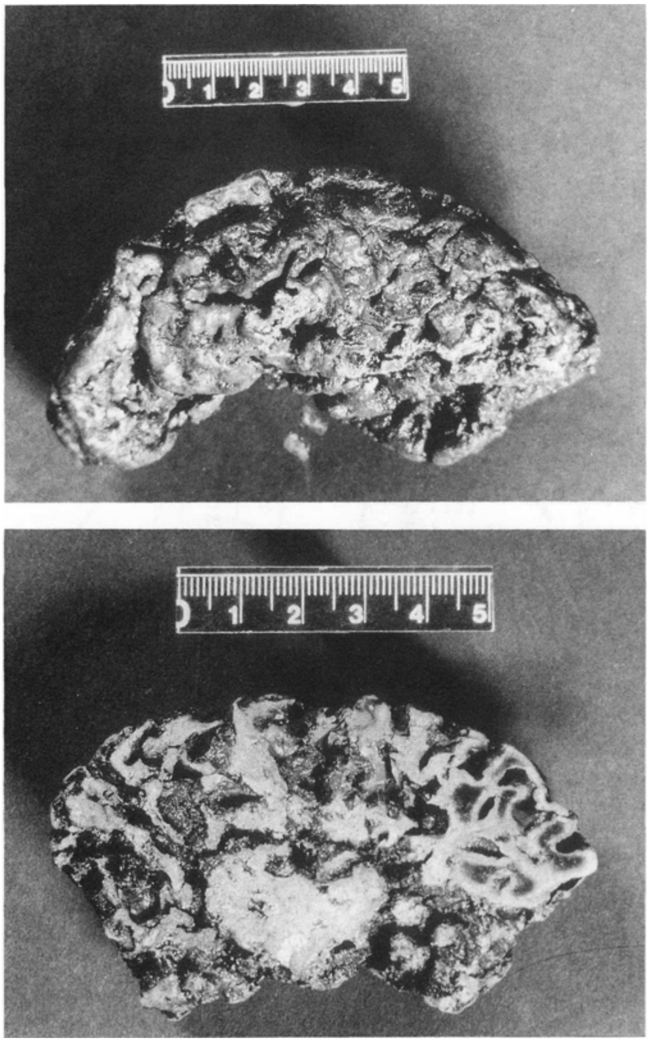


Fig. 5. Above, one of the best preserved Medieval brains from Svendborg. Length: 11.6 cm. – Below, section through the brain shown above. Photo by the Institute of Anatomy, University of Odense.

for God, king and country. Despite considerable knowledge of hygiene, many women died in labour. One should be aware however of one possible source of error in these calculations. An estimated 10% of the churchyard was excavated and it is known from other sites that it was the practice to bury children in a particular part of the churchyard, a phenomenon which was possibly also encountered during a small investigation of the western part of the churchyard in 1980.

The average height of the inhabitants was 175 cm for men and 163 for women. Naturally we were amazed by these figures. If they are compared with those for Denmark as a whole in the 17th and 18th centuries, the latter appear almost as 'midgets'. Even as late as 1850 when compulsory national service was first introduced, the average height of men in the first intake was found to be only 162 cm.

The Svendborg analyses show furthermore that the Medieval men were large and strong and had well-developed muscles. In contrast to today's population which has mesocephalic crania, those of both men and women in Svendborg were dolichocephalic and some of them, a total of 57 in all, contained remnants of brain (fig. 5). The fact that it was possible to make such fantastic finds is probably due to the very special biochemistry of the brain and Svendborg's anaerobic alkaline soils. That these shrivelled remains really were the remnants of brains was established by a combination of light and electron microscopy and biochemical analyses and although nothing remained of the meninx, the scanning electron micrographs clearly showed that brain structures were present. The largest brains measured up to 12 cm in length and 9 cm in breadth and were 5–6 cm in height. They weighed between 170 and 200 gr., whereas the small fragments weighed only 10–15 gr.

All the skeletons of people over the age of 25 showed evidence of osteoarthritis particularly on the spinal column. Osteoarthritis was probably more widespread than it is today almost certainly as a result of the hard physical labour and lack of labour-saving devices at that time. It is clear that poor housing and life in open boats would have predisposed people to these afflictions, which were treated both by medicine and magic. The medical treatments used included herb decoctions and salves as well as abdominal belts of animal skin. Magical items included precious stones, magic spells and pilgrimages to the graves of the saints.

In many cases it is difficult to establish the cause of death from the skeleton alone in that many diseases caused by bacteria and viruses leave no trace on the bones. The bone material therefore shows only a few pathological changes. Some of those which were apparent will be described here.

Firstly a very unconventional burial, No AG 18 (fig. 6), where the corpse died of an affliction which has never before been demonstrated so far back in time. It appears that it was a man in his fifties who was buried in a domestic lidded bench, made of soft-wood. The corpse's head rested on a fine pillow made of wool and flax and there were traces of a shroud and possibly of actual bandages. X-ray investigations showed that he

Fig. 6. Grave AG 18, a man buried in a wooden bench. The deceased suffered from cancer of the prostate. It is the earliest known case of this disease, the coffin being dated to 1472.

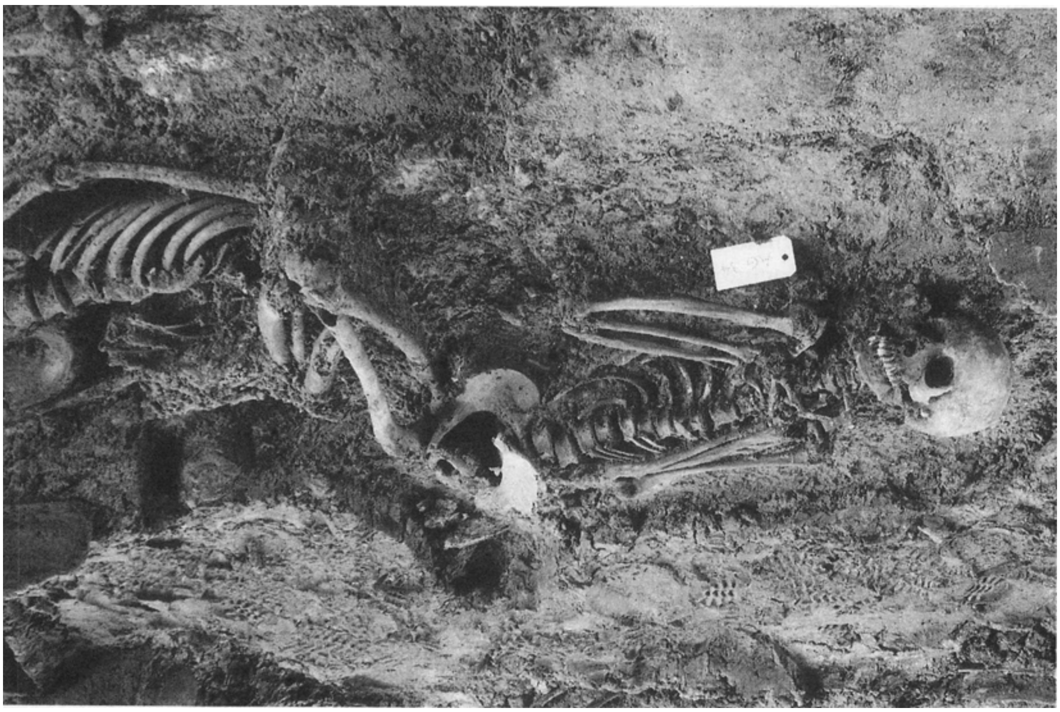


Fig. 7. Grave AG 34, a 17 year old girl who died of syphilis or yaws.

suffered from cancer of the prostate and metastasis in the ribs, the vertebral column and the hip. The coffin is dated to 1472 and as mentioned earlier this is the earliest recorded case of this disease in the western world.

Many women died in childbirth, and although this is not an easy thing to show from the skeletons, in at least 4 cases the researchers are sure that this was the case.

A further burial, without a coffin, involved a great deal of work for the researchers. The skeleton was of a 17 year old girl who was buried quite differently from the traditional Christian burial in that she lay on her side with her legs tucked up (fig. 7). There is a radiocarbon date of c. 1580 and the cause of death was either syphilis, the so-called non-venereal kind, which means that the girl was infected from her mother whilst in the womb, or yaws. Nonveneral syphilis, like yaws, is usually acquired in childhood under unhygienic conditions through body contact or use of common eating and drinking utentils. It was known even at this early time that syphilis could be treated with mercury, but this did not happen in this case however. It is my theory that the doubtlessly indescribably repulsive body of the poor girl was buried in the graveyard after the latter had gone out of general use. This would also explain the odd attitude of the corpse.

As can be seen from the above we have dates for some of the coffins, however we are still waiting for the final dendrochronological dating of a number of them.

The exceptionally well-preserved skeletons continue to attract the interest of new researchers. Professor Philippe Grandjean of the Institute of Hygiene at Odense University has begun a heavy metal analysis of the teeth from the Franciscan churchyard. The concentrations of several heavy metals, including cadmium, lead and mercury, will be compared with those in teeth in children in present day Århus. The results will show whether the present-day Danish population contains more or less of these elements than their Medieval predecessors.

Very few of the skeletons show signs of violence. On one man's skull a cut-like lesion was identified. The man lived for a short while after receiving the blow but as the cut never healed properly and he was found with bandages around his head, it is very probable that he died of a fractured skull. Conversely two women who had fractured skulls, one after a blow to the face and the other after blow to the back of the head, both survived their injuries.

One young man had apparently survived numerous battles as there were many healed cuts on his cranium. On top of this he must have suffered from unbearable toothache. Dentist Niels Brøndum has demonstrated that there were 16 individual sites of caries on his teeth of a type which today is found amongst bakers. Cavities in teeth were not common in the Middle Ages. Judging by his injuries he could have been a mercenary who also indulged his sweet tooth. It was in the middle of the 1400's onwards that sugar from the Azores was introduced into the better circles in Europe.

In general the doctors conclude that the inhabitants of Svendborg lived well, a conclusion which is supported by the zoological and botanical analyses. This would certainly explain the apparent decline in height and the standard of health evident in the centuries after the Reformation in Denmark. The Medieval population's attitude to personal hygiene and nutrition was obviously quite different from that which has been assumed up until now. In connection with this we only need to consider the many bath houses which had to be closed hastily when syphilis spread like lightning across Europe during the first decades of the 16th century.

BOTANICAL ANALYSIS

As early as 1979 Hans Arne Jensen was able to present his pioneering work on material from the first years investigations in Svendborg in volume 2 of *The Archaeology of Svendborg*. This work has since been continued by others including Grethe Jørgensen, who was the first person in Denmark to investigate human fæcal residues from latrines and who similarly reported her findings in volume 4 of *The Archaeology of Svendborg*. From the botanical analyses it has been possible to show the presence of imported plants, particularly spices but also fruit and, for instance, walnuts from 13th century Svendborg, both carbonised and uncarbonised. Remains of houses destroyed by fire, latrines and other refuse often contain considerable numbers of seeds and fruits and in co-operation with a pollen analyst and a wood anatomist it has been possible to build a fairly complete picture of local, collected and imported plants with respect to their use by the human population and their domesticated animals.

Grethe Jørgensen has concentrated her activities on material from the extensive archaeological investiga-

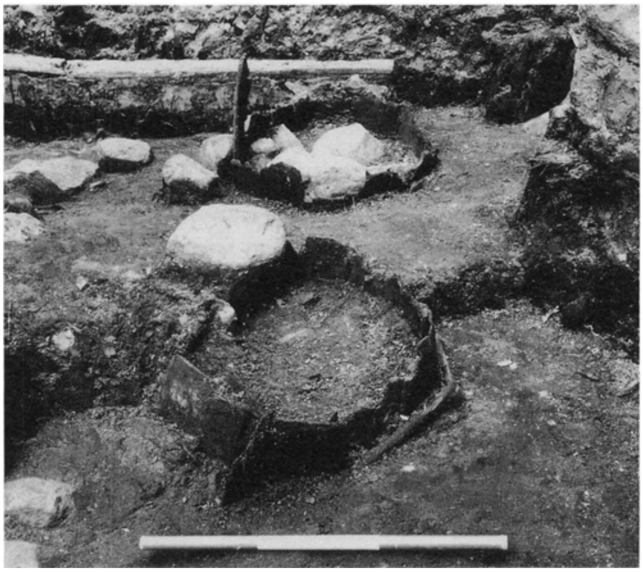


Fig. 8. Two latrines in a courtyard dated to the second half of the 14th century. The photograph was taken before excavation of the barrels. Note the stones 'sealing off' the barrel in the background. The smell persisted until they were reopened in the autumn of 1976.

Fig. 9. The excavation at Møllergade 6, Land. Reg. no. 607a. Note the well-preserved stone pavement. The houses are dated to 1308 and 1318, respectively, being built of both logs and staves. The wood was shaped at the large chopping-block at the stick used as scale near the centre of the picture. The chopping-block remained in its position surrounded with debris and wood shavings when a clay floor was laid on top of it. At the bottom of the picture a barrel with slaked lime is seen. Nearly all house-sites investigated had a barrel like this; seemingly the wooden houses were whitewashed.

tions which took place between 1976 and 1977 in Møllergade (Land reg. No 607a). The preservation was exceptionally good at this site and many artifacts manufactured of organic material were recovered, in particular wooden kitchen utensils (turned bowls and plates, barrel beakers, wooden platters, spoons, knives and distaffs) but also very many leather items, as well as the actual structural remains of the burnt buildings on the site. It perhaps should be pointed out that the plant remains which do not have a resistant testa or outer coat such as peas, beans, leaves and rootcrops could not be detected in this investigation. Furthermore account has to be taken of the possible sources of error in any statistical calculations which are made. Individual plants of certain species can produce considerable numbers of seeds or fruits, for example fat hen (*Chenopodium album*), sheep's sorrel (*Rumex acetosella*) and various of the persicarias (*Polygonum* sp). Imported figs (*Ficus carica*) can contain in excess of 400 seeds whereas a cherry (*Prunus* sp) is represented by a single stone (1).

In total Grethe Jørgensen recognized 164 different taxa in material from Møllergade and she added 3 new records to Hans Arne Jensen's already impressive list. These being, fig (as already mentioned), motherwort (*Leonurus cardica*), which as the latin name suggests can be used for heart ailments and cat-mint (*Nepeta cataria*) which was recommended in Medieval times as a treatment for adder bites. As would be expected many new plants were introduced to Denmark when monasteries were established over the whole country. Mediterranean plants such as dill (*Anethum graveolens*), bishop's weed (*Aegopodium podagraria*) and cummin (*Carum carvi*) together with other monastery plants, such as cabbages and celery, quickly became part of the daily diet. Bishop's weed which now plagues all gardeners was popular as a kind of spinach but could also be used as a laxative, just as cummin was recommended for flatulence brought on by eating too much rich food. The presently popular spice coriander (*Coriandrum sativum*) was good for expelling wind and also helped the digestion. Even cultivated apples and pears were available thanks to the gardening-loving monks. It was first in the 1300's that the inhabitants learnt how to lay out orchards and herb gardens for themselves.

As already mentioned Grethe Jørgensen also analysed the contents of a latrine barrel that was recovered from a layer dated to between 1350 and 1400. From these analyses she could, one might say, take a backward look at the contemporary menu. One result of this work was the earliest Danish record of sour cherry (*Prunus cerasus*). Amongst the many medicinal plants, mention should be made of the ubiquitous chicory (*Cicorium intybus*), the leaves of which are recommended as healthy fodder for both people and animals but which could also be used against melancholia, hypochondria, consumption, piles and gout. Also revealed were remains from plants used in beer brewing: bog myrtle (*Myrica gale*), hops (*Humulus lupulus*) and of course barley (*Hordeum vulgare*). From about 1200 onwards German introduced hop beer became the most popular in Denmark and hops are found in all layers above the level of the barrel. It was again the monks that were the teachers in this respect. Hops were also thought to be active in reducing male sex-drive, probably a reason for why they were so popular in monastery gardens.

Seeds of flax (*Linum usitatissimum*), hemp (*Cannibis sativa*) and gold of pleasure (*Cammelina sativa*) are all rich in oil. The two former are also known as sources of fibres that can be spun to make textiles and ropes. In this case however it appears that all three had clear medical applications. The narcotic effects of hemp, so well known in later times, come from resin that is secreted from glandular hairs on the female plants.

For the sake of completeness the four species of moss found in the barrel should be mentioned. They answer the question regarding what could have been used as toilet paper in Medieval times. *Climacium dendroides* was collected from damp grassland, whereas *Hypnum cupressiforme*, *Neckera complanata* and *Antitrichia curtipendula* were taken from tree trunks and stones.

A sample of grain that was found in a hearth dated to the period 1308–1318 contained c. 13000 grains of barley, c. 1100 grains of oats (*Avena sativa*) and 17 grains of rye (*Secale cereale*) as well as seeds and fruits of flax, hemp, gold of pleasure and many weed species including corncockle (*Agrostemma githago*). As the grain had sprouted it is likely that the find represents grain left to germinate as a preliminary to brewing beer, that is home-brewing, even though all the cereals and the other plant remains for that matter were present in the latrine material in the barrel. Maybe the finding of sprouted barly grains on a hearth suggests that they were being roasted as the next stage in preparing the malt.

The reason that testa (seed coat) fragments of corncockle but only the chaff (glumes, lemmas, paleas and rachis segments) of cereals are present in the barrel is because the testa of corncockle is indigestable. Corncockle seeds also contain githagenin, a poisonous saponin, which is readily taken up in the digestive tract. The consumption of food such as bread and porage contaminated in this way and the subsequent poisoning which results, were not unusual in the Medieval community and in severe cases proved fatal.

In concluding this section it should be mentioned that Grethe Jørgensen also analysed samples of cattle dung that lay in the yard of the building in Møllergade. In particular the samples contained many seeds and fruits of late summer plants as well as species of grazed commons, damp pastures and carr. There were also large numbers of seeds and fruits of arable and wasteland weeds. Several samples of excrement from domesticated animals were given to Peter Nansen of the Royal Veterinary and Agricultural College, Copenhagen, for parasite analysis, but the results are not as yet available.

Plant macrofossil analysis of the very fine material from Møllergade, which spans the periods 1150–1600, is not yet completed. Jan van Dijk of the University of Copenhagen is working on a series of samples from the layers which accumulated in the yard during this period. His results will be included in a later publication.

WOOD ANATOMY AND DENDROCHRONOLOGY

It is pioneering work which will be recounted in this summary, a great effort on the part of Thomas Bartholin which has contributed many new aspects to our knowledge of life in the Middle Ages. Thomas Bartholin has examined all the preserved wood that was recovered from excavations in Svendborg during the period 1972–1980. His analyses are not however completed yet due to lack of funds for the final stages of the work. The material from Svendborg provides an important link in an evaluation of:

a) the development of the vegetation and landscape

b) the town

c) trading and

d) the history of the vegetation for the western Baltic in the period 700–1700, where Hedeby covers the period 700–1000, Slesvig covers the period 1000–1200,

Fig. 10. Barrel-beakers of common spruce and with osiers of willow found in layers dated to c. 1300 at the site Møllergade 8, Land Reg. no. 607a.

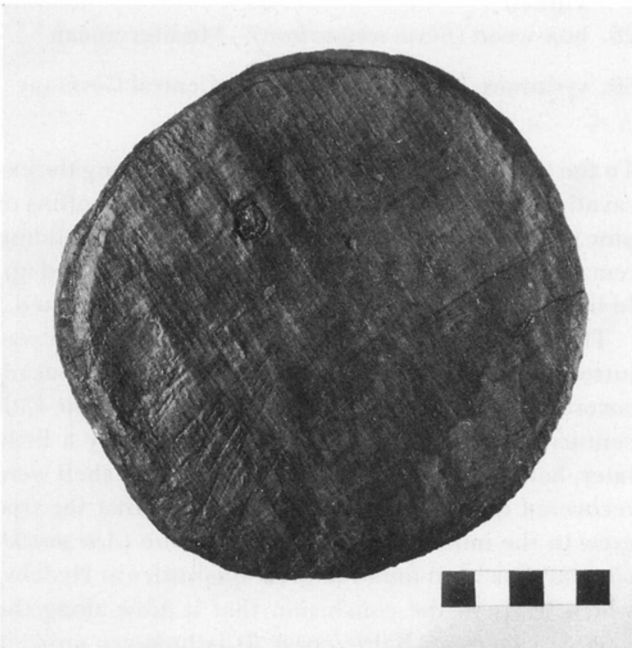


Fig. 11. Wooden platter or trencher of beech found in layers from the 14th century.

Fig. 12. Ladle of sycamore found at the bottom of a well from the 15th century.

Fig. 13. Turned soup-plate of alder found in layers of the 12th century.

Svendborg covers the period 1200–1500 and Lübeck covers the period 1500–1700.

With regard to the German towns only Hedeby has been subjected to a level of dendrochronological and wood anatomical investigation equal to that carried out at Svendborg. In order to make the Svendborg material available for inclusion in this important study Thomas Bartholin and the author will release a catalogue of the finds, a summary of which is given in tables 2 and 3.

With regard to the development of the vegetation, the comprehensive list of species recorded shows heavy usage of the existing woodland and scrub. It appears in fact as if there was total exploitation, with even the relatively rare elm, lime and willow being included.

In the Middle Ages unrestricted access to oak timber came to an end. In Viking Hedeby and 11th century Lund we see two completely different pictures with regard to the use of oak timber in buildings and the like. The previous centuries' ruthless exploitation of this coveted timber made oak wood into a scarce commodity in the High Middle Ages and this is clearly reflected in Svendborg. Oakwood from Viking sites often has several hundred annual rings whereas in Svendborg it is very rare to come across timber of such dimensions. There simply was not time to wait for oak trees to reach the proportions of earlier times. Despite this it has been possible for Thomas Bartholin to construct a standard curve for the dendrochronological dating of oakwood from Svendborg and this has been of invaluable assistance in mapping the development of the Medieval town.

The identification of wood on the basis of its anatomy can also give information regarding trade in timber. According to Bartholin, in table 2–3, species 3–6, 9, 15, 17, 26 and 30 are imported. Their nearest natural occurences are as follows:

3. silver fir (*Abies alba*) – Germany – Poland
4. common spruce (*Picea sp.*) – Central Germany
5. spruce or larch (*Picea* or *Larix sp.*) – Central Germany
6. Scots pine (*Pinus sylvestris*) – Central Sweden, Germany, Poland
9. walnut (*Juglans regia*) – Mediterranean
15. sweet chestnut (*Castanea sativa*) – Mediterranean and possibly other wine growing areas
17. bog myrtle (*Myrica gale*) – Jutland (probably also Funen)
26. box-wood (*Buxus sempervirens*) – Mediterranean
30. sycamore (*Acer pseudoplatanus*) – Central Germany

To the above list it should be added that during the excavations of the Franciscan churchyard some coffins of pine were found. Similarly in the late Medieval building remains, building timber of the same type cropped up. In both cases it is likely that the timber was imported.

There is great interest regarding walnut which was introduced by the monks. A chip of walnut wood was recovered from matr. no. 449a in a layer dated to the 13th century and from the same century, possibly a little later, half a walnut shell plus a whole green shell were recovered on matr. no. 607a. This shows that the tree grew in the immediate vicinity. Sycamore (*Acer pseudoplatanus*) has been found in great quantities at Hedeby, which leads to the conclusion that it grew along the northern German Baltic coast. It is however unlikely that it spread to Fyn, in that it was first introduced onto the estate of Brahetrolleborg of Opperman around the

Artifact categories:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1. *Taxus (baccata)*, yew								1	4	14		1														20
2. *Juniperus* (*communis*), juniper										2																2
3. *Abies* (*alba*), silver fir		1					1				1															3
4. *Picea* (*abies*), Norway spruce	1	570								1		1										4				574
5. *Picea* or *Larix*, spruce or larch																										0
6. *Pinus* (*silvestris*), Scots pine	1									2		3						6				3				16
7. *Populus sp.*, poplar			1														1				1					3
8. *Salix sp.*, willow						1			2		5	3					1				1			1		14
9. *Juglans* (*regia*), walnut																								2		2
10. *Betula sp.*, birch																									8	8
11. *Alnus* (*glutinosa*), alder	3		162	18	6				1	4		12					13	1			16	8		28		272
12. *Carpinus* (*betulus*), hornbeam																								2		2
13. *Corylus* (*avellana*), hazel						5			10	62	5	23							4		7	5		44		165
14. *Fagus* (*sylvatica*), beech	13		3	3	1		2	1	3	16	4	39					14	16	3	2	21	6		97		244
15. *Castanea* (*sativa*), sweet chestnut																										0
16. *Quercus sp.*, oak	51		1	1					2	9	4	19					111	29	6	3	29	14		21		300
17. *Myrica* (*gale*), bog myrtle																										0
18. *Ulmus sp.*, elm										1							1							2		4
19. *Pomoideae*, apple family			1						1		1	1					1				4			1		10
20. *P. cf. Crataegus sp.*, cf. hawthorn			1				1																			2
21. *P. cf. Sorbus sp.*, cf. rowan			1							1	1	1									1			2		7
22. *Prunus sp.*, plum, cherry etc.											1															1
23. *cf. P. spinosa*, cf. sloe										4																4
24. *Rosa sp.*, rose																										
25. *Ribes* (*uva-crispa*), gooseberry																										
26. *Buxus* (*sempervirens*), box								3																		3
27. *Acer sp.*, maple family			15	2	1		5					2														25
28. *cf. A. platanoides*, cf. Norway maple			2				2															1		1		6
29. *cf. A. campestre*, cf. field maple	1		1	3			1				2	1														9
30. *cf. A. pseudoplatanus*, cf. sycamore			5	1	1	1	4		1																	13
31. *Tilia sp.*, lime										1											1					2
32. *Fraxinus* (*excelsior*), ash	1		16	5	1		1			2		11					3	2			1			5		48
33. *Euonymus* (*europaea*), spindle tree						4	12			47	6	1														70
34. *Rhamnus* (*cathartica*), buckthorn												1														1
35. *Sambucus* (*nigra*), elderberry						2	7		1	19		3												3		35
36. *Lonicera* (*periclymenum*), honeysuckle																										0
Total	71	572	209	33	10	13	36	5	26	184	30	122					145	54	13	5	82	38		209	8	1865

Table 2. Determinations of 1865 wood samples from the excavation at Møllergade, Land Reg. no. 607a. Numbers above refer to functional categories, see key to tables 2–3.

Artifact categories:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1. *Taxus* (*baccata*), yew								1	4	20		1								1						27
2. *Juniperus* (*communis*), juniper										2																2
3. *Abies* (*alba*), silver fir		1					1				1															3
4. *Picea* (*abies*), Norway spruce	1	624								1		4	53	1		4		3	11			1		4		707
5. *Picea* or *Larix*, spruce or larch												1														1
6. *Pinus* (*silvestris*), Scots pine	1	1								2		10	108			28		14	91			5		3		263
7. *Populus sp.*, poplar			1									4					1				1		1	15		23
8. *Salix sp.*, willow						1			4	1	15	12		13			1	1	8		2	2		20		80
9. *Juglans* (*regia*), walnut																								3		3
10. *Betula sp.*, birch												1										4			8	13
11. *Alnus* (*glutinosa*), alder	3		171	19	11				1	4		34	3	9			13	3		1	21	101		153		547
12. *Carpinus* (*betulus*), hornbeam									1															2		3
13. *Corylus* (*avellana*), hazel						5			10	72	19	50		211	2				48	28	8	41		127		621
14. *Fagus* (*sylvatica*), beech	78		3	3	2		2	2	3	17	4	250	6	4			14	126	5	126	81	33	13	461		1233
15. *Castanea* (*sativa*), sweet chestnut											14															14
16. *Quercus sp.*, oak	90		1	1	1				3	9	4	252	3	3			120	77	8	6	79	114	3	106		880
17. *Myrica* (*gale*), bog myrtle																								1		1
18. *Ulmus sp.*, elm									1					4			1				1			5		12
19. *Pomoideae*, apple family			1						1		1	2					1				6			35		47
20. *P. cf. Crataegus sp.*, cf. hawthorn			1		1		1		1		1	4							4			1		2		16
21. *P. cf. Sorbus sp.*, cf. rowan			1							1	1	3									1	1		9		17
22. *Prunus sp.*, plum, cherry etc.											1			4					4			4		8		21
23. *cf. P. spinosa*, cf. sloe										4														8		12
24. *Rosa sp.*, rose											4													2		6
25. *Ribes* (*uva-crispa*), gooseberry																								13		13
26. *Buxus* (*sempervirens*), box								3																		3
27. *Acer sp.*, maple family			19	2	2		5				1	3										1		3		36
28. *cf. A. platanoides*, cf. Norway maple			4				3					5		1								1		3		17
29. *cf. A. campestre*, cf. field maple	1		1	3			1				2	3												1		12
30. *cf. A. pseudoplatanus*, cf. sycamore			6	1	1	1	6		1			1								1						18
31. *Tilia sp.*, lime										1											1					2
32. *Fraxinus* (*excelsior*), ash	1		18	5	1		1		3	2		79		10			3	2	7		10			9		151
33. *Euonymus* (*europaea*), spindle tree						4	12			54	6	3							2	1				1		83
34. *Rhamnus* (*cathartica*), buckthorn												1														1
35. *Sambucus* (*nigra*), elderberry						2	7	1	1	19		6									2			18		56
36. *Lonicera* (*periclymenum*), honeysuckle																								1		1
Total	175	626	227	34	19	13	39	7	34	209	74	729	173	260	2	32	154	226	188	164	213	309	17	1013	8	4945

Table 3. Determinations of 4945 wood samples from the excavations 1972–80, all localities. Numbers above refer to functional categories, see key to tables 2–3.

year 1800. Yew (*Taxus baccata*), in Bartholin's opinion, may have grown in the Svendborg area. Several of the so-called 'pølse-' or 'spilepinde' (skewer-like artefacts) of yew have been recovered and their function is not completely clear. It was thought that yew became extinct in Denmark much earlier than this.

In conclusion it should be mentioned that where there are large quantities of oak and common spruce recorded in the two tables it is due to the fact that during the excavations oak wood was collected preferentially for the purposes of dendrochronology and the many fragments of barrel-beakers were collected because Thomas Bartholin needed this wood type for his comparative analysis of material used to make these items. In nearly all cases they are thought to be made of common spruce.

Again it is the fantastic preservation in the rubbish layers which allows description of the above wood and the identification of its use in building, tools and household effects. Here the cooperation between archaeologist and wood anatomist resulted in many new and original contributions to both our picture of Medieval life and of contemporary trade in timber as a raw material or as a half-finished product.

More about this will be published in the projects English language series *The Archaeology of Svendborg* as will the analyses of the many leather finds carried out by Professor Willy Groenman van Waateringe of Amsterdam University. In connection with this I would like to invite all those interested to become involved in further work on the material recovered from the excavations which have taken place over the years in medieval Svendborg. Every assistance in this respect would be welcome.

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Key to tables 2–3

1. Staves, lids, and bungs of the barrels and vats
2. Staves and bottoms of 'stavbægre'
3. Carved and turned bowls
4. Carved and turned plates
5. Other turned wood
6. Distaffs
7. Spoons
8. Knife handles
9. Other tools: Leisters, arrows, brooms, thimbles, etc.
10. Various pointed sticks
11. Other articles: Rosary beads, gaming pieces, bindings, etc.
12. Worked wood with an unknown function
13. Coffin planks/boards
14. Bars and ribs in the coffins
15. Hazel rods in the coffins
16. Wood shavings in the coffins
17. Building timber
18. Planks and boards
19. Pegs, rivets, and dowels
20. Wedges in pegs, rivets, and dowels
21. Posts
22. Other structural timber (from gullies, wells, water-pipes and the like)
23. Tree trunks
24. Wood chips, branches, charcoal, nuts etc.
25. Bark

Animal Bones from Svendborg

by TOVE HATTING

The many excavations which together make up the Svendborg project have produced an immense amount of bone material which primarily stems from midden layers containing kitchen refuse. The analysis of this material is not yet completed in that only material from Land reg nos 449a, 482, and the Franciscan Monastery is sorted and identified. Sorting of the material from matr. no 607a and Ørkild castle is finished but only the mammals are identified to species from the latter. The finds from Ørkild are extensive and are in the process of being registered on computer, so the final fragment totals are not yet available. Similarly the fish bones are not identified from this excavation. The main body of the bone material is made up of domesticated animals, which were the basis of the population's diet. It is obvious from the list of species however (tables 4–6) that fishing and wildfowling also contributed, whilst hunting of the woodland animals was reserved for the occupants of the castle.

The largest part of the material is made up as usual of cattle bones thanks largely to their size and robustness. The smaller species, such as pig and sheep, are however also so well represented that they too must have played an important role in the domestic economy. Pigs in particular made up a large part of the diet at Ørkild. An analysis of the age distribution of sheep jaw bones has

Mammals	Land Reg. No. 449a	Land Reg. No. 482	Greyfriars Monastery	Ørkild Castle	Land Reg. No. 607a
Domesticates					
Dog (*Canis familiaris*)	4	25		126	x
Cat (*Felis catus*)	9	17		109	x
Pig (*Sus domesticus*)	222	731	216	2054	x
Goat (*Capra hircus*)	1	7	2	20	x
Sheep (*Ovis aries*)	208	881	148	670	x
Cattle (*Bos taurus*)	385	1806	618	2297	x
Horse (*Equus caballus*)	2	6		12	x
Non-domesticates					
Hedgehog (*Erinaceus europaeus*)				1	
Hare (*Lepus europaeus*)	1	9		14	x
Squirrel (*Sciurus vulgaris*)					x
Black rat (*Rattus rattus*)				3	
Fox (*Vulpes vulpes*)	1	1		36	x
Otter (*Lutra lutra*)					x
Seal (*Phoca sp.*)	1				x
Roe deer (*Capreolus capreolus*)	1	2	2	51	x
Red deer (*Cervus elaphus*)	2			55	x
Fallow deer (*Dama dama*)				61	x
Porpoise (*Phocaena phocaena*)				1	x
Man (*Homo sapiens*)		118		1	x

Table 4. Summary of bone material: mammals.

Birds	Land Reg. No. 449a	Land Reg. No. 482	Land Reg. No. 607a
Red-throated diver (*Gavia stellata*)			x
Swan (*Cygnus sp.*)	x	x	
Whooper swan (*Cygnus cygnus*)			x
Mute swan (*Cygnus olor*)			x
Bean goose (*Anser fabalis*)			x
Mallard (*Anas platyrhynchos*)			x
Pochards (*Aythya sp.*)	x		x
Pochard (*Aythya ferina*)		x	
Tufted duck (*Aythya fuligula*)		x	x
Scaup (*Aythya marila*)			x
Goldeneye (*Bucephala clangula*)			x
Common scoter (*Melanitta nigra*)			x
Velvet scoter (*Melanitta fusca*)		x	
Goosander (*Mergus merganser*)			x
Red-breasted merganser (*Mergus serrator*)	x	x	x
Osprey (*Pandion haliaetus*)			x
Sea eagle (*Haliaeetus albicilla*)		x	x
Great black-back gull (*Larus marinus*)			x
Razorbill (*Alca torda*)		x	
Raven (*Corvus corax*)		x	x
Carrion or hooded crow (*Corvus corone*)			x
Rook (*Corvus frugilegus*)			x
Jackdaw (*Corvus monedula*)			x

Table 5. Summary of the bone material: birds.

Fish	Land Reg. No. 449a	Land Reg. No. 482
Herring (*Clupea harengus*)		x
Salmon (*Salmo salar*)	x	
Pike (*Esox lucius*)		x
Carp family (*Cyprinidae*)	x	x
Eel (*Anguilla anguilla*)		x
Garfish (*Belone belone*)		x
Cod family (*Gadidae*)	x	x
Cod (*Gadus morhua*)	x	x
Haddock (*Melanogrammus aeglefinus*)	x	x
Ling (*Molva molva*)		x
Perch (*Perca fluviatilis*)		x
Mackerel (*Scomber scombrus*)		x
Sea scorpion (*Cottus scorpius*)		x
Brill/turbot (*Scopthalmus sp.*)		x
Plaice/flounder (*Pleuronectidae*)	x	x

Table 6. Summary of bone material: fish.

	Spur	Total length	Proximal width
left	cutmarks	81,2	14,2
	scar	77,9	12,6
	cutmarks	76,9	13,4
	sp.	76,5	13,8
	cutmarks	75,0	13,7
	scar	74,4	14,0
	cutmarks	73,3	13,7
	scar	71,9	14,0
	sp.	71,3	13,8
	÷	66,2	11,5
	÷	65,0	12,2
	÷	62,6	11,1
	÷	62,0	12,3
	÷	61,2	11,3
	÷	61,9	12,4
	÷	59,6	12,0
right	scar	80,6	13,8
	cutmarks	78,8	13,3
	scar	76,1	12,9
	scar	74,4	13,3
	scar	71,1	13,6
	cutmarks	68,9	15,4
	÷	68,9	12,2
	÷	67,9	11,9
	÷	66,1	11,6
	÷	59,7	11,0

Table 7. Measurements of the metatarsal bones of domestic Fowl (Gallus domesticus). The bones were recovered at the site Land Reg. no. 607a in Svendborg. – Sp. = undamaged spur. ÷ = female. Measurements in mm.

shown that in Svendborg sheep were preferentially slaughtered as lambs and very few animals were allowed to grow old. In corresponding material from Medieval Viborg both young and old animals were slaughtered, whilst in iron age Ribe it was mostly older animals which were represented. Apparently in Viborg, all aspects of the sheep were exploited, whereas in Ribe they were kept specifically for wool production. This idea is supported by the finding of many loom weights and the textile finds, although these are few, suggest local textile production (Lise Bender Jørgensen, in press). In contrast, sheep were kept in Svendborg primarily to produce tender young meat.

Another indication that the people of Svendborg set great store by their food can be seen in the poultry remains from Land reg. no 607a. During a routine examination of domesticated fowl bones the metatarsal bones (*tarsometatarsi*) were sorted out for the purposes of sex and size determination (fig. 14). As a rule in the female (hen) only the scar at the junction with the lateral toe is visible on the bone, whilst in the male (cock) there is in addition the body process which bears the spurs. The presence of this bony process has usually been taken as a reliable indicator of sex, but according to Coy (1985) and others, it is not quite so clear cut after all, in that old hens can have rudiments of spurs (spur scars). In addition, it was known as early as the Roman Iron Age how to produce capons (castrated cocks), something which influences the spurs as they are a secondary sexual character. In birds, the testicles are not, as in the case of mammals, positioned on the outside of the abdomen, but lie at the rear of the abdominal cavity and it is a very difficult operation to destroy them. Pliny and Aristotle describe how to castrate male chickens by inserting a red hot iron into the abdominal cavity, not always with successful results (Aldrovandi: Lind 1963). Another method is described by Columella in the 1st century A.D. (Ghigi, 1939) whereby only the spurs are burned away, again using a red hot iron. This results in the bird losing the ability to fight and it is therefore excluded from the pecking order. Castration by these methods could bring about changes in the development of the spurs which would be reflected in the bone mate-

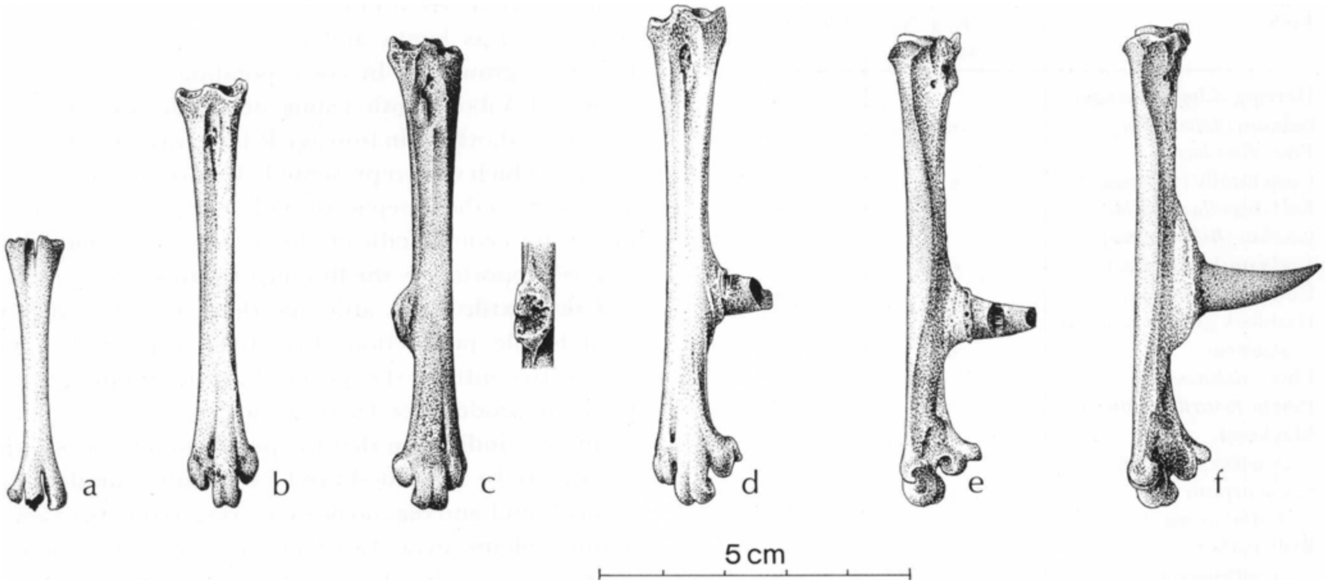

Fig. 14. Metatarsal bone of domestic fowl (Gallus domesticus). – a, chicken. b, hen. c, cock with scar. d–e, cock with cutmarks. f, cock with undamaged spur. Robert Nielsen del.

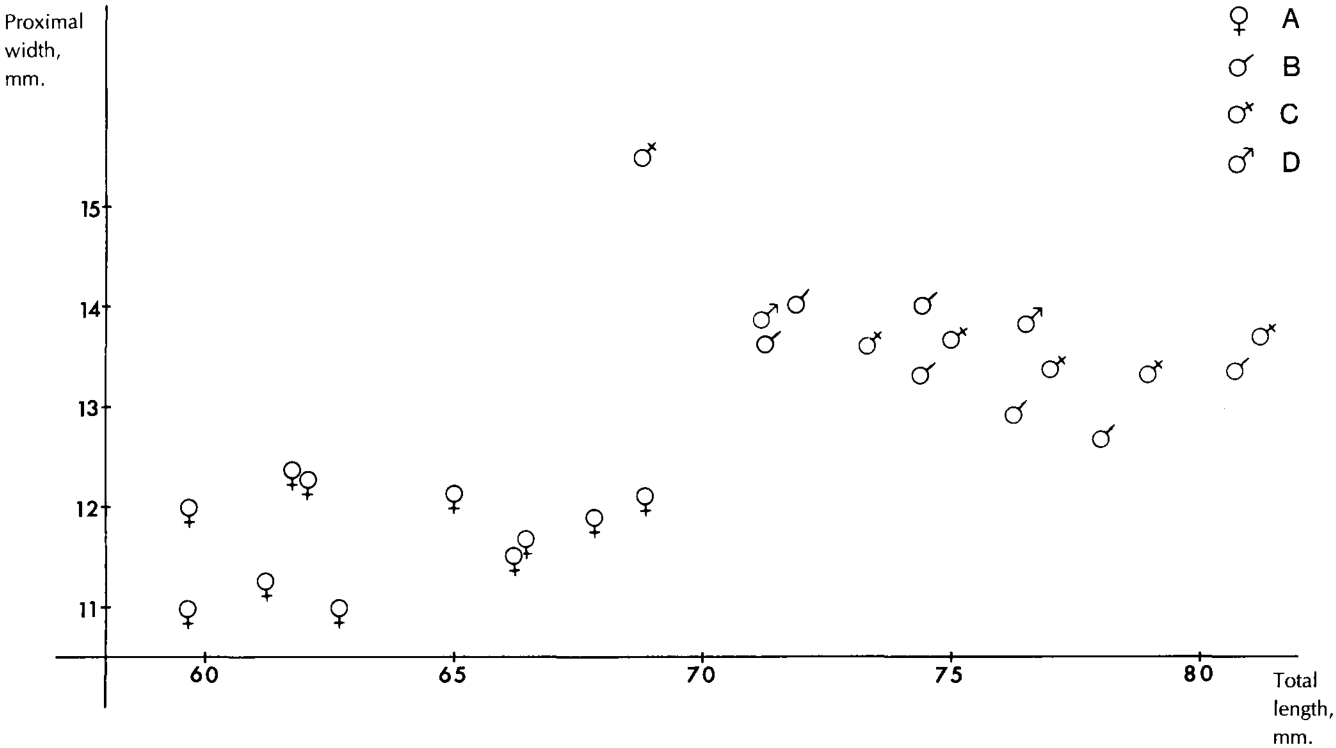

Fig. 15. Metatarsal bone of domestic fowl (Gallus domesticus). Signatures: a, hen. b, cock with scar. c, cock with cutmarks. d, cock with undamaged spur.

rial. Unfortunately suitable recent reference material is lacking.

A total of 72 middle foot bones were recovered from the Svendborg material. Of these 22 were from young birds or chickens and 20 were clearly from hens in that they showed no sign of spurs. There were a further 27 bones bearing spurs of which 7 were whole and undamaged (table 7). Of the others, 9 bore scars, of which several could be interpreted as being the result of the spur having been burned off. Finally, clear cutmarks were visible on the remaining 11 pieces which may have been the result of the removal of the spurs. This phenomenon could signify that a simpler method of producing capons was chosen. In comparison, 30 metatarsal bones were recovered from the Medieval layer in Søndervold in Århus, of which 14 were without spurs. Of the remaining 16 only 2 showed cutmarks, whilst 4 had scar tissue. From a contemporary but smaller body of material from Sct. Pedersstræde in Viborg, 4 metatarsal bones were recovered, of which 2 had whole spurs and one showed scar formation.

The very large percentage of damaged spurs in the Svendborg material could signify that fat capons were prized particularly highly. It could be that in addition to castrating chickens, they were force-fed prior to slaughter but such a practice would not be reflected in the bone material.

As a matter of interest it should be mentioned that spurs are removed from cocks for a purpose far removed from that described above, namely that of raising fighting cocks. Several classical authors mention that cock fighting was indulged in on the Greek Islands and that to equalize the birds the natural spurs were removed from the combatants and artificial spurs of iron or bronze were fitted. In more recent times at Greyfriars in Oxford examples of metatarsal bones with the spurs cut off are known which correspond exactly to the Svendborg examples (West 1982) just as there are stuffed specimens of fighting cocks with spurs removed and artificial ones fitted. However the fact that for the moment nothing that could be interpreted as artificial spurs from the Middle Ages has been found in Svendborg or elsewhere in Denmark, could be taken to mean that spur removal was purely for the purpose of producing capons.

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Pollen Analysis in and around Svendborg

by INGRID SØRENSEN

In recent years archaeologists and historians have sought help from many branches of the natural sciences in reconstructing daily life in a medieval town. The understanding of how useful this can be has increased in step with the results which have been produced and even though it must be acknowledged that is has not always been possible to give specific answers to specific questions, further investigations do result in the broadening of experience and provide results which can be the basis for comparison.

Obvious methods in investigations of the natural environment that the people of the town lived in and the natural resources which they doubtlessly exploited are plant macrofossil and pollen analysis of the culture layers. Samples for botanical analysis were collected from all excavations in Svendborg and although the analyses are far from complete, a number of results have already been published.

There are however problems in using this kind of material, stemming largely from the fact that the deposits are for the most man-made rather than naturally accumulating. With regard to plant macrofossils (seeds, fruits and the like), they could have originated from plants growing on the spot or they could have been brought in by people or their domesticated animals. The situation regarding the pollen content of the culture layers is rather more complicated, in that the pollen could have originated anywhere in the area and have been transported to the site on air currents. So despite the fact that the pollen analyses show a greater spectrum of the region's vegetation, the results are difficult to interpret.

In order to investigate these problems further, the pollen analytical investigations from Svendborg have been divided into two parts. From the culture layers in the town, the same samples as used by Grethe Jørgensen and Hans Arne Jensen for plant macrofossil analysis are being analysed, partly in order to compare macrofossil and pollen content, but also because a number of seeds can be determined to species level whereas the pollen analyst is forced to give up at the level of genus or even family. Of equal importance are the pollen analyses from natural deposits, partly from the town moat and partly from a valley called Dronningmaen, an area which in medieval times lay outside the limits of the town. It is this part of the investigations that will concern us in the following.

Dronningmaen is a long crack-like valley running along the northern edge of Svendborg and was considered well-suited to the project. The investigation of an open profile on the southern side of the valley in 1974 gave surprising results however. In contrast to the natural development of a lake basin, where gyttja formed under open water gives way to peat as the lake becomes overgrown, here the peat was overlain by almost 40 cm of gyttja. This situation could only have arisen from a marshy area having been flooded and then standing under open water. It seems likely that the construction of a dam in order to create a mill pond was responsible and this idea is supported by the fact that since the Middle Ages there have been mills sited at the point where the supposed narrow outlet to Svendborg Sound was located.

Radiocarbon dating of the peat a few centimetres below the boundary with the overlying gyttja, gave a date of 1050±70 bp, calibrated to 950 AD. The uppermost layer of peat, which comes in contact with the gyttja, was not dated because phytoplankton from the dammed-up water had found their way into the peat and the dating would consequently have been too young. As can be seen in figure 16, which shows the upper part of the profile up to the level of the recent made ground, the peat has not accumulated at a steady rate (the peat at this point is 156 cm thick and peat formation began c. 6000 BP uncalibrated, the dates given in brackets are calibrated). However despite the irregular sedimentation and the uncertainties which surround conventional and calibrated radiocarbon dates from peat, such that these must be taken as guidelines rather than absolute dates, it is probable that that damming of the valley took place in the 11th or 12th century.

The resulting deposit is a fine homogeneous gyttja, containing seeds and fruits as well as pollen of aquatic plants. For such a deposit to accumulate requires at least 2 metres depth of water. It would be no mean feat of engineering to produce a mill pond of this order and it presumes the availability of considerable economic resources. From a topographical point of view the site was optimal for the creation of a mill pond that could be used for a large-scale operation. A combination of a long narrow valley, which at the time of dam construction had an overgrown marshy floor, and a substantial input of water from the morraine hills along the valley side, made this an ideal site for the many mills which were constructed around the same time or later than the dam itself. Maybe it was this activity which provided the economic background for the foundation and development of the medieval town.

No remains of the original dam or the medieval mills have been found. They must have lain nearer Svendborg Sound than the mill which is known from Tullebrinke, where there are metre-thick deposits of gyttja resulting from the damming of the valley. Neither is it known when the mill-dam was breached. However, overlying the gyttja in the profile there is 4 cm of peat which has been compacted by the 150 cm thick layer of made ground which was added during the course of the

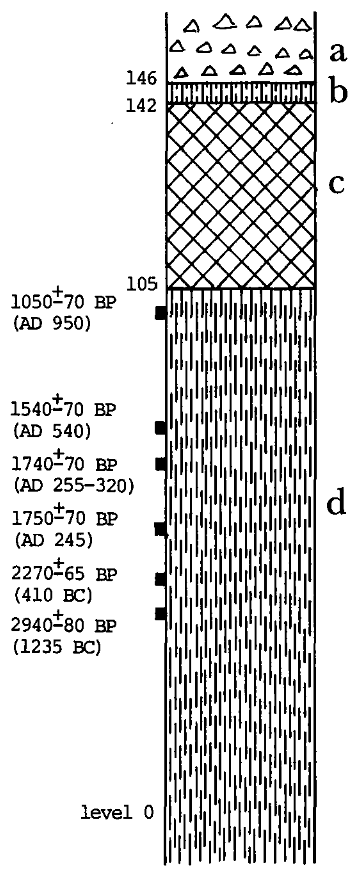

Fig. 16. Part of section in Dronningmaen with Carbon 14 dates. – a, sand. b and d, peat. c, gyttja.

present century. In the peat is pollen of bogbean (*Menyanthes trifoliata*), which means that for period Dronningmaen again became a marshy area.

The chalk-rich gyttja of the millpond cannot be radiocarbon dated and it has not been possible so far to find a basis for the dating of the pollen analyses of the gyttja. Accordingly it has not yet been possible to compare the pollen content of the gyttja with that of the contemporary culture layers in the town.

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Translated by David Robinson

NOTE

1. Nomenclature for flowering plants follows *Flora Europea* and for bryophytes (mosses) follows Nyholm (1954–69).

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Debate

The Bog Find from Sigersdal

Comment by the excavator

by SVEND TH. ANDERSEN

In August 1949 the author examined for the National Museum a human skeleton found by peat diggers in Sigersdal Mose near Veksø, northern Sealand. Various other objects including a second skeleton found by the peat diggers were also saved for the museum. A detailed account was deposited at the National Museum. The author had at that time been trained in bog geological and excavation techniques at the then Bog Laboratory of the museum, whose leader was J. Troels-Smith. The find was not examined further.

It is to be welcomed that the Sigerdal find has once again been brought to the light of day and placed in its context with other finds (Bennike and Ebbesen 1987). There was at the time of the investigation little doubt that the excavated skeleton belonged to the early neolithic. This has been confirmed by the radiocarbon dating (Bennike and Ebbesen 1987).

The author gave in his account a detailed description of the position of the various parts of the excavated skeleton (skeleton 'A' by Bennike and Ebbesen), supported by photographs, plan and sections, descriptions of the sediments and an explanation of the position of the body. Unfortunately this information was not used or was misinterpreted by the above mentioned authors (Bennike and Ebbesen 1987). The misinterpretation appears immediately if one compares the figures 4 and 7 in that article. According to the excavator's drawing (fig. 4), the right foot stuck deep into the sediment, whereas the reconstruction in fig. 7 shows head and feet lying on the lake bottom at the same level. Based on the reconstruction these authors assume that a dead individual was lowered into the lake and that the highest parts of the body disintegrated quickly due to contact with the open air. These bones could then have become displaced by current or "the displacement of the bones may have been caused by ice or faults in the bog". (p. 88). Why the bones from other parts of the body lying in the water were not displaced is not explained. This new interpretation by Bennike and Ebbesen (1987) casts doubt on the origin of the body as a human sacrifice. It might in that case just as well be that of a person who drowned accidentally or died from natural causes and was then put into the lake. The circumstances under which the skeleton was found leave no doubt that the skeleton represents a human sacrifice; however, in order to elucidate this, a thorough description of the sediments and the position and preservation of the various skeletal parts is necessary.

Two sediment columns from the vicinity of the find were described, one near the finding place of the lugged vessel (see fig. 3 in Ebbesen and Bennike 1987), and one at 0,65m south of the cranium. The pertinent sediments were lowermost light calcareous gyttja, above it brownish calcareous gyttja, and then a dark coloured coarse-detritus gyttja. The calcareous gyttja and the detritus gyttja were separated by a sharp erosional boundary, which was somewhat uneven. The skeletal parts occurred in all of the three sediment units mentioned above. Skeletal parts derived from the detritus gyttja were distinguished from those derived from the calcareous gyttja by a darker colour.

It was noticed that the bones from those parts of the body that were found in the calcareous gyttja were either in natural order (head and the neck, the upper part of the chest, the right arm and scapula, the left hand, the shin-bones and feet), or somewhat displaced (the lower part of the chest, and parts of the lower abdomen). The left part of the pelvis and the right thigh were also displaced. They were later partly uncovered by erosion of the calcareous gyttja (see figures 1 and 2). To one of these groups also belongs the left arm, which had been removed by the peat diggers. This shows that those parts of the body which were not lodged in the calcareous gyttja were somewhat displaced during the formation of the upper part of that sediment. Skeletal parts found in the detritus gyttja (manubrium, sacrum, some vertebrae and a rib) were further displaced (see figures 1 and 2). To this group also belong some bones removed by the peat diggers (some ribs and vertebrae, the left half of the pelvis and the left femur). The interpretation of these observations must be that parts of the body sunk into the calcareous mud were protected against displacement, whereas other parts were somewhat displaced during formation of the upper part of the calcareous gyttja. The left part of the pelvis and the right thigh were partly uncovered by erosion and then incorporated in the detritus gyttja, whereas other bones were further displaced. There is no evidence that parts of the body or the sediments were ever exposed to the air or subjected to movement by faults in the bog.

An understanding of which skeletal parts were in a primary position and which were later moved is necessary for a reconstruction of the original position of the body and how it was placed in the lake. In this connection it is crucial to notice that the right foot and shin-bone stuck into the light calcareous

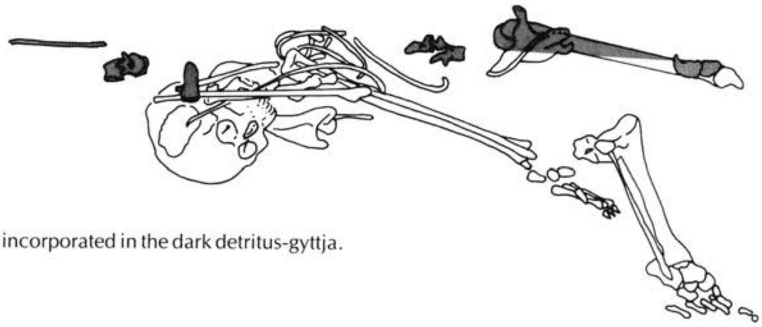

Fig. 1. Excavation drawing of the skeleton from Sigersdal showing the vertical position of the bones. Black: Skeletal parts incorporated in the dark detritus-gyttja.

gyttja 20cm below the head, whereas the left foot was placed beneath the upper part of the right shin-bone (figures 1 and 2). Lumps of the brownish calcareous gyttja occurred in the light gyttja near the right foot; one of them actually under the heel-bone. The explanation must be that the individual was placed vertically in the lake and that the feet sank into the light calcareous gyttja, and pushed some of the brownish calcareous gyttja downwards. The individual then fell over on its right-hand side, whereby the left foot moved across the right knee and the left leg was bent up in front of the body (see fig. 2). During the fall, the right arm was bent upwards so that the hand was placed in front of the face. The left arm presumably fell on the chest, as parts of the left hand were found in the chest cavity. The head fell on its right side with the face partially downwards and sank partly into the mud due to its weight. During disintegration of the body, bones from its highest part (thighs, the lower abdomen and presumably the left arm) were dislodged, spread on the lake bottom and incorporated in the brown calcareous gyttja and some of them were later spread further away and incorporated in the detritus-gyttja.

This sequence of events, which is fully documented by the position of the bones, indicates that the body of the individual was sufficiently strong to remain in a vertical position while the feet sank into the mud due to its weight. If the individual was dead and the muscles still flexible, the legs would rather have bent and the body have fallen over approximately in the position indicated in fig. 7 in Bennike and Ebbesen 1987. If *rigor mortis* had occurred, the feet could have been pushed into the mud with the body in a vertical position, however, the body could not have crumpled up in the way shown by the position of the bones, but would have fallen in a straight position on the lake bottom. It must be concluded, accordingly, that the live

Fig. 2. Excavation drawing of the skeleton in fig. 1 showing the horizontal position of the bones.

individual was placed in a vertical position in the lake and then met with sudden death, which caused it to fall on its right side. As there were no other foot tracks in the calcareous sediment, it can be concluded further that the individual did not walk to the place but was transported there, probably in a boat.

In the original report from 1949, the excavator suggested that the cause of death was a vigorous blow on the left side of the cranium, which produced the large lesion seen on Fig. 13 in Bennike and Ebbesen 1987. The skull itself was not investigated in detail by him, because the cranium was brought to the museum in an intact state and was later examined by others. As mentioned by Bennike and Ebbesen 1987, only a few splinters of bone occurred in the cranial cavity and a large piece of the tempolar region including a part of the cheekbone was missing. Bennike and Ebbesen 1987 conclude that the cranial lesion had been caused by the peat diggers using a fork and that the large missing bone fragment was removed by them. They also found that the edges of the lesion partly follow the sutures and that the lesion therefore was inflicted after death, and they maintain that a displacement of the jaw could not have happened before or shortly after death (p. 94).

At that time peat diggers did not use a fork, but rather spades or shovels, which could not have caused the indentations mentioned by Bennike and Ebbesen 1987. The peat diggers carefully saved all bones found by them including even very small specimens. It is therefore inconceivable that they should have discarded the large bone fragment from the skull. The effect of a vigorous blow on the cranium could easily have caused a dislodgement of a fragment along the sutures, as the individual was still quite young, whereas the indentations mentioned by Bennike and Ebbesen 1987 may or may not have been inflicted in recent time. The missing cranial fragment could have become displaced by water movement further away than other parts of the skeleton, and therefore not recovered during the excavation. The jaw was displaced by pressure of the sediments as its support on the chin-bone was missing. The present author therefore finds no evidence that the cranial lesion was not inflicted during life, but rather, that a blow caused the individual to collapse whilst standing with its feet sunk into the mud.

The present author therefore adheres to his original opinion that the individual was transported to the finding place in the lake and was sacrificed by a vigorous blow on the side of its head whilst standing in the water, probably by the side of a boat, which supported the killer.

Svend Th. Andersen, Geobotanical Department, Geological Survey of Denmark, Thoravej 8, DK-2400 Copenhagen NV.

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Reply to a Review

by AXEL HARTMANN

As an exception, the editors have accepted a reply to a review. Whether this is fairness or not, the reader will have to decide. We think, however, there is one good reason to publish the following comments by Axel Hartmann: they demonstrate the importance of a close cooperation between the archaeologist and the natural scientist, be it fifteen years ago, or at all times.

In volume 4 of Journal of Danish Archaeology H. Thrane has reviewed my book "Prähistorische Goldfunde aus Europa II. Spektralanalytische Untersuchungen und deren Auswertung". I would like to comment on some points in this review.

It is obvious that as a natural scientist I cannot be expected to possess the whole specialized archaeological knowledge necessary to come anywhere near exhausting the potentialities for new insights latent in the results of the analysis of prehistoric gold objects. This is all the more the case when their geographical and chronological range is as wide as it is in the present case. It seemed therefore a very promising start when in 1970 I was able to embark in the company of H. Thrane and K. Randsborg on a study of the gold objects in the collection of the National Museum in Copenhagen. It hardly seems worth investigating today what reservations may later have arisen at the National Museum, but 1½ years after the agreement reached in October 1970, both colleagues abandoned the study of the Copenhagen gold – Thrane for fresh fields in Odense, and Randsborg to devote himself to other researches. Being aware of the difficulties that would arise, I wrote first to E. Lomborg requesting collaboration – unfortunatly without success. After the National Museum in October 1974 made the astonishing suggestion that the analyses should be published without any Danish participation at all, I was lucky enough to get P.O. Nielsen to work through and check the already existing list of provenances on a private basis. This happily corrected a number of inacuracies and mistakes. P.O. Nielsen is also to be thanked for many of the references to publications. As the National Museum was unable to provide either drawings or photographs owing to pressure of work on its photographic laboratory, I was obliged as a last resort to make use of the inadequate private working photographs in the publication – "a poor example of international collaboration" indeed, as Thrane remarks. However it is odd to hear such vigorous complaints about the volume's lack in archaeological weight coming from Denmark in full knowledge of the circumstances.

At this stage, however, it would have been an irresponsible procedure to abandon the project or leave the existing analyses unpublished, so I was forced to the decision of presenting the results attained, linking them together with a conclusion of the more general kind that was all I as a natural scientist without specialist knowledge was capable of. Obviously this is unsatisfactory for experts in Danish prehistory, for it leaves many important questions and problems untouched. The aim, how-individual was placed in a vertical position in the lake and then met with sudden death, which caused it to fall on its right side. As there were no other foot tracks in the calcareous sediment, it can be concluded further that the individual did not walk to the place but was transported there, probably in a boat.

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For this reason one finds nowhere in the text the suggestion attributed to me by Thrane, that the Trundholm sun-chariot might date from the urnfield period. I am content to leave detailed study of such questions to the archaeologists. My only wish is to point out that gold with added copper is an exception in Montelius II. This is a fact now established by the tables of analyses, which ought not be overlooked in any future examination of the dating of the sun chariot.

Thrane's remark that the 20 wire rings with flat leaf-shaped ends shown in Pl. 28 are incorrectly attributed to Montelius VI and probably are from the Copper Age, is naturally of great value. In the Bronze Age exhibition of the National Museum, of which H. Thrane was in charge when the samples were taken, they were exhibited as Late Bronze Age. Confident in the rightness of this attribution I placed the 20 wire rings in Pl. 28, but am now naturally most grateful for the correction after a delay of fifteen years. It shows how valuable the participation of the National Museum would have been a step further than to the mere taking the metal samples.

Of some of these wire rings, which are now known to be very early, the observation may be made that pairs found together sometimes differ strikingly in composition (incidentally Au 3724 was not found with Au 3737 but with Au 3727). This is somewhat unusual, as in later periods gold ornaments found together in pairs are generally of very similar composition. This observation in the case of these early pieces ought not to confuse "us poor archaeologists", as Thrane opines, but make one appreciate that at that time the objects were not made in pairs simultaneously by the same goldsmith, but more likely at separate times and places. Apparently gold was not yet so abundantly available that pairs of ornaments could always be produced together.

At this stage it already becomes obvious how wrong it is to approach experimental data – in this case the gold analyses – with preconceived notions and fixed expectations, for objective statistics seldom confirm subjective prejudice. Thus Thrane is disappointed to discover how little the gold from the hoard from Råddenkjær bog in central Jutland, with its unambiguous attachment to group N and NC, differs from the gold of other Bronze Age finds in Denmark, although the forms at Råddenkjær suggest an origin far away to the south-east. This disappointment is due clearly to an attitude of expectation, that is unjustified and leads nowhere so long as maintained. One ought instead to adduce from this surprising result that the same gold N was used in the south-eastern area where this object originated, as in Bronze Age Denmark. As all the gold used in Denmark in view of the obvious lack of local occurrences must have come through some kind of trade, this might have given a first clue to the direction from which gold of type N may have been imported. Certainly no occasion for disappointment!

We have H. Thrane's vigilance to thank in the last part of his review for calling attention to various mistakes and printing errors. The incorrect provenances given for Au 3575, Au 3847, Au 3853–54, and Au 4055 may be attributed to mistakes in the lists sent to Stuttgart. These were prepared under Thrane's supervision by a female student at the National Museum, I myself being unable to read the inventories. When Thrane calls attention to the fact that in SAM 5 the Danish place names are not always spelled correctly (e.g. Brønsted instead of Brøndsted, Tjærborg instead of Tjæreborg, Tudved instead of Tudvad, etc.), these mistakes are regrettable, but in some cases spelling variants may have played a part.

Thus in the penultimate paragraph of his review Thrane writes once Skødstrup and once Skydstrup. He specifies the provenance of Au 4085, which does not appear in SAM 5 at all, writes "pl.1" where he must mean "pl.71", attributes Au 3747 to the provenances Hvidbjerg and Toftehøj both, and says Au 4368 comes from Brøndhøj when he means Au 4968 did. And this is all in a single paragraph, whose purpose, of course, is to provide supplementary information to help the reader avoid the confusions arising from my errors! It really is difficult to produce in print a large and difficult text without a mistake.
[Translated by David Liversage]

(25th August, 1986)

Axel Hartmann, Murrstrasse 16, D-7410 Reutlingen 25 (Altenburg).

Stylistic Analysis

A Critical Review of Concepts, Models, and Applications

by ANNE BIRGITTE GEBAUER

Studies of stylistic variation in prehistoric artifacts have played an important role in archaeological research since the beginning of the disciplin. Assumptions about the causes of patterned stylistic variation have always been central to the development of cultural chronologies and to traditional concerns with culture-historical relationships and are equally important in "processual" or "post-processual" studies today. Beliefs about the processes by which stylistic elements have spread through time and space have differed. Despite a rich history of interpretive disagreements the subject has remained poorly understood.

Recent years have witnessed an increase in systematic efforts to identify the forces that create different patterns of stylistic trait distributions. There has been an expansion of archaeological interest in the social conditions that promote and inhibit the transmission of stylistic traits. These studies have produced some interesting results which has renewed the ever, was to make results and ideas available to archaeologists and enable them to make further use of them in their own work.

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Recent years have witnessed an increase in systematic efforts to identify the forces that create different patterns of stylistic trait distributions. There has been an expansion of archaeological interest in the social conditions that promote and inhibit the transmission of stylistic traits. These studies have produced some interesting results which has renewed the field of stylistic studies and helped to define some directions for future studies.

Systematic research on social causes of stylistic variation is still small and from a theoretical perspective, somewhat disjointed. Thus a general theory cannot be presented. Below the main approaches to stylistic studies are surveyed and comments are made on the main problems in analyzing stylistic variation.

Two basic ideas have underlain most stylistic analyses in archaeology. The first is that style is a passive reflection of social demography and social interaction (Binford 1963, Deetz 1965, Hill 1970, Longacre 1970, S. Plog 1980, Whallon 1970):

normative theory
social interaction-learning theory
motor habit approach

In contrast the second basic idea is that style is an active form of non-verbal communication which plays an important role in social strategies (Conkey 1980a & b, 1984, Hodder 1979, 1982a & b, Wiessner 1983, 1984):

information exchange approach
structural-symbolic approach
behavioral approach

Up till the 1960s archaeological studies are based on normative theory. According to normative theory culture is shared and homogenous. Broad cultural areas are thought to be characterized by a single norm or idea concerning stylistic behavior. Learning is the recognized basis of transmission between social units not linked by regular breeding behavior. The aim of stylistic studies within this approach was to develop chronologies or mapping spatial variation.

A large amount of research has concentrated on the discovery and description of stylistic change through time in order to date sites. Using sets of artifacts from stratigraphic sequences or from dated deposits for temporal control, it has been established in many areas how stylistic attributes changed through time. The succes of such studies led to wide spread use of stylistic attributes, such as types of ceramic designs or characteristics of projectile points as index fossils for the dating of sites.

Spatial analysis was influenced by the concept of diffusion which can be traced to anthropologists like Kroeber, Boas and others who worked in the period 1900–1945. Today the study of diffusion is unpopular among archaeologists, partly because new paradigms have been developed, but also because of misapplication of the concept of diffusion. Although no archaeologist denied the significance of the cultural milieu as a factor in the transmission and adoption of traits, it seemed impossible to account for it in real archaeological situations. Instead, archaeologists implicitly adopted the position that in the absence of countervening evidence, diffusion rates could be assumed to be context-free. It came to be assumed that diffusion rates were directly proportional to the frequency with which people learned about an innovation, at least within a single society. Since the archaeological record rarely provided hard evidence of social or ideological constraints on diffusion, the working assumption meant that a large corpus of archaeological data could be employed to directly measure intercommunity contact. By means of this conceptual leap, culture contact stood in place of an explanation for interassemblage similarities in the presumably context-free realm of style. Thus, the concept of diffusion has often been employed by archaeologists as a surrogate for explanation. Cultural similarities are assumed to be satisfactorily explained if they can be said to be products of diffusion. This is of course a misapplication of the concept of diffusion. Diffusion is only a description of results, not an explanation of the processes behind it (Davis 1982).

In studies of chronology and cultural-historical relationships style is seen as broadly distributed aesthetic similarities typical of a time period in a given area or of an artist. – This view on style is very similar to usual modern employment of the concept of style. – The locus of variation is cultures. Only rarely have stylistic innovations been attributed to individual artists, like the designs at the Oseberg Viking ship (A. W. Brøgger, H. J. Falk, Haakon Shetelig 1920). Stylistic variation has also been studies as art. These analyses are influenced by our modern concept of art as a sfere independent and seperate of other aspects of society. Thus the primary concern of older normative studies was simply recording the stylistic variation in time and space assuming the variation was context-free.

In the 1960s archaeologists became more concerned with explaining culture change. Many archaeologists argued that culture change must be understood in terms of a society's adaptation to its physical and social environment. Yet, the emphasis on the natural environment exceeded that of the social environment in many studies. However, the concern with explaining culture change did increase the interest in stylistic studies in order to infer characteristics of prehistoric organization.

This interest was stimulated by Binford's criticism of historical and normative approaches to explanation of cultural variation (Binford 1963). In this paper Binford defines style as the non-technological, non-functional part of material culture.

In a series of stylistic studies Deetz (1965), Hill (1967, 1970), Longacre (1964, 1970) and Whallon (1970) analyzed prehistoric residence patterns in North America by measuring the variation of ceramic design elements. Their approach to stylistic analysis has been called social interaction theory or social interaction-learning theory.

Social interaction among individuals was emphasized as the primary determinant of the stylistic variation. Thus, the locus of variation is the individual. According to social interaction theory individuals will paint designs like other individuals to the degree that the individuals interact, i.e. the degree of stylistic similarity is directly proportional to the amount of interaction. As individuals have varying sferes of interaction with other individuals that are determined by organizational units such as residence groups, lineages, clans, villages etc., it can be expected that varying degrees of stylistic similarity can be found at different spatial scales reflecting these units.

Social interaction theory is very similar to normativ theory. Both theories emphasize learning and interaction between individuals in the transmission of ideas through space. Both theories stress the concept of norms. The difference between the two perspectives concern arguments for broad norms, those of a single social group as assumed by normative theory, versus more narrow norms, those of individuals according to social interaction theory.

The second basic assumption behind the studies of prehistoric residence patterns was first made explicit by Deetz (1965) in his study of Arikara ceramics. This hypothesis predicted that mutual associations among stylistic attributes would tend to be particularly developed on items produced by women in a community with a high rate of matrilocal residence. This pattern of stylistic behavior was theoretically attributed to the chanelling of interaction among female artisans within the lines of matrilocal residence groups (Whallon 1970).

Utilising practically the same assumptions Hill (1970) and Longacre (1964, 1970) measured similarity between design elements in pueblo rooms and felt that there was evidence of spatially localized clusters of rooms. They argued that these spatial clusters represented matrilocal residence groups. – Following the same approach Whallon suggested that the degree of stylistic homogeneity would be a function of the amount of movement of women between villages, i.e. a function of the rules of postmarital residence.

Significance of weakly formalized communication networks for stylistic distributions in pottery is analysed in a series of ethno-archaeological studies by David and Hennig 1972, Friedrich 1970, Hardin 1977, 1979, Longacre 1974 and Stanislawski and Stanislawski 1978.

The motor habit approach to stylistic studies was suggested by Hill (1977) and following this idea Hill and Gunn edited a book on "The individual in Prehistory" in 1977. Hill suggested that differences between individuals in motor habits are the primary source of variation in a number of attributes. This variation is subconscious and therefore independent of social interaction or learning the production of a craft. Thus motor habit variation can be used to isolate the products of individual artisans. Attributes suited for this kind of analysis would be line and space width, angles, and the use of space in general.

Criticism of the social interaction theory

Although the social interaction approach has some explanatory power there are many situations which cannot be accounted for. Particular noteworthy are ethno-archaeological findings that there can be intensive interaction over a boundary, yet styles remain discretely distributed and in no way reflect this interaction (Hodder 1982 a og b, Wiessner 1983, Wobst 1977). Conversely, there may be marked social boundaries which do not inhibit the flow of style. The distributional patterns predicted by social interaction theory are gradually increasing or decreasing stylistic similarities, whereas homogenous style zones with marked boundaries cannot be explained.

The disagreement also concern the social conditions that promote or inhibit transmission of stylistic variation. Hodder (1979) argues, that the simple relationship between learning and stylistic variation which is assumed by the social interaction theory, will only be found in ideal situations free of social or economic constraints or stress. Wiessner (1984) has tested the social interaction theory against the distribution of stylistic traits at beaded headbands used among the San bushmen in Kalahari. Her analysis indicates that stylistic similarity does not drop off with distance, rather stylistic differences are related to the nature of interaction among artisans.

The idea of style as passive reflection of interaction and learning has been criticised by Wobst (1977), because style is solily related to context of production, that is to processes which preceeds the use of artifacts. Stylistic variation has no relation to the use context. Following the social interaction approach style becomes a strangely selfcontained variable within the cultural system. Also style has no function or adaptive value.

Style as an active component in social strategies

Opposed to studies utilizing the normative approach, social interaction or motor habit approach, a number of stylistic analyses have stressed the active role of material culture in social strategies. Stylistic behavior is emphasized as a cultural phenomenon that should be investigated in terms of the function such behavior performs in relation to other cultural variables. At the most general level it is argued that the decoration of domestic products, dress and surroundings is a form of social display or advertising behavior, encoding information not only on the identity of the maker or user, but also potentially about hers or his social group membership, status, wealth, religious beliefs, and political ideology.

Information exchange theory

This approach was first developed by Wobst (1977). Using information theory he defined style as formal variation in material culture which transmits information. From a perspective of cost effectiveness for style in transmitting messages, Wobst made a number of predictions on the possible content of the stylistic message and the ideal reciever. He argued that style is only efficient for transmitting simple, invariate and recurrent messages like group affiliation. Examples of this kind of stylistic variation would be flags, uniforms etc. More complex information would be too costly to transmit using material culture and too difficult to decode.

The ideal recievers of stylistic messages are intermediate socially distant people. People at close social distance would know the message already or it would be easier to transmit it verbally. On the other hand the receiver should not be too distant since decoding or encountering of the message could not be assured.

Two important predictions can be made from the information exchange approach. First the most visible artifacts are most appropriate for the transmission of stylistic messages. That is features that are encountered by most people like body decoration, dress, artifacts used in a public context like ceremonial objects or artifacts used as exchange items.

The second prediction circumscribes the potential receiver as intermediate in social distance to the emitter of the message. From this perspective Wobst argues that stylistic behavior will increase with the size of the social network – simply because the group of potential receivers increase. Small social networks in band societies on the other hand will only produce a weakly developed stylistic behavior. Wobst argues that this kind of stylistic variation has a highly adaptive value as it helps integrating members of society by expressing group membership and boundaries: Also stylistic messages facilitate social interaction across boundaries because the signal of social identity makes certain norms of interaction predictable.

It deserves notice that Wobst is only dealing with that part of material culture which transmits information. In his opinion that is the highly visible part of material culture. Other artifacts will show the same kind of variation as described by social interaction theory.

In analyzing prehistoric ceramics in the American Southwest Plog (1980:136) suggest that stylistic variation found here is best explained by information exchange theory. The study includes a thorough discussion on problems related to stylistic analysis.

In a recent study of the TRB West Group Voss (1982:45) suggests a fusion of the social interaction and information exchange approaches centered on the concept of style as identity expression. The formation of personal identity results from a dynamic process linking the individual with the larger social environment. Stylistic behavior is generated on the basis of social expectations and is directed towards others in the social sphere. Style permits social evaluation of the individual and at the same time transmits information concerning group affiliation and unique statuses. The concept of style as identity expression suggested by Voss is very similar to studies by Wiessner (see below). However, Voss relates stylistic behavior to social psychology without stressing human cognitive processes.

Predictions of information content and potential recievers are very similar to those stated by Wobst and comments on information exchange theory applies to Voss as well. The limited scope of information content of style, as implied by Voss, results in a view on stylistic variation as passive reflections of communication and social interaction in a presumably context-free space. Thus contextual use of pottery and changing importance of pottery at funeral rites is not considered in the interpretations of stylistic variation.

Criticism of information exchange approach

Wobst succeeded in pointing out when and how a specific type of information will be communicated through stylistic signalling. However, the information exchange approach has been critisized for the following two reasons.

First this approach fails to account for the underlying behavior which is expressed through stylistic variation. Style may well express and justify ethnic differentiation, but the manner in which they do this cannot be explained. Why certain types of artifacts are chosen to reflect the differentiation in stead of others are not explained. The conditions which brought out the social differentiation in the first place are not explained either.

The second problem using the information exchange approach concerns Wobst's predictions of narrow information content of stylistic messages and of the socially distant recievers. Hodder's ethnographic studies indicate that visibility is not a primary determinant of an item's value as an ethnic marker. His data shows that features with low visibility, such as hearth location inside houses, may be patterned similarly to objects outside in the external world (Hodder 1982). Here stylistic variation works two ways, both marking ethnic differences and binding people at close social distance together. Thus style plays an important role in communicating more complex and subtle messages both at a distance and in close proximity. – Our everyday experience confirms this. One need only look at dress style among teenagers in our society to realize that style plays an important role in nonverbal communication for those in close proximity and that style is often appropriate for complex and variable messages (Wiessner 1984).

The structural-symbolic and the behavioral approach

The more comprehensive view on style taken by Meg Conkey 1980a & b, Ian Hodder 1979, 1982a & b and Polly Wiessner 1983, 1984 raises questions about relevant social conditions and spatial structures that were not considered explicitly by Wobst and Voss. Studies on the social conditions underlying stylistic variation has followed two lines of investigation, a structural-symbolic approach taken by Hodder and Conkey, and a behavioral approach taken by Wiessner.

The difference between the two approaches concerns different intellectual levels behind the function of material culture in social strategies. Conkey and Hodder are concerned with the conceptual framework of society. Whereas Wiessner studies the mechanisms that guide the stylistic behavior of the individual within a given cultural frame of reference.

The structural-symbolic approach

Conkey and Hodder define style as the particular way in which general principles of meaning are assembled and reorganized in a local context as part of the social strategies of individuals and groups.

Style may be viewed as a conceptual process, a cultural code that produces variability in the formal attributes of material culture and that relates to the social context of manufacture and use. The existence of stylistic variability implies not only participation in a similar cultural encoding and decoding strategy but the transformation of that code into material culture. This transformation, itself a form of communication, is based on a mutually intelligible communication system and produces material culture exhibiting "family resemblances" or some degree of standardization.

Participation in a common cultural encoding and decoding strategy and the transformation of this code via stylistic treatment of artifacts may be viewed as a cultural integrating mechanism. This is so because participation in a style enhances predictability of a message by restraining it. Arbitrariness and ambiguity in a style is restrained in favor of redundancy.

Just as participation in a style may serve as an integrating device it may also serve as an isolating mechanism such that the message may not readily be translated out of the cultural context. This is the reason behind archaeological interpretations of style as an indicator of social boundaries. However, style is not so much to be viewed as an indicator of social boundaries, but as a component in the process of boundary maintenance. Maintenance of a style is related to selective pressures favouring both internal integration within and external differentiation among identity conscious groups.

Meg Conkey (1980a & b) has related the appearance of stylistic variation to human cognitive evolution. The ability to communicate anything that can be conceptualized signals a threshold in the human means for storing and transmitting information. The transformation of concepts into not only vocabularies, but also material culture such as engraved bone and antlers gives better possibilities of communication.

This communicative advantage could have enhanced the learning of new adaptive tasks and probably contributed to the replacement of Neanderthals by fully sapiensized populations. Since then human evolution has been characterized not by species diversity, but by cultural differentiation. A shift in the organization of adaptive behavior led towards behavior dependent on symbolization. Symbolic behavior is a means of managing both intragroup and intergroup dynamics.

The studies by Ian Hodder concern specifically the role of style in maintenance of social group boundaries. In 1979 he proposed that material culture items were most likely to show a sharp fall off at ethnic boundaries when intergroup competition made it advantageous to reinforce ethnic identities. Material culture can affect the way people behave and can be used to change people's ideas. It is part of the active negotiation of social change by individuals. The outcome of this negotiation depends on the relationship between individuals, culture, and history. "There is no causal relationship, because the relationship depends on how individuals use material culture in social strategies, and the way they use it depends on the framework of meaning in which material culture is involved in particular historical contexts" (Hodder 1984:48).

The behavioral approach

Like Hodder and Conkey, Polly Wiessner (1983, 1984) emphasizes the active role of material culture in social relations and the importance of cultural and historical contexts in stylistic interpretations.

Social and symbolic structures define persons and styles in artifacts as comparable, and because stylistic decisions are made relative to these, style can only be understood within its appropriate cultural and historical context. On the other hand, if stylistic behavior is based on a fundamental human cognitive process as proposed by Wiessner, then an understanding of this process is essential for developing a theory of style.

Wiessner defines style as variation in material culture which is involved in negotiation of personal or social identity relationships. The behavior underlying style is an expression of identity which is aimed at projecting personal and social aspects of the bearer to others in order to create a positive image. Both social and personal aspects are important in the formation of self-image. Social identity will be that part of an individual's self-concept which derives from knowledge of membership of social groups. Personal identity concerns the more personal aspects of self-concepts and usually denote specific attributes such as bodily attributes, psychological characteristics, feelings of competence, ways of relating to others, intellectual concerns, personal tastes etc. (Wiessner 1984:5).

The motivation of individuals to differentiate themselves from others is a desire to project a representation of this image to others, preferrably others who are socially more succesfull. Individuals who can present a positive self-image seem to be more succesfull in interaction with others (Crook 1981:105). – Style is one of the many channels through which such a representation can be presented negotiating personal and social identity relations, either consciously or unconsciously.

Under most conditions daily comparison will occur at the level of the individual, not that of a group acting as a unit. The choice of persons or groups for comparison are guided by cultural and symbolic structures in society which defines persons and groups as being comparable along certain dimensions. A skilled hunter would compare himself with his spears and not with an old man or a young boy who had just started to hunt.

Under certain conditions style will take on collective associations and the spatial distribution of specific designs will yield information on social boundaries. This requires a reduction in the number of associations evoked by certain stylistic features. A number of conditions may produce a reduction in the range of association related to certain stylistic features:

1. The frequency with which an artifact is subject to comparison has to be sufficiently intensive.
2. Stress and competition between persons or groups will enhance comparison along certain dimensions.
3. A specific functional or symbolic role of an artifact will limit possible referents.
4. A stable history between people over time allows for a specific style to become associated with certain referents.

The fact that people will negotiate both personal and social aspects of identity implies that style potentially holds information on harmony and tensions in society caused by the balance or inbalance between these two aspects of indentity.

The choice of subjects for social and stylistic comparison are guided by existing cultural structures. Thus a comparison of subjects over space and between social strata might provide information on cultural structures. Lack of stylistic comparability can result from a number of reasons:

1. Isolation or lack of knowledge of another social group and its material culture.
2. Desire to avoid comparison and statement of identity relative to certain persons or groups.
3. A conscious attempt by persons or groups to differentiate themselves.

A variety of relationships can be negotiated through social comparison and by the use of different stylistic strategies. Usually in hunter-gatherer studies style has been interpreted as a means of creating social solidarity or as a way of maintaining the social boundaries necessary to redistribute people over social and natural resources. However, many different kinds of relationships may exist along these two opposing dimensions, affilation and differentiation (Wiessner 1984).

Conclusion

It is evident from the survey of stylistic studies that there is no coherent theory on style. Perhaps Whallon is very close to the truth in saying "The meaning of style has so many ramifications, that an attempt at a comprehensive definition must either arrive at a vague theoretical statement or become involved in an extensive review of specific usages" (Whallon 1970:224).

In working with material culture, it is however important that archaeologists develope interpretative frameworks about the material implications of different kinds of social behavior and information content.

Obviously the two basic ideas underlying stylistic analyses describe different kinds of variation in material culture resulting from different social behavior. Wiessner (1984) cautions that the concept style does not include all formal variation. Studies by for instance Hodder and Conkey have neglected that not all material culture plays an active role in social strategies. Thus, the concept style has been applied to data that were not comprehensive from this approach. Normative variation, the replication of ways of doing things, is generated by different social actions.

A recent discussion between Sackett (1985) and Wiessner (1985) clearifies the distinction between normative or isochrestic variation (Sackett 1982, 1985) and stylistic variation. Normative or isochrestic variation is described by Sackett (1985:158) as "choosing specific lines of produce from the nearly infinite arc of possibility and sticking to them". This variation permeates all aspects of social and cultural life. Functional traits are also subject to isochrestic variation. While it's causes may be obscure, it's need is obvious. Order, skill, facility in human relations, and technology require the definitiveness and effectiveness that come from conforming to and perpetuating isochrestic options dictated by craft traditions of a given social group. Normative or isochrestic variation is generally acquired unconsciously, taught by insinuation and employed automatically. Isochrestic or normative behavior has a symbolic element of its own right as conforming to standard values provides a mutual identity and security.

The intriguing question is, how and why procedures become adapted in populations that often cover vast areas (Wiessner 1985). Only little is known about the identification of this kind of variation or the content of social information. Wiessner (1985:162) suggests that isochrestic variation will vary around one or a few standard mean types, whereas several competing alternatives might be expected in stylistic variation. Also, isochrestic variation should remain stable through time, while stylistic variation is currently updated and dynamic. Social contact would only have a limited effect on isochrestic variation, once it is established, whereas style potentially would be influenced due to regular stylistic and social comparison. Items used in stylistic variation are choosen within the range of isochrestic variation of a particular social group. Style can lapse into isochrestic variation if the symbolic role of an artifact disappear.

"Style is not acquired through routine duplication of certain standard types, but through dynamic comparison of artifacts and corresponding social attributes of their makers. Stylistic outcomes project positive images of identity to others in order to obtain social recognition" (Wiessner 1985:161). Recent studies have concentrated on the aspects of material culture that play an active role in social strategies. Certain predictions can be made on the kind of social information contained: Existence of social groups and boundaries, nature of personal and social relationships and balance between personal and social identity through time.

Thus, two kinds of stylistic variation might be expected in the archaeological data. Both aspects of stylistic variation might play a part in the same social strategies or one might express group identity while the other aspect might be involved in simultaneous attempt to lessen the level of conflict (Hodder 1979).

Despite increasingly complex analysis of the social conditions producing stylistic patterning these processes are still poorly understood. Confirmity to social norms occur as a result of selective pressures which makes integration and boundary maintenance adventageous. Usually unspecified tensions and competition, socially or economically, are referred to as selective pressures.

Based upon information exchange theory and cost effectiveness Wobst (1977) suggested some general links between stylistic strategies and social behavior at group level (iconographic variation Sackett 1985). This kind of stylistic variation should appear as all-or-nothing uniform zones concerning specific, mainly non-functional, aspects of material culture, especially items with a relatively long period of manufacturing and use and high visibility. These predictions have not stood up to ethnographic testing (Hodder 1982a, Wiessner 1983, 1984).

No clear predictions can be made for either style or isochrestic/normative variation with regard to artifacts or traits in which the two kinds of variation would be expected to reside. Analysis must proceed by carefully scrutinizing frequency of appearance and contextual use of the artifacts. Spatial variation of different artifacts must be contrasted. These analyses should provide basic information for seperating normative/isochrestic variation and stylistic variation. Which artifacts are involved in stylistic variation, in what context do they occur and in what combinations with other artifacts? Is it possible to distinguish several kinds of stylistic variation in contrast to normative/isochrestic variation? Questions like these should provide insights to the use of material culture in different social strategies at a given time.

Many stylistic analyses are synchronic studies or comparisons of several synchronic studies. Studies of temporal variation might provide further informations on stylistic strategies in society. Various artifact groups showing different degrees of temporal variation might indicate normative/isochrestic variation versus stylistic variation or individual versus social stylistic variation.

Different areas might show varying degrees of temporal change indicating needs of conformity to social norms. An extreem example is the Egyptian art which remained virtually unchanged for centuries, probably because this part of material culture was linked to Pharao's status as god and concepts of an eternal unchanging order of life.

On the other hand, the Single Grave Culture in Jutland provides an example of fast temporal changes of the male status symbol, the battle axe, in relation to Eastern Denmark and Continental European Battle Axe Culture. This might be due to tense and competitive social conditions in Jutland. Also, the role of battle axes as male status symbol might be reduced in favor of metal objects during the late Battle Axe Culture in continental Europe (Glob 1944, Harrison 1980:68).

The analytical approaches suggested above aim towards critical questioning of the archaeological data concerning the content of social information and the behavioral basis of material culture. Analysis within this framework might be fairly small-scale regional studies rooted in specific social situations (D. Miller and C. Tilley 1984:151). However, such studies might provide a more adequate understanding of longterm changes by improving our knowledge on the relationship between social behavior and material culture.

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Reviews

IAN LONGWORTH and JOHN CHERRY (eds.): *Archaeology in Britain since 1945.* British Museum Publications, London 1986. 248 pp.

This book, published by the British Museum, is aimed at the general European reader as well as at the student and the scientist. It deals with the practical results of field archaeology during the last 40 years in Britain, a period in which all the European countries have wittnesed a dramatic increase in archaeological field work, an improvement of the related techniques, and a considerable accumulation of data. It covers all the Prehistoric and Historic periods until ca. 1600 A.D. including the following chapters: "Prehistoric Britain", "a Roman Province", "Anglo-Saxon England", "Technology, Towns, Castles and Churches AD 1100–1600" and "the Medieval Countryside". For the non-specialist reader the state of results before the war are briefly summarized at the beginning of each chapter, and the authors succeed well in balancing the different approaches and ideas prevalent in British archaeology, although this book clearly is meant to deal with the practical results, not theories, models, computeranalyses etc.

It must certainly interest any reader to be acquainted with the most recent results within the sphere of field archaeology, and perhaps especially in Britain, where the concepts of the prehistoric period seem to have changed more dramatically than in any other European country, most pronounced with respect to the Neolithic. In the beginning of the 'fifties, the Neolithic was seen as a period only covering about 500 years, but now its lifetime is regarded as almost four times this. This change is partly due to the introduction of the C14 method, which, in Britain, is named the C14 "revolution". This widening of the time-scale has, of course, altered the ideas of how the Neolithic societies developed – now there is much more room for independent cultural development; invasions from the Continent or the coming of a superior priesthood are not any more seen as the main reason for cultural change. Also, concerning the Bronze Age and Iron Age, invasions were formerly seen as the main factor governing cultural development; but now things have changed, and even the until-recently maintained ideas of Beaker invasions seem now more or less outmoded. Perhaps this book has gone too far – the Anglo-Saxon invasions are almost not mentioned.

As in all other European countries the stripping off of the topsoil over larger areas has given new and valuable information concerning the daily life of the Prehistoric population – now, archaeology is not only dealing with valuable objects from burials and river deposits, or ritual monuments, now we know the villages and hamlets. Especially British archaeologists and related natural scientists have achieved very fine results within the sphere of environmental archaeology; in many cases it has been possible to establish the settlements in a general framework of land use. Perhaps this part of British archaeology has not been emphazised enough in this book – only the description of the Bronze Age field systems at Dartmoor and the Medieval parts deals more thoroughly with these aspects. But it must be admitted, that it must have been an indeed very difficult task for the authors to select among the numerous sites and results from the last 40 years.

Many of the sites mentioned in this book have already gained a name as a "classic" site in field archaeology. From the Mesolithic, Star Carr can be mentioned, from the Neolithic, the intensive excavations on the complex causewayed enclosure Hambledon Hill or the many wooden trackways in the Somerset Level. Also the many excavations of the earthen long barrows and the megalithic tombs have given new information. The large scale excavations have yielded small villages such as Itford Hill from the Bronze Age or Little Woodbury from the Iron Age; those at Danebury Hill Fort have given new clues as to the activities going on, on such a site. Perhaps a more detailed account of the South English oppida system from the last preconquest century, and the results from the recent excavations on Hengistbury Head concerning trade patterns, minting etc., could have been expected.

As to the Roman period we now have a much more varied picture; both urban, rural and military sites of different kinds have been excavated. The most brilliant find is perhaps the "palace" of Fishbourne. Among other finds, the Water Newton Hoard has shown that Christianity was well established in late Roman times in England. Another interesting fact is, that not all sites in Roman Britian saw an economical set-back during the 4th century; for instance, Verulamium kept going very well until quite the end of Roman Britian.

Also, the excavations of the Anglo-Saxon period have yielded a lot of new information – now, a number of settlement sites with houses are known: before the war only sunken huts on a few sites had been found. A much broader picture is now emerging, including royal residences, trade centers, rural settlement etc. Among the most important sites are those interpreted as royal residences, such as Yevering. Also, the city excavations have contributed to our much broader picture of the Anglo-Saxons (e.g. York, Northampton). In the field of Anglo-Saxon and Medieval church archaeology a lot of new sites have been recorded, while excavations in Winchester have given us a much better understanding of the development of this cathedral.

In this section dealing with the churches, a certain inaccuracy appears in the text: on page 150, we are told that "the destruction of churches in war (the second), ... provided the impetus for church-investigation in Germany and Denmark." In fact, the only severe damage inflicted upon Danish churches in war in recent times was the occasion of the English terror-bombardment of Copenhagen, by incendiary projectiles and aimed at the civilian population, in the year 1807, carried out by General Arthur Wellesley, later 1st Duke of Wellington.

In the same way as open field excavation has given quite a new range of information concerning the Anglo-Saxon period, this method of excavation has also given a much more coherent and complex picture of the Medieval village, its development and land-use – the picture is much more varied than had hitherto been thought. Especially the Warham percy project has given us a better understanding of the changes in a village, the daily life and the exploitation of its surroundings.

Last, but not least, mention must be made of the many very attractive reconstruction drawings, which give life to a number of sites (but why are the late Palaeolithic hunters on fig. 2 totally naked?).

In the foreword is mentioned a similar survey, which members of the staff of the British Museum wrote in 1932, Archaeology in England and Wales 1914–31. This book, however, does not include the times after the Anglo-Saxon period. In comparison with this predecessor, the balance of the present book is perhaps not enough in favour of the Prehistoric period. This can be illustrated by the fact, that the whole Palaeolithic, Mesolithic and Neolithic are covered in only 24 pages, of which two are used for full page distribution maps, which do not need to cover that much in a general and popular book, while 11 full pages are used to describe one single (though interesting) medieval site.

This very interesting book vividly shows the reader that field archaeology is not merely a science collecting data confirming results earlier obtained (although many of the data come from the well known and not always too satisfying rescue situation), but that it is indeed a very dynamic science – during the last 40 years excavation has rendered obsolete numbers of notions, which earlier were built solely upon speculations, and the daily life of prehistoric man has come into archaeology.

May many other European countries bring out similar books surveing the most recent results in field archaeology, enabling both the general reader as well as the student and scientist to feel himself up to date!

Flemming Kaul

ALASDAIR WHITTLE: *Neolithic Europe: A survey*. Cambridge World Archaeology. Cambridge University Press, Cambridge 1985. 363 pages and 116 figures (drawings and black/white photos).

It seems to be a tradition with British Archaeology to write surveys covering specific issues accross huge areas and with great time depth. In theory at least this must be considered a very laudable venture, something that we should all appreciate very much. In practice, however, it is often difficult to see the virtues of the resulting book. In cases of specific technological issues like "the history of the wheeled chariot" or "the history of the boat in European prehistory", and in cases where a specific theory is tested against a large and comprehensive material, it may work out well. But in cases where the issue is of a very general nature it is less likely that the result will be worth the effort.

The book *Neolithic Europe: A survey* by Alasdair Whittle is unfortunately of the latter kind. There is no doubt that the author's knowledge of Europe during these four thousand years is very comprehensive, and anyway far greater than the one possessed by the reviewer writing these lines. Yet, simply because there is too much information crammed into each and every page in a staccato manner, I learned very little from reading this book. Literally every sentence holds new information. The following is a good example of how the book is compiled:

> At Karanovo I houses were about 7 by 7 m, though the smallest was 5 by 3.5 m. It is interesting again that the feature of a wooden subframe, interpreted as damp proofing, was not found in the very earliest houses. There was an oven on the back side wall of each house. Anza illustrates variation, from interconnected mudbrick rectangular houses 12 by 6 m in phase I, to more free-standing rectangular buildings 8–10 by 4 m, with a timber frame of small close-set uprights and a daub covering, and some with stone footings. Occasionally, preserved details indicate that some houses at least were carefully built and furnished. Parts of a roof of roughly trimmed trunks and branches were recovered at Prodromos in Thessaly: house models have gabled roofs. There is evidence from Karanovo that the walls were pained red and white. A fragment of a clay house-model from the Körös site of Röszke-Ludvár has an animal head on one gable apex, and other models from Greece, from the Sesklo phase for the most part, have features such as smoke holes in the roof. Some buildings were two-storeyed. (p. 51).

From a technical point of view, this compilation of information is perfectly correct. You are simply given a list of hard facts concerning the issue at hand, here it was houses in the Balkan Early Neolithic. However, the problem is that to form a mental picture of the issue discussed you have to concentrate very hard. In fact, I had to read the above paragraph several times before I considered myself to have a (fair?) picture of the building customs of the Balkan Early Neolithic. But, when you have to read page upon page of compressed information like this, you either lose your concentration and lose track of what is actually written on the pages, or you rather quickly forget what you read, because you are bombarded with so much information that you are unable to store it properly in your mind.

Reading or rather cross-reading this book made me wonder for whom a book like this is intended. It may be intended for the student as an introductory reading to Neolithic Europe. But as such, it is not recommendable. The amount of hard fact information embedded in the book is so staggering that students trying to read the book will be left with virtually no overview or mental picture of the Neolithic in Europe. It is far more valuable to let students read papers or books on specific subjects and areas in Europe, and leave out survey compilations like this. The net outcome in terms of the knowledge of and the feel for what the Neolithic of Europe is about becomes far greater that way.

It may also be intended as a book of reference, a handbook in which you can look up specific information on an area with a direct piping into the relevant literature. Seen from this point of view, there is indeed something to say in favour of the book. There is a nice "select" – perhaps too select – bibliography that gives you the handles for a study of the specific areas and periods. However, if the primary intention of the book is as a handbook, I would certainly have wished for it to be structured differently; with an emphasis on discussions of sites and specific problems.

Finally, it may be intended as a book of reference and inspiration to the professional with specific interests in part of Neolithic Europe. However, for this purpose, the book is absolutely unsuitable due to the fact that it is far too superficial in its discussions. Something I did indeed experience with the parts of the book that dealt with South Scandinavia.

It is thought provoking that although I had experienced the South European chapters to be crammed with information, the parts covering Southern Scandinavia revealed themselves to be superficial to say the least. Take the following for instance:

> In the EN there was a variety of burial modes including flat graves, round and long dysse or megalithic monuments and long earthen barrows covering graves at one end. Some flat graves were flanked by axial pits, which are interpreted as the remains of tent-like mortuary structures, as at Konens Høj in Jutland. This contained a single inhumation. Others of its type may have been covered by earthen mounds as at Lindebjerg on Zealand which suggest a possible development sequence in mortuary ritual, some but not all sites being important enough for mound construction. Few grave goods were deposited, chiefly pottery in small quantities. The supposed longhouses at Barkaer on Jutland have recently been reinterpreted as long mounds in the same tradition, house compartments being seen now a constructional compartments. In the MN the nature of burial monuments changes and the so-called passage grave becomes dominant, with polygonal chamber and capstone approached by a passage and set in a circular, often kerbed mound (p. 228).

Even though I know the material outlined in the above cited lines very well indeed, I had to concentrate to connect the picture I have with the information given here. Most of the information is in fact correct, but it is so fragmentary, out of context, and so non-communicative on the nature of TBK burial forms and burial practice that in reality it tells you nothing about this whole matter.

Reading the book made me realise that to make a survey like this, and to do it properly so that those archaeologists working with the material in the individual areas will nod there heads aprovingly, takes more than reading a lot of facts from hundreds of books and recompiling them into the framework of a single book. It takes an intimit knowledge of the material, acquired through a close first-hand study. The shorter the paragraph covering each issue has to be, the better must the knowledge be.

The above cited lines represents all information in the book on TBK burial forms and burial practice. I am convinced that limited to the above number of lines I would not be able to give a fair account myself of this particular issue. Indeed, I would not expect anyone could do so. Returning to the first citation in this review, one cannot help wondering if the reason why it was so difficult to perceive was just a matter of the jamming of information?

I have to apologise to Alasdair Whittle, as well as to any reader who might find the book recommendable, that I for one cannot recommend the book. I must stress that I do not blame this on the professional capabilities of the author, which I know are perfectly good. Indeed, his only fault has been that he tried to write a book, which in my opinion cannot be written.

Torsten Madsen

H. THRANE: *Lusehøj ved Voldtofte – en sydvestfynsk storhøj fra yngre bronzealder.* Fynske Studier XIII. Odense Bys Museer, Odense 1984. With contributions by I. TKOCZ, K.R. JENSEN, *et al.*

Lusehøj is the name of the richest burial mound from the Late Bronze Age in Denmark, situated in the island of Funen.

The publication, written in Danish, takes up 215 pages including an extensive and useful bibliography (pp. 180–193) and four appendices (pp. 194–215). 116 figures and three folded plates accompany the text.

The main objective of the publication is to present a detailed description of the excavations in 1973–75 and to discuss the problems relating to the site itself and to the culture-historical implications of the archaeological material recovered. The importance of this field monument pertains not only to the reason of its excavation: the once huge tumulus with all the associations of chiefly ceremonial prompted by the rich find made in it earlier – but also to the surprising discoveries underneath it of some smaller burial mounds and the remains of a settlement, all from the immediate past of the time of the construction of the great mound itself.

The monument now called Lusehøj attracted the archaeological attention more than a hundred years ago (about 1861) during a time, however, when the excavation of prehistoric mounds was a passtime aimed at the unearthing of antiquities, the more valuable the better, for private and public collections rather than a responsible scientific undertaking of wider perspectives. In *Chapter 1* the author therefore devotes himself at clearing up the complex circumstances of the whereabouts of the items found during the first diggings in Lusehøj which produced the astonishing assemblage of bronze and gold antiquities known as the rich Voldtofte burial find from the Late

Bronze Age. These artifacts and their relations to the urn burial are described in detail and all the cultural aspects and implications are discussed at length.

Chapter 2 deals with the problems of the antiquarian identification of the Lusehøj mound and its topographic setting and summarizes the history of the site in terms of the new excavation. While an analysis of the unsatisfactory and confused archival informations only makes it a probability to identify Lusehøj with the mound in which the old 1861 dig took place, the matter is being clinched by reference to fragments of artifacts excavated in Lusehøj in 1973–75 that derive from the objects of the rich burial found in 1861! – The once huge mound (36 m across and 7 m high) has not escaped the fate of numerous mounds of having been destroyed; it had been ploughed down so thoroughly that the remnants were indistinguishable from the smaller natural elevations common in the area. The new excavation spared the SW. quarter of the mound for future investigations.

Chapters 3 and 4 bring the basic evidence of human use of the site in the Bronze Age before the tumulus was constructed in Period V, evidence that adds to the archaeological uniqueness of this site. At the bottom were remains of occupation dating to Period III, consisting of many holes from mostly heavy house posts and of some ordinary pits. This occupation phase was sealed in by a zone of plough, or more correctly, ard furrows whose closely arranged pattern is of a more realistic appearance than mostly seen under barrows; one really gets the impression of fields having been well prepared for the growing of crops. On the surface of this cultivated field, four small grave mounds containing various complex evidence of burial rites dating to period IV had been thrown up. All structural features and portable artifacts relating to these three phases are described.

Chapter 5 records the structures and artifacts relating to the Period V tumulus, beginning with the rich Burial GX and the evidence of the events of the erection of the mound itself, all in the chronological order of the construction. Due to very keen observation and technical ingenuity, a number of unusual phenomena have been recorded such as an extended layer of reeds surrounding the burial which was itself delimited by a wattle and covered by a woven straw mat. And to control the throwing up of the mound, a process taking place immediately after the interment in GX, radial fencework supported by thin sticks had been put up along at least four lines. They were confined to the area with Burial GX, a fact that may not be quite incidental. Important observations are made on the turfs providing the mound fill. The rich grave from the 1861 dig was located though its stratigraphic relationships could not possibly be reconstructed. It is, however, interesting that neither of the two rich burials was situated in the centre of the mound but several metres away from it. Only one more burial (AJ), without grave goods, belonging to this mound was recorded. It was also a-centrally placed though nearer to the centre than the two first mentioned ones. All of these three graves were situated away from the small mounds dating to Period IV.

Chapter 6 reports the evidence of activities later than the Bronze age. The previous discussion (p. 100) of the 1861 dig and the location of this rich grave is continued here but it ought altogether to have been made more clear including proper reference to plans and profiles. Note (p. 108) the misprint "AQ" for "AO".

Chapter 7 provides a detailed analysis of the portable artifacts and the structures from the overploughed Period III settlement under the mounds. That on the pottery is especially important because published treatments of Bronze Age pottery are much too rarely seen. Influences from the Central European Bronze Age cultures are noted to have made themselves felt in the local craft of pottery making. No matter how the distribution of the many postholes recorded are viewed, no definite house plans are being suggested. The unexcavated quarter of the mound may, however, hold the answer to the question since the largest group of postholes continues into this area and it might in fact be part of a three-aisled house orientated NW-SE of the well-known Bronze Age type.

Chapter 8 opens the discussions of the second half of the monograph aimed at viewing the results of the excavation at Lusehøj in wider perspectives. The reflections here and in the sequel on the recorded evidence on practical agriculture, both crop growing and animal farming, add very important contributions to the current debate of the nature of the farming and the conditions of settlement in the Bronze Age. Protection of crop fields with fencing against animals is in a way an obvious device, and the fencework connected with the building of the tumulus (plus the wattle around Grave GX) at leasts supports the idea that field fencing could have been practised at the time. The evidence also points to the systematic removal of stones from the field plots to ease the ploughing of the top soil for crop growing. In this connection the attention is drawn to the fact that the Lusehøj settlement and agricultural activities took place in an area with almost continuous heavy clay soil, quite in contrast to the traditional view of the preference of lighter soils for the farming land in the Bronze Age. A statement made in the previous chapter springs to the mind here: the field observations showed the Period III occupation at the site to have been thoroughly destroyed by ploughing litterally subsequent to its abandonment. There is thus more than one reason not to underestimate the efficiency of prehistoric ploughing with ards and thus neither the relative importance of crop growing.

In *Chapter 9* the question of the origin and occurrence of the smaller burial mounds typical as primary mounds of the Late Bronze Age is focused upon. In spite of the source-critical problems involved, a relatively fair sample of these small, exposed field monuments in agriculturalized Denmark is presented (Appendix 3). They are classified as *small mounds* or *mini-mounds*, the former ones not quite unknown in the Early Bronze Age, the latter ones being confined to the Late Bronze Age. Both classes are seen as a rational consequence of the introduction of the cremation rite which basically requires less space for the interment. It is argued that the small mounds no doubt link up with the bigger mounds predominating in the Early Bronze Age while the mini-mounds are more likely to reflect influences from the Continent.

Essential in the remaining part of the chapter are two points.

One is the detailed exposition of the ceramics from the small mounds at Lusehøj which are very representative of the type range in period IV and the emphasizing of the features of form and decoration which are of continental origin, supplemented by one or two vessels being Lausitz importations. Moreover, the author remarks of the rather neglected study of the Late Bronze Age pottery that the potential of this material for comprehensive analyses is small owing simply to its limited variability and originality in ceramic types.

The other point relates to the demographic considerations based on the number of burials in the small mounds at Lusehøj suggesting that the small community in the locality is unlikely to have exceeded a very few families at a time. – The results of the anthropological determinations of the burnt human bone material from the Lusehøj burials and from contemporary graves elsewhere (cf. Fig. 107 and Appendix 1) also give rise to reflections on the sociology of the burial rites. This point of view forms a welcome supplement to the normal study of the Late Bronze Age graves. Particularly interesting is that sex-specific objects of bronze were buried not only as expectable with adults but also with juveniles, probably individuals who had passed the rites of initiation. Infants were also given bronzes as grave gifts but never of this specific category or so many as were given to members of the other age groups. The evidence thus suggests that bronzes in graves reflect status regardless of the age group or sex involved.

Chapter 10 begins with a very useful comparative survey of the Late Bronze Age cremation rite in Denmark. It is demonstrated that the rich Burial GX at Lusehøj dating to period V is one of the earliest, if not the earliest indisputable example of the fully accomplished cremation rite in South Scandinavia: the cremation pit with no container for the burnt bones, these fragments being left in the pit intermixed with the remains of the funeral pyre and of the fire damaged grave gifts. Its obvious continental background most probably should be traced in East Central Europe via West Poland. The author takes the opportunity here as further below to point out that cultural novelties from abroad – such as this variety of cremation burial – are liable to be introduced by high ranking social groups as a means to maintain and strenghthen the social prestige.

The problems of interpretation in various burial functional terms of the recorded metal objects from various types of cremation burials are also touched upon. It is suggested that perhaps in general the quantity left in the graves represents but a minor proportion of the full personal outfit brought to the funeral pyre. Supporting comparisons are made with the observations at the large Slusegård cemetery from the Roman Iron Age where the pyres have been located and shown to contain what never reached the graves!

The fortunate detailed observations of the structural components of Grave GX are commented upon in terms of the total burial process, and rare parallels to some of them, also abroad, are mentioned.

Tracing cultural relations is an easier task with portable artifacts than with aspects of burial customs. The author shows that in fact it is not always quite in vain to venture investigations within the latter sphere. This leads very interestingly to a kind of confession of faith in his capacity as an archaeologist. He thus rightly advocates for a "both-and" stance in opposition to the cheap and unrealistic "either-or" view when it comes to the theories of culture history. Diffusionism of course cannot be rejected as a dynamic force in culture change but must be accepted alongside local, internal forces at work.

An extended comparative exposition of the very fine damaged and fragmentary metal objects (of bronze, gold, and iron) from Burial GX brings the chapter to an end. Importations from the Southwestern Urnfield Culture are pointed out particularly in terms of the bronze fittings to a cart. The use of a cart with this funeral adds to its uniqueness and surprisingly no parallels are on record from contemporary graves elsewhere in Europe. The archaeology of the Late Bronze Age carts is briefly discussed, and reference is made to the bronze remains of a contemporary cart found hoarded in a small bog (Egemosen) only some 6 km away from Lusehøj. This find serves to stress the strong authority of the district in period V, circumstances that appear to be still further illustrated for example by the sword and the heavy cast bronze chain (a belt?) found in Grave GX. So, all things considered, the funeral of this Lusehøj chief evokes associations of his having been a person of strong character, individuality and political power. A closer examination of his relations to the other Lusehøj chief, known from the grave discovered in 1861, would be interesting, though on this particular point most unfortunately the stratigraphic relationship between the two graves is lost forever.

Space does not permit to mention but a few of the many observations made in *Chapter 11* about the construction of the tumulus. The radial fencework meant to aid this work is thought to reflect a broad pool of experience drawn upon widely in space and time when it came to the building of gigantic mounds at a stretch – the Jelling tumuli of the Danish Viking Age is a well-known example. Calculations show the original dimensions of Lusehøj to have been about 36 m across and seven m high made up of some 3200 m^3 of earth, i.e. turfs cut from an area of a good seven hectares, equivalent to the interior of a circle of 153 m radius and to a work effort in the order of 100 workmen active for about six months. These figures relating to the requirements of grassgrown fields give rise to considerations of the whole spectrum of social involvement, also in relation to the agricultural strategy, a subject surely worth a separate, extended treatment.

Throwing up a huge mound on top of a group of small mounds being only a few generations older, appears to represent an unusual procedure of the Danish Bronze Age. This makes it tempting in the present case to think in terms of a lineage being in the process of social ascent wanting to confirm the significance of its earlier burial sites. It is stressed, however, that what matters is not the contour of any huge mound, i.e. not of a mound having been made gradually bigger over several phases and centuries, but only a tumulus attaining huge size in a short, continuous once-for-all effort as an exceptional reflection of the craving for social prestige – at Lusehøj satisfied in relation to possibly only two buried high ranking persons (the unexcavated quarter of the mound may hold more). The present excavation results are thus in many ways of relevance also for the understanding of the nature of the settlement of the Voldtofte region.

The immediate archaeological problem discussed in *Chapter 12* has to do with the possibilities of reconstructing the Late Bronze Age social structure using the graves as a basis. This is rooted in the nature of the available evidence being made up of cremation burials that are generally poorly, if at all, furnished with grave gifts and that only rarely muster rich outfits. But the fundamental question would seem to be what these limitations really mean in relation to the universal cremation rite of the time. The answer obviously depends on the basic theoretical point of view. Though complicating the investigations, the author advocates for a differentiated approach which of course is more realistic than a simplistic one; reality was complex also in prehistory. The essentials of this idea are that a funeral as a display of religious and social symbols took its form as much, if not more, to satisfy the social requirements of the participants as to please the departed member of the society.

The more we ask, the more carefully the ground must be prepared to get an equivalent answer. Vital is thus clear discrimination between the cultural aspects involved in the original, total funeral event and the elements of it that may be identified archaeologically. The author warns against viewing the limitations of the recorded funeral investment of the Late Bronze Age as an expression of basically changed conditions and scale of status compared to the situation in the Early Bronze Age. Status relationships are taken to have remained unchanged in the Late Bronze Age, it is only the idea of the cremation rite that is thought to have made its general impact not only on the size and construction of the grave but also on the nature of the symbols in terms of the grave gifts placed in it. The evidence from SW. Funen involving exceptions to such a rule is clearly in support of such a view but the interesting question is why comparable rich burials are infrequent or rightout lacking elsewhere in South Scandinavia. The study of social structure based on Late Bronze Age burials has, however, only just begun. The brief, clear statement of the subject in this chapter deserves to be known as a significant introduction to it, but it is being stressed that new, specialized excavations are badly needed to improve the evidence.

In order to view the two Lusehøj chiefly burials in their proper pespective, the author in *Chapter 13* makes a useful account of what may in English be put as the "burials of splendour" of the Late Bronze Age occurring scattered in N. Europe. These very rare finds are characterized by a varying range of precious objects including imports, and almost without exception these especially structured graves have been covered by monumental, primary mounds. The situation is particularly well brought out in the Seddin region of N. Germany where no less than three large mounds with sumptuous burials in contiguous districts can be related to a great number of other graves at all levels of lower funeral investment right down to the predominating humblest of urn burials. The conditions of comprehensive interpretation are exceptionally fine here and there is no doubt that this evidence is going to be very instructive for attempts at a detailed evaluation of the much sparser and incomplete material of most of the other regions.

With reference to the recent litterature on the subject, the social functions of these burials demonstrating the highest of chiefdom standards is briefly and clearly discussed. It is pointed out that a full understanding of the phenomenon cannot be achieved without an analysis of the total social structure in its fullest possible economic context. But the core of the social function of these burials apparently has to do with the basically labile nature of chiefdoms. The everlasting struggle for rank only made the expenses at monumental signs and other manifestations of power vital during the very phase of its mobilization. This dynamic force thus explains why such efforts are not repeated in the same place during any extended period of time. It is suggested that similar forces may be at work also during times of significant cultural change.

In *Chapter 14*, the last of the publication, the rich Lusehøj burials of Period V are put into their local context. It is interesting that they turn out to illustrate but an episode in the Bronze Age and the Early Iron Age history of the region, being without basis in the preceding periods and echo in the following periods. It is worth noting that of all the cases mentioned in Chapter 13, the Lusehøj region is the only one where an important range of settlement sites have been recorded to supplement the other categories of finds. This is mainly owing to the very meticulous reconnaissance and the excavations carried out as part of the current settlement archaeology project in SW. Funen. Unfortunately, however, there is still a long way before the full fruits of these significant efforts may be harvested. This is because, as already noted, investigations of the local economic basis make up one of the indispensable approaches – and that a very demanding one – to a comprehensive explanation also of the occurrence of chiefly burials.

The author succeeds in identifying the Late Bronze Age archaeological pattern in SW. Funen with a chiefdom type of society by confronting the find material with the criteria defined by social anthropology. The establishment of exchange connections with chiefdoms on the Continent undoubtedly contributes to explaining both the similarities between them and not the least also their very appearance.

On the whole, the essential data excavated are clearly documented in the publication. The text is adequately supported by extended notes and references to the literature and by illustrations of quite good to excellent standard – even the small photographs come out generally well. The line drawings of the artifacts are especially fine and informative. What is sometimes being missed is a description of the smaller profiles and a clearer statement of the identification of the structures particularly in the plan drawings. Why for instance are the identifications of the holes not stated in Fig. 105?

In view of the very complex stratigraphic and structural evidence recorded at such a large-scale excavation as at Lusehøj, references to plans and profiles are somewhat restricted. This sometimes makes it a disproportionally time-consuming job to become familiar with the material. A few pages with a cross-reference system would thus have been very useful. What I have in mind is a total list in consecutive order of the numbered structures, postholes, profiles, etc. with reference to their mention in text and presence in figures, preferably also to their localization in relation to the square metre units of the excavation.

To these few critical remarks there is only to be added that it is deplorable indeed that the publication – or at the very least a summary of it – has not been translated into one of the current foreign languages. A large range of colleagues abroad are thus unable to benefit from reading this important monograph.

One of the problems in archaeology is to get the finds published. Some archaeologists might therefore be inclined to envy the author of having accomplished a comprehensive publication of the excavation of a unique field monument only a decade after its completion. – In the essence, besides the all-important presentation of the observations and the artifactual evidence, H. Thrane has also successfully taken the opportunity of discussing many facets of the current problems relating to the study of the Bronze Age archaeology, all in a most inspiring and at the same time common sense manner.

Jens Poulsen

STEEN HVASS: *Hodde. Et vestjysk landsbysamfund fra ældre jernalder.* With contributions by TORBEN DEHN and GRETHE JØRGENSEN. Arkæologiske Studier vol. VII. Akademisk Forlag. København 1985. 367 pp. (220 pp. text, 149 pp. ill., 161 pl.). English abstract.

This book is the final presentation of the extensive excavations at Hodde in the early 1970s, which have been treated in numerous publications by Steen Hvass.

The book chiefly deals with the description of the large village, but the results of several minor excavations also help throw light on this Iron Age settlement on the hill island at Hodde northeast of the town Varde. A total of approx. 19,000 squaremetres was excavated and investigated.

The beginning of the book contains a short geological description of the Hodde area and a presentation of the methods used during the excavation. Then follows the description proper in chapter 3, and chapter 4 contains the analysis of the village and the artefacts it yielded.

Thirty-eight structures can be identified in the village, most of them farms. Each structure is presented phase by phase accompanied by plans in scale 1:200. On each plan the depth of the excavation below the surface of the subsoil is indicated at three levels: 0–40 cm, 40–60 cm, and more than 60 cm. The plan of the excavated area is equipped with contour lines of the surface of the subsoil, eliminating irregularities due to presentday cultivation. The numbering of postholes, pits, fences, and other remains is the same as was used in the original excavation report; however, only structures referred to in the text are numbered. The actual location of the book's photographs and sections is shown on individual maps. This makes the book, as well as the original excavation report stored at the National Museum, Department I, easily intelligible for further studies.

Then follows a description of the locations where each of the artefacts were found. The artefacts are mainly pottery, but there are also small tools, mostly of iron, iron slag, clay lumps, glazing stones a.o. Furthermore, there are animal bones of ochs, horse, sheep, goat, and pig. However, there are so few that they cannot give us a detailed picture of the village's live stock. A posthole from one of the houses dating from the 1st century B.C. contained charred grain, which was analysed by Grethe Jørgensen. It is remarkable that wheat was abundantly represented as wheat has so far been missing or only sparingly represented on Iron Age sites in Jutland. Also abundantly represented at the contemporaneous grain find at Overbygård, wheat has probably been more widespread than hitherto believed.

The chapter is concluded by a discussion of the chronology of the pre-Roman Iron Age including a dating of the phases of the separate structures to period IIIa and b. Phase 1 is dated to the beginning of period IIIa, phase 2 to late IIIa, and phase 3 to IIIb; i.e. from 150 B.C. to around the birth of Christ. The dating of the pottery supports this division into phases, which is based on stratigraphical observations.

Chapter 4 contains an analysis of all the 86 houses based on size, structural details, and function. The existence of two types of houses is shown: small houses measuring 4½–8 m, and long houses measuring 9½–22½ m. The average of the two types are 5–6 m and 11–13 m respectively. Charcoal from around a dozen roof-supporting posts shows that they were made of oak. The extensive presentation of the houses is followed by a comparative analysis making use of many early Iron Age sites, and some of these older excavations are reconsidered in the light of the results from Hodde. A similar analysis is made concerning the fences, and in this case the comparative material includes enclosed Iron Age settlements in Britain, the Netherlands, and northwest Germany.

Finally there is an overall interpretation of the Hodde village and all its contemporaneous farmsteads, their possible relocation, partition, rebuilding, and possible traces of fire. A comparative analysis includes a long series of villages and separate farms from the early Iron Age in Jutland and northwest Germany. Structural similarity between Hodde and Østerbølle, Tolstrup, and Borremose is established. The author concludes that the layout of the settlement seems to depend on its size: small settlements have the farms aligned in two rows, whereas larger settlements have the farms gathered around a central square.

Though the author maintains that he finds the structure of Hodde duplicated elsewhere, it should be kept in mind that Hodde with its 27 contemporaneous farms including the large farm is by far the largest and best organized of the villages known from the early Iron Age. It is important to take this into consideration; otherwise this well-investigated village might easily be construed as a prototype of villages of the period.

Then ensues a detailed review of the artefacts, especially the pottery, which is divided into 11 separate groups. All artefacts are illustrated with drawings, and their original locations are shown on the map of Hodde. The analysis of the distribution of the artefacts indicates that the blackglazed pottery is only found around the big farm and, furthermore, shows that a small number of farms have had potteries and smithies. The existence of these activities in the village is further supported by the presence of 75 kg. of iron slag and the remains of a potter's oven.

The final two short chapters analyse Hodde's economy and its community. The oldest farm, the large one, retains its leadership throughout all the phases of the village, and the other largish farms (*i.e.* farms with long houses measuring more than 15 m in length) remain the largest in the village. This suggests a community with a stable economic differentiation and a permanent leadership associated with the large farm. Furthermore, the examination shows that some of the small farms have had potteries, and that their products have been supplied to the rest of the village. One farm has had a smithy. However, no crafts or trade seem to be associated with the large farm.

The village Hodde has had stabling for a maximum of 460 animals, and its fields have covered an area of around 3.7 squarekilometers, ⅔ of which have probably been grazing areas. A pollen analysis would provide an interesting insight into the exploitation of the environment throughout the Iron Age.

It is typical that the village has been moved around inside a limited area. The site Hesselagergård is partly contemporaneous with the latest phase of Hodde and continues into the early Roman period; the graves at Karensdal, presented by Torben Dehn, are contemporaneous, but the site at Hessel is dated to the early Germanic Iron Age. The settlement on the hill island at Hodde has followed the same pattern as other Iron Age settlements: having been situated on the same spot for 100 to 200 years the farms were removed, and the old sites with their excellently fertilized soil were then cultivated.

These are some of the most important results the publication of Hodde yields. However, the book is so full of information that it is very hard to find anything that has not been covered. The book is well-arranged and easy to read as every section is followed by a summary that encourages the reader who is not primarily interested in detailed descriptions. The extensive map material and Henning Ørsnes's excellent illustrations of the artefacts are an instructive supplement to the text. The weakest point is the interpretation of the social aspects of the site. Here the author is clearly not familiar with the relevant literature.

The Hodde investigations are an example of basic archaeological research at its best. It consited of a clearly purpose-oriented excavation project, followed by preliminary reports in local as well as international publications, finally to be published in the approachable and informative book only 10 years after the termination of the original excavation – an excellent achievement.

One final point of critique: it is to be regretted that a publication central to the understanding of early Iron Age village organisation in northern Europe is not available in an international language. [Translated by Ul S. Jørgensen]

Lotte Hedeager

PER ETHELBERG: *Hjemsted – en gravplads fra 4. og 5. årh. e.Kr.* With contributions by STIG JENSEN and TORSTEN MADSEN. Skrifter fra Museumsrådet for Sønderjyllands amt, 2, Haderslev 1986.

This is an important and very useful book, which has been attractively produced by Haderslev Museum. The major part of it was written by Per Ethelberg, a graduate archaeologist of Århus University, attached to Haderslev Museum as Field Officer. On behalf of Museum Inspector Steen Andersen of Haderslev Museum, Ethelberg has conducted comprehensive excavations in advance of major development at Hjemsted, Skærbæk kommune in south-western South Jutland. The archaeological site lies upon a sandy *geest* bank out towards Ballum marsh. Excavations carried out up to now have uncovered three cemeteries. Two are cremation cemeteries of the early Roman Iron Age, with 44 and 30 cremations respectively. These two cemeteries are only briefly considered, as most attention is concentrated on cemetery 3 of Area I, a cemetery of 88 burials, nearly all inhumation graves of the later Roman Period but continuing, significantly, over the chronological boundary of 400 A.D., and thus crossing into the early Germanic Iron Age.

In the first development area, Area I, in addition to these three cemeteries, 14 building groups with buildings of various lengths were exposed. To judge by the series of postholes exposed in the natural, the largest building is up to 40 m. long and of nave-and-side-aisle construction. We apparently have here parts of a substantial village which runs over into the neighbouring areas, II–III. Some exposed building groups are illustrated on pp. 9–11.

The excavation of cemetery 3 lies at the heart of the book, in that the chronological observations relating to the later Roman Iron Age and the Germanic Iron Age which are introduced in this context are the most significant. The author therefore permits an account of this cemetery to take up most of the book. The graves are illustrated in plan in Figure 7. There were three cremations. The remainder were rectangular inhumation graves of depths up to 1.3 m., all oriented more or less directly E-W, often so closely situated that graves overlapped one another. The dead lay in the sleeping position on the side, with the head either to the west or the east; there were however also examples of the supine position. Five of the inhumation graves could be dated by grave goods to the early Roman Iron Age with pots of a typical southern-Jutish and Fynish style, representing a relationship between these two areas which has already been recognized. In 39 cases the outline of a coffin could be seen in later Roman Iron-age graves. With the exception of three plank-built chamber graves, these comprised buried timber coffins. The overlapping of graves was frequently indicative of the relative dates of the graves. A thoughtfully produced catalogue with detailed drawings and fine photographs is presented on pp. 111–193.

But so the problem emerges: which methods, what chronological line is one to follow in dating the graves in Hjemsted's large cemetery? In his discussion of the dating problem in Chapter 3, Ethelberg essentially follows Stig Jensen's interesting studies in *Kuml* 1979 (p. 167ff.). This introduces a new phase within the later Roman Iron Age, his 'Raa-Mølle horizon'. It is this reviewer's opinion that the proposition rests upon a rather weak foundation, which should also be clearly seen to be implied by *Fynske Jernaldergrave*, 1968, p. 307, fig. 63. I do not think that the brooch from Raa Mølle falls outside the chronological milieu of C2 (my Period II) or that distinctive leading types, such as brooches, may be discerned in a phase connected with this brooch. The chronological pattern appears to me to be visible in the sequence C2, C3 (my Periods II and III) in that C3 (III) is identical with the period of use of brooches of the Nydam and Haraldsted Types: see *Fynske Jernaldergrave*, 1968, p. 308, fig. 64.

After the discussion of the chronological problems reviewed here, Chapter 4 proceeds with the finds from the cemetery. An interesting account of the brooches of the later Roman Iron Age is given here, with particular emphasis on the group which, starting from the gold brooch in Sanderumgårds grave 2, developed into thinner forms of silver or bronze which the author therefore characterizes as *blikspænder* (sheet brooches). Subsequently they evolve into the large silver brooches with a long footplate and characteristic stamped ornament. They are associated in finds with Haraldsted and Nydam brooches. In the North-Jutish region, in the cemetery and settlement site at Sejlflod near Ålborg and other places, these large brooches evolve into *de luxe* brooches with profile animal heads and rich Sösdala-style decoration. These late brooches are associated in graves with the earliest cruciform brooches, the successors to the Nydam brooches. In such graves the boundary to the Germanic Iron Age has been crossed.

Following the survey of these important brooch types, there comes a discussion of the pottery and a series of artefacts which commonly appear as grave goods: buckles, knives and especially beads of glass and amber, the latter disc- and figure-of-eight shaped, which are cautiously treated as chronologically diagnostic. On the basis of these and, naturally, of the pottery deposited, on p. 47 one grave is dated to period C2, four to the Raa-Mølle horizon, two to the Nydam phase and thirteen to the early Germanic Iron Age, the latter particularly on the basis of the cruciform brooches.

Finally in Chapter 5 there appears as a conclusion to the survey of artefact-types an analysis of the three-sectioned pots. This involves a chronological study of the ceramic finds. The author uses here a method which seeks to undertake a graphic analysis of the vessels' form and ornament through mathematical seriation. Since this method is totally unknown territory for this reviewer, refuge must be sought in a diagram, Figure 40 in the book, which shows a series of pots' chronological association with the previously considered periods. Despite personal doubts I must acknowledge from a reading of Chapter 6 in the book that the method appears to be practicable. The splendidly illustrated series of each grave's artefacts was able in every single case to correspond to my dating and assessment.

All in all Per Ethelberg's book presents a well-based overview of the position which Danish archaeological research has reached in trying to extract a surer view of the start of the Germanic Iron Age, a period at which traces of the formation of polities in particular regions begin to show themselves. Ethelberg himself takes up the point in so far as he notes a situation such as the common distribution of inhumation burial in this period in southern and South Jutland while Angeln has cremation burials. In connection with this, attention is drawn to the *Olgerdige*, which is possibly interpretable as a boundary barrier between two groups. Alongside these observations belongs the intensive research work which has been under way for some years in the field in southern Jutland. For the inhumation cemetery from the middle of the later Roman Iron Age investigated by Lund for Haderslev Museum at Stenderup, which H.C. Broholm supplemented with his excavations, and published in *Aarbøger* 1953, a series of research drawings made by Stig Jensen is now added in this book.

With the two major cemeteries, Stenderup and Hjemsted, fully treated we have come a good way along the right road. There remains to be added to these the cemetery at Enderup Skov, which is nearly fully excavated by Erik Jørgensen: the inhumation graves at this site show great similarity to those from Hjemsted, and likewise seem to continue into the Germanic Iron Age. Contemporary with these southern Jutish sites is the major cemetery and settlement site at Sejlflod south of the Limfjord, but before the graves and buildings here can be drawn more fully into the discussion the material must be published. Not least is it now necessary for the settlement site's building groups to be investigated and published. At Hjemsted too such a study of the buildings is as yet still in an embryonic stage. The building groups at Drengsted, which were excavated at the end of the 60's, have not yet been made accessible through publication, nor has the important Dankirke settlement at Hviding marsh. We can look forward with great expectations to the publication of the villages at both Vorbasse and Dankirke. Two interim reports have been published on these sites, indicating the use of these two major sites down into the early Germanic Iron Age. Samples of the domestic pottery from these two sites are reproduced by Ethelberg in his Figures 50 and 51. With a view to future studies, one may hope that progressively new observations on the ceramics could lead to an increasing knowledge of the period's material culture, and that developments in this field will lead us closer to an image of the area's political status and social conditions in this phase of our history, a hidden phase in many respects. [Translated by John Hines]

Erling Albrectsen

G. Kossach, K.-E. Behre & P. Schmid (eds.): *Archäologische und naturwissenschaftliche Untersuchungen an ländlichen und frühstädtischen Siedlungen im deutschen Küstengebiet vom 5. Jahrhundert v. Chr. bis zum 11. Jahrhundert n. Chr.* Band 1. *Ländliche Siedlungen.* Deutsche Forschungsgemeinschaft. Acta Humaniora der Verlag Chemie GmbH, Weinheim 1984. 461 pages, 136 figures.

In the years 1969–77, the German Research Council provided, through its project 'The prehistoric settlement of the North-sea area', a significant contribution to the furthering of archaeological research into the settlement of the North German coastal zone in the period of the first millenia B.C. and A.D. A comprehensive assessment of the results of the various individual projects is given in the two volumes of this publication. Only the first volume, on rural settlement, will be reviewed here.

All the archaeological settlement studies are shaped by close cooperation with historians, geographers, and with various scientific disciplines such as geology, soil science, botany and zoology in particular; through this the involvement of scientists in the programme has brought considerable pressure to bear in individual sub-disciplines such as zoology, dendrochronology and palaeoethnobotany.

The assessment of all the individual projects within the common design of establishing the natural conditions governing the choice of contemporary settlement sites, and the determination of their limits and historical change, enhances their value.

The aim of these publications is not the presentation of the results of the individual projects but the evaluation of the archaeological and scientific results in respect of the comprehensive, fundamental problem which was set out to be solved.

The area of study is first and foremost the north-west German marsh and drift sand/gravel (*geest*) area, while the most important sites in the neighbouring areas of the northern Netherlands and Jutland are brought into the study.

The last 30 years' ambitious research projects in the north-west German marsh and *geest* area were inaugurated with the Deutsche Forschungsgemeinschaft's (DFG)'s decision to excavate the terp of Feddersen Wierde, north of Bremerhaven, completely. The site was excavated by W. Haarnagel in 1954–63 and published in 1979. The next project was the investigation of the termp Elisenhof by Tönning by area excavation in 1961–64.

After this DFG concentrated its attention on three long-term studies of sites on the *geest*, Gristede (Ammerland), Archsum (Sild) and Flögeln (Wesermünde). The massive excavations at Flögeln have been under way since 1971 and are still not completed. There were also several minor investigations of settlements in the coastal area, and as a supplement the cemetery at Liebenau (Mittelweser) of the late 4th. to the first half of the 9th. century and the East Frisian cemetery of the 8th. to 10th. centuries at Dunum west of the Weser were excavated. There are multiseason excavations of selected, individual areas, where it is possible to dig the rural settlements in full and to investigate their relationship to the natural environment.

The archaeological and scientific studies are divided into three principal sections:

1. The settlement areas
2. The settlements
3. The cultural context.

In the section on the settlement areas, first consideration is given to the change in the coastline, its causes and effects. It is essential to have a clear view of the change in sea level in this period, and thus the various phases of transgression, to investigate the possibilities of settlement in the marshland and on the *geest* edge.

The next section deals with the plant cover in the coastal zone. The typical constitution of the plant cover reflects most clearly the various biotopes and ecological change.

In a section on changes in the marsh and their influence on the development of the landscape, attention is focussed on the extensive construction of ditches, in which summer dykes are constructed from the 11th. century and supplemented by winter dykes in the 13th. century. As the marshland is drained the conditions of the landscape change so thoroughly that new settlement and subsistence forms are developed.

Although Man began to settle in the marshland from the end of the Bronze Age, this did not happen everywhere at once or with the same intensity. The area of Groningen (Ezinge) in the Netherlands and the flat marshes along the Ems (Boomborg-Hatzum) were settled at the end of the Bronze Age. The coast between the Weser and Elbe (Feddersen Wierde) was settled from the end of the pre-Roman Iron Age. Dithmarschen and Eiderstedt (Hodorf, Tofting) were first settled later, in the Roman Iron Age. The settement of the marshland reached a peak in the 2nd. century A.D.; many settlements were abandoned again in the course of the later Roman Period, and all cease in the Migration Period.

The examples of settlement sites show the very labile character of the coastal settlement; only when in the Middle Ages dykes were built and the land drained could one keep the settlers put. From the earliest settlement, village form shows an astonishing variability; to some extent settlement forms were imported from the *geest*, to some extent people were directed by the conditions of the environment. Whether the abandonment of the settlements of the 4th. and 5th. centuries is solely due to the frequency of major inundations is a quite separate question.

In Lower Saxony, settlement in the marsh begins in the second half of the 1st. century B.C. as flat settlement on the beach embankment (Feddersen Wierde). The construction of terpen around individual farmsteads, nuclear terpen, begins later. In the 3rd. century nuclear terpen grow together into village terpen; in the 4th. and 5th. centuries the storm surge grows higher and in the middle of the 5th. century the settlements cease. The terpen are next occupied in the 7th./8th. centuries as Frisian settlements. The latest pottery from Feddersen Wierde is from the 12th./13th. centuries. Subsequently new settlements appear in the new marsh further west, originally as flat settlements, later raised again into terpen. These new terpen become church centres in the Middle Ages and are densely occuped up to to-day.

In contrast to the open marsh out towards the sea, the flood marsh offers far more limited possibilities for the choice of settlement and subsistence areas. A chain of settlements along the lower Ems in Reiderland were investigated under the DFG programme. The earlier settlement begins in the 7th./6th. centuries B.C. on high embankments to the flood area of the Ems. Jemgum I (7th./6th.-century B.C.) and Boomborg-Hatzum (6th.- to 3rd.-century B.C.) have been studied through major area excavation. There then come repeated inundations, and the settlements cease in the 3rd. century B.C.. In the late pre-Roman Iron Age the settlements return with substantially more buildings than before: of these Jemgumkloster, from late in the 2nd. century B.C., and Bentumersiel, from late in the 1st. century B.C., have been investigated. The finds from Bentumersiel give a different picture from Jemgumkloster with its agriculture: the site is interpreted as a store or collection place. Both terpen (Jemgumkloster) and flat settlements (Bentumersiel) remained to the 4th. century A.D., after which all sites were abandoned. There is again a re-settlement of the ems marshland in the 7th.–8th. centuries A.D., partly on the old terpen and partly on new sites.

On the *geest* between the Weser and the Elbe, by the marshland where the terp Feddersen Wierde was excavated, lies the *geest* island of Flögeln, entirely surrounded by bog. This outcrop divides into four sections by natural delimitation, of which three, which each form individual settlement areas, have been marked from the very end of the 1st. century B.C. by a settlement, fields and a cemetery. Settlement ceases in the 5th century, as shown both by a break in the series of finds and the pollen diagrams. A now settlement appears on a new site on the island, Dalem, in the 7th./8th. centuries. This is the sole settlement on the island and ceases in the 14th. century. A second village is founded on the island in the 11th. century, the present Flögeln.

The next major section of the book deals with the very comprehensive material from the settlements themselves, firstly the buildings.

The nave-and-side-aisle longhouse is distributed from the Lower Rhine across the north-west German costal zone to Denmark. These buildings are generally uniform in the north-west German coastal zone in the early pre-Roman Iron Age, both in the marsh and on the *geest*. The best examples are from Jemgum I, Boomborg-Hatzum and Grøntoft in West Jutland.

The richest material of the late pre-Roman Iron Age is from Feddersen Wierde, with a wide range of building remains from the 1st. century B.C. to the 5th. century A.D. including building timbers. There is no great change in the principles of construction through this period. Buildings on the *geest* (Flögeln) have on average greater living space than those in the marshland, and from the 2nd. to the 3rd. centuries A.D. the buildings become longer, up to as much as 38 m. long. The longhouses at Flögeln are divided into several rooms from the 2nd. century A.D., frequently with the byre placed in the middle. The same changes are effective at Vorbasse in Central Jutland. In contrast to Feddersen Wierde, the gravel site Flögeln has many sunken huts, of which a quarter have a fire-place.

There is a break in settlement from the 5th. to 7th. centuries both in the marsh and on the *geest*. Continuity is only found on the Dutch sites Odoorn and Eursinge. New elements are brought into the construction of buildings in the new building phase in the marshland of the early medieval period, as shown at Elisenhof, Hessens and Niens: massive, split posts rammed in the wall line and sloping posts outside the wall. From the 10th. to 13th. centuries building construction on the gravel changes, with wall posts in large post-holes, occasionally with a wall slot between the outer posts, and no roof-bearing posts, as in the simple buildings at Dalem. A similar development is recorded from Grasselte in the Netherlands.

The development of the fixed village site begins with the enclosed farmsteads which are known from extensive excavations at Wijster (The Netherlands) and Vorbasse (Jutland). The most wide-ranging view of the structure and development of a fixed village site on the *geest* in North-West Germany comes from Flögeln, which in the 2nd. to 3rd. centuries A.D. has block-like enclosures for several activities. The village moves north at the turn of the 3rd. and 4th. centuries and the longhouses become larger with more entrances, which is suggested to indicate more families dwelling in them, and are situated at greater intervals. The number of granaries decreases. There is a change from farmsteads with many activities to large-scale farmsteads, which must reflect social conditions. Stability of the site for six-seven generations is typical; subsequently a change in the settlement comes about.

The farmstead mounds with stable settlement for up to 300 years have a different settlement structure. Major excavations at Archsum on Sild have given a thorough insight into a farmstead mound on the gravel island.

The last major section of the book deals with the cultural context, with a study of the economy. A large area of Celtic Fields with very broad banks was investigated at Flögeln. Cultivation tools, the plough and ard, are surveyed, the manuring of fields and harvesting tools.

Before Feddersen Wierde was excavated pollen was only collected on a sample basis. At Feddersen Wierde, because of the exceptional preservation, a substantial body of pollen- and plant-material has been systematically collected and analyzed. To-day one must study the total pollen remains from buildings, granaries, pits and so on: new methods must therefore be developed for the removal and identification of this material.

Domesticated animals were the most significant basis for the settlements in the marshland, as shown by the number of byres in the longhouses. Cattle and sheep/goat predominate on these sites, at 70–80% of the stock. In settlement phase 5 at Feddersen Wierde the number of stall units indicates a total cattle stock of 450 head. An average farmstead at Feddersen Wierde would conceivably have had 20–22 cattle, 6 sheep, 2 or 3 pigs and 4 or 5 horse.

Examples of highly advanced woodwork are known from Ezinge, Feddersen Wierde and Elisenhof. Carpenters, turners and wainwrights worked at places within the villages, as shown at Feddersen Wierde.

The terpen provide optimal preservation contexts for bone and antler: craftsmen working with these material are found in the farmsteads at Feddersen Wierde.

The organization of iron-working is clearly visible at Feddersen Wierde, reaching a substantial level in the 3rd. century A.D. and exclusively associated with the principal farmstead.

The good preservation on the terpen has also produced many textile fragments.

An overview of the extensive body of household utensils, dress-accessories and jewels is given. Most of the artefacts come from Feddersen Wierde, Tofting and Hodorf. Imported

Roman pottery is particularly important, the distribution of which is concentrated in the marshland settlements and which is absent inland.

The forms of both metal objects and pottery show regional differentiation. The Elbe-Weser region is frequently in view because of its striking find-groups, including Roman imports, which can be viewed in light of the question of whether there were here an economic centre of special dynamism.

There is also evidence of sacrifice in connection with building and cult sites. Regular sacrifices are known from Feddersen Wierde and Tofting with human and animal material. On the *geest* island Archsum a round embankment of the early Roman Iron Age, Archsumburg, 80 m. in diameter, was investigated. It is interpreted as a mootplace for the surrounding population. Two similar constructions are known from Tinnum on Sild and Trælbanken in southern Jutland, north-east of Højer.

Two major cemetery studies are then reported. One is the site at Liebenau, 15 km. west of the Weser, where about 500 cremation and inhumation graves were excavated. The inventory carries many parallels to Merovingian row-grave cemeteries and shows that the cemetery was in use from the late 4th. to the first half of the 9th. century A.D. Thus there is continuity of population here from the late Roman Iron Age to the Merovingian Period. The second site is on the East Frisian *geest* island Dunum west of the Weser of the 8th. to 10th. centuries A.D. This provides the fullest picture of a Frisian cemetery, with 778 graves divided amongst five sites which presumably represent five farmsteads over *circa* 300 years. The extensive excavation permits a horizontal-stratigraphical ordering of the grave finds.

If one wishes to isolate the individual parts of the society of an agricultural population one must begin with the smallest unit, the farmstead, and then follow the development of farmsteads, the village and larger settlement assemblies. The DFG project, together with the large area excavations in the Netherlands and Denmark, have contributed more information towards this problem than could previously have been commanded on the basis of individual studies.

The last section of the book deals with the North-sea zone as a cultural contact area. After the fall of the Roman Empire, England is Germanicized through the well-known migration of the 5th. and 6th. centuries of Saxons, Angles and Jutes. If one looks at the known artefact material from England and the continent, the difficulty resides in pointing-out the first Germanic folk in England. In general, the metal objects and pottery show similarities between south-east England and the continent, especially the area between the Rhine and Elbe, but it is one-sided to treat the similarities in the finds only as a result of migration. They must rather be regarded as the result of cultural exchange in the North-sea zone.

The book includes both a comprehensive bibliography for the book's many subjects and a special book-list covering the individual projects of the full DFG programme, rendering this a very useful publication.

Looked at from a Danish viewpoint, the north-west German settlement research and this published summary of the major lines are of great significance and a source of inspiration for research into the development of settlement in Iron-age Denmark.

The marsh and gravel areas of South-West Jutland form a continuation of the marsh and gravel areas of the Netherlands and North-West Germany dealt with here. Purposeful archaeological investigations of settlements to clarify when and how the Danish marshland was settled and thus to make possible a direct comparison with the results of research in North-West Germany are still lacking on the Danish side.

Along the *geest* edge of South-West Jutland there have been two major excavations which as yet are only provisionally published: Drengsted (O. Voss 1976, 68) and Dankirke (E. Thorvildsen 1972, 47). In recent years two surveys of iron-age settlement along the Danish section of the marsh and *geest* area have been published (S.W. Andersen & F.R. Rieck 1984, 95; S. Jensen 1984, 5). [Translated by John Hines.]

Steen Hvass

Recent Excavations and Discoveries

The following survey is based on summary reports of archaeological activities in 1986, submitted by the Danish museums to *Rigsantikvaren*. A review of all field investigations and major finds, including treasure trove and 513 notes on excavations, has been published in Danish in *Arkæologiske udgravninger i Danmark 1986* (Det arkæologiske Nævn, Copenhagen 1987).

Also published in 1987 was a comprehensive report on the archaeological field work in connection with the Danish natural gas project: *Danmarks længste udgravning. Arkæologi på naturgassens vej 1979–86*, edited by Rigsantikvarens arkæologiske Sekretariat and published jointly by the National Museum and the natural gas agencies of Denmark (Herning 1987. 515 pp, with English summaries). The book contains descriptions of all of the c. 1700 sites from which archaeological data were obtained.

Please note the following abbreviations:
s. sogn, Danish parish
a. amt, Danish county
All places mentioned in this list can be located on the map p. 255 and identified by their no.

MESOLITHIC

1. STATIONSVEJ 19, VEDBÆK, Søllerød s., København a. **Occupation layers and graves.** In the course of the demolition and rebuilding of a house on the site of no. 19, Stationsvej, Vedbæk, a small exploratory excavation was carried out, which documented several Ertebølle layers embedded in the beach ridge and a thick Kongemose layer underlying this on an island in the then Vedbæk Fjord. The first investigation in 1986 took place in the hole made during the demolition. Along its north, west and south sides, partial excavation took place in 1 m squares, and the resulting profiles were documented. Even at the highest part of the island, a thin Kongemose layer was preserved under a variety of sterile and culture layers, the latter from the Ertebølle culture. In the northern profile, the south end of an inhumation grave was found between two Ertebølle layers, with the skeleton of a woman aged 30–35, unfortunately without grave-goods. When excavation was extended to the area around this grave, another inhumation grave holding a woman of the same age as the first one was found a mere couple of metres to the west. This grave, too, was without grave-goods or red ochre. Unfortunately, the skeletons of both graves were extremely poorly preserved. Both graves must be largely contemporaneous with those from Henriksholm-Bøgebakken, just on the other side of the station. In addition to the graves, a fireplace and a heap of fire-cracked stones were found in the same layer. The other investigation in 1986 concentrated on the Kongemose layer on the south side of the island, the overlying Ertebølle layer of up to 2 metres' thickness being removed mechanically without being investigated. This allowed a settlement horizon of 30 m^2 to be investigated as a whole, although due to groundwater it was not possible to reach the original shoreline, let alone investigate any part of the refuse layer. Bore probes out there showed, incidentally, a steep fall. The occupation layer was in some places ½ m thick and was mostly covered by marine gyttja. In the middle of the excavation area, several structures were revealed, such as cooking-stone pits and small fireplaces, but otherwise each ¼ m^2 contained copious amounts of charcoal, cooking-stones and not least flint, besides a smaller amount of animal remains, water-sieving being employed throughout. The outer part of the settlement layer represents the lowest-lying site known from the Vedbæk area. The Kongemose settlement taken as a whole seems to show the usual phenomenon in Vedbæk, where the settlements, in step with the transgression, move upwards. *Nationalmuseet*, Prehist. Dept. 6340/85. [E. Brinch Petersen, Johan Sobotta]

2. ENGVANGSVEJ 52, STRØBY EGEDE, Strøby s., Præstø a. **Graves.** During the extension of a carp-pond in the garden of a house, a Mesolithic grave was found (fig. 1). In the same area, which lies 3–4 m above sea-level down towards the River Tryggevælde, a large settlement area from the Ertebølle culture in particular had previously been recorded. The grave contained 8 skeletons in a hole measuring about 1 × 2 m. Here lay two new-born babies and an infant, a boy 5 or 6 years old, a girl of 9 or 10, an 18-year-old woman, a 30-year-old man and a 50-year-old woman. Each woman had a flint knife at her waist, but only the young woman and the girl had beads of red-deer teeth around their waists. There was also a bone pin behind the skull of the 18-year-old woman. The man had a flensing-knife of bone, a decorated deer-antler axe, and five large flint knives. The little boy also had two flint knives, like one of the new-born babies. The other baby had tooth beads around its head (X-ray exposure), while on the infant a single wild boar tooth and hoofs of roe deer were found. In several parts of the grave red ochre was present, especially near the younger individuals. No signs of external injury were observed, but all eight must have been buried together. The precise dating of the grave awaits radiocarbon determination, but judging by the relation to the settlement material, it is either coeval with the graves of Henriksholm-Bøgebakken in Vedbæk, or slightly later. The grave was at a late stage of the investigation taken up *in toto* in a large block and transported to the Conservation Section of the National Museum. Here the continued investigation and consolidation will take place, but it is intended that the grave first be inverted, to allow investigation of the interesting areas

Fig. 1. The Mesolithic grave from Engvangsvej 52, Strøby Egede (no. 2). Photo: L. Larsen.

under a couple of the skeletons. The grave will later be exhibited as a whole mount in Køge Museum. – *Køge Museum* 1214 and *Nationalmuseet*, Prehist. Dept. 6554/86. – Lit.: E. Brinch Petersen, "Eight persons in one grave – the Mesolithic record?", *Mesolithic Miscellany* 1987. – "Ein mesolithisches Grab mit act Personen aus Seeland", *Archäologisches Korrespondenzblatt* (in press). [E. Brinch Petersen]

3. GRISBY, Ibsker s., Bornholm.
Ertebølle site with occupation layers embedded in beach-ridge gravel. In a profile trench at the top of the beach ridge, two settlement layers were demonstrated, separated by washed-up gravel, and in a 12 m^2 square segment on the inner side of the beach ridge, a number of refuse horizons and some small pits, including two cooking-pits with fire-embrittled stones and the remains of "tenon-shaped" pot bases. The investigation yielded, besides numerous flint implements and animal bones, a quantity of pottery, *i.a.* sherds with pitted ornament, which hitherto has been known only from the Scanian Ertebølle culture. – *Nationalmuseet*, Prehist. Dept. 4854/83. [Peter V. Petersen]

4. TYBRIND VIG, Ørslev s., Odense a.
Submerged settlement. Principally in order to delimitate the area precisely, a series of exploratory pits measuring 1 × 1 and 1 × 2 m to the east and WNW respectively were investigated. They permitted the eastern, landward extent of the refuse layer to be ascertained, while a clear definition of the find area to the west could not be arrived at, mainly owing to bad weather which hampered the divers. The area where the woman's grave was earlier found remains to be investigated. The find area seems, however, to have had an E-W extent of about 125 m and a N-S extent of about 20 m. In connection with the investigation, *i.a.* a paddle with ornament on both sides, besides a complete bow and the base of a similar one, were found. – Lit.: *JDA* vol. 4, 1985, pp. 52–69. – *Forhistorisk Museum*, Moesgård, 2033. [Søren H. Andersen]

MESOLITHIC AND NEOLITHIC

5. BJØRNSHOLM, Ranum s., Ålborg a.
Shell heap. Continued excavation. With a view to obtaining material for radiocarbon dating, an up-to-date sampling of the artefact inventory and finds to illuminate the economy, investigation of the E-W section through the shell heap was continued. Further, a section was opened in the lower-lying meadow tract east of the kitchen midden. To the east, the excavation continued down through the Early Neolithic shell layer – dominated by cardium. This year's excavation succeeded in getting through the later deposit. In order to gain an impression of the thickness of the kitchen midden and stratigraphy, 2 m^2 in the centre of the section were excavated to the bottom. It turned out that the shell layer at this spot had a total thickness of 70 cm, the top 30 cm of which is Early Neolithic. In connection with this section, *i.a.* two fireplaces were demonstrated, one of which was connected to an old surface and was linked to an area devoted to flint-working. Under the kitchen midden was a thin black occupation layer with artefacts of early Ertebølle type. Under the kitchen midden, marine sand was found. A 1 m wide section through the marine layers opposite the midden showed that there were no primary deposits (rubbish) in this area, only scattered water-worn flint. In a later, higher horizon, a horizontal stone setting of partly fire-embrittled, large stones was demonstrated, which on the basis of the potsherds must be assigned to the early Iron Age. The excavation succeeded in delimiting the shell heap to the west. A copious artefact material of flint, antler, bone and pottery was found; in addition a large amount of animal bones – especially fish – a material which is being studied. – *Forhistorisk Museum*, Moesgård, 2911, and *Aalborg historiske Museum* 972. [Søren H. Andersen and Erik Johansen]

6. BJØRNSHOLM FJORD, Oudrup, Overlade, Ranum and Voldsted s., Ålborg a.
Settlements. As part of continued investigations of the Mesolithic settlement of western Himmerland, reconnaissance has been carried out along the edge of the Stone Age fjord at Bjørnsholm. This has revealed 23 new settlements from the Ertebølle culture and 3 new Neolithic settlements. – *Aalborg historiske Museum* 2300, and *Forhistorisk Museum*, Moesgård, 3232. [Erik Johansen and Søren H. Andersen]

NEOLITHIC

7. ONSVED MARK I, Skuldelev s., Frederiksborg a.
Long barrow site, investigated in collaboration with the Folk University in Copenhagen. The ploughed-over long barrow could on the basis of stone-marks be ascertained to have been c. 15 m long and 7 m wide. Traces were found of one chamber, measuring c. 2.5 × 2.0 m. The floor was paved and covered by a layer of crushed flint. Insignificant traces were found of the passage to the chamber, but outside the chamber was a layer of potsherds from offering pots dated to Early Neolithic C/ Middle Neolithic I, and various Middle Neolithic artefacts. One of the stones from the packing around the kerb-stones was furnished with 12 cup-shaped depressions. It is likely that these were made before the barrow was raised, in which case it is the earliest recorded instance of cup-marks. – Lit.: F. Kaul in *Aarbøger for nordisk Oldkyndighed og Historie* 1987 (1988). – *Nationalmuseet*, Prehist. Dept. 4945/83. [Flemming Kaul]

8. SKÆVINGE BOLDBANER, Skævinge s., Frederiksborg a.
Causewayed enclosure. During the construction of a sports ground, two ditches from a causewayed enclosure were exposed. Further surface-clearing and exploratory trenches revealed three more ditches. The ditch system could be observed in a single row and in an arc over a NW-SE oriented stretch of 200 m on a flat hilltop. It is likely that the structure continues in both directions. No associated palisade was ascertained. Only two ditches were exposed in their entirety, measuring 21 × 7 and 13 × 7 m respectively. The ditches were preserved to a depth of 1–1.5 m. All five ditches contained artefact material,

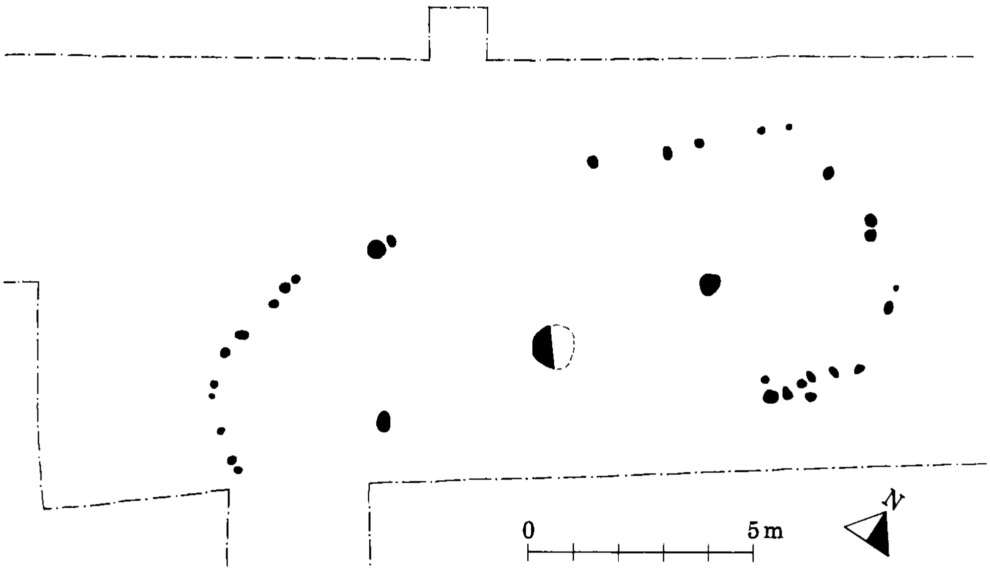


Fig. 2. Plan of Neolithic house remains from Ornehus, Zealand (no. 11). After *Danmarks længste udgravning*

especially potsherds, sherds from baking-plates/clay discs, flint implements and flint flakes. A large part of the pottery – and the clay discs – is decorated. Several whole vessels can be reconstructed, and many are whipcord-decorated. Based on the artefacts, especially the pottery, the structure can be dated to Early Neolithic C (Virum phase). In addition, a hoard from the Battle-axe period, consisting of two thick-butted flint axes, was found. One axe is hollow-edged and unpolished, the other straight-edged and partly polished and resharpened. The axes lay butt to butt. – *Gilleleje Museum* 3167. [Arne H. Andersen]

9. MARKILDEGÅRD, Bårse s., Præstø a.
Causewayed enclosure, found during motorway construction. The pit system of this structure was traced over a stretch of 250 m around the foot of an elongated ridge. There were 23 pits – up to 8 m long. Dating pottery: Funnel Beaker C (Virum phase), but only a few pits contained finds. In the area studied, no traces of a palisade were found, but there were post-holes and settlement pits. In the western part of the area were thick Middle Neolithic occupation layers containing pottery and flint. – *Sydsjællands Museum*, Vordingborg, 28/86. [Birgitte B. Henriksen]

10. BAKKELY, Frøslev s., Præstø a.
Flint workshop. During reconnaissance prior to the laying of a gas pipeline, a heavy concentration of flint swarf was found. The ensuing excavation revealed a workshop for working four-sided flint axes. Rejected blanks show that this was a place where the thin-butted axes of the Funnel Beaker culture were made. – *Sydsjællands Museum* 1986. [Peter Vemming Hansen]

11. ORNEHUS, St. Heddinge s., Præstø a.
Settlement with house-site. Investigation undertaken in connection with the laying of a gas pipeline. In the southwestern part of the c. 2,600 m^2 investigated area, which occupied flat terrain, a small long-house was found with a central pillar construction (fig. 2). Three post-holes are interpreted as being for roof-bearing posts in the c. 15 m long and 6 m wide long-house. Post-holes interpreted as being for wall and gable posts were largely preserved, although occasionally disturbed by later pits. It was not possible to distinguish entrances, nor were floors or fireplaces preserved. The orientation of the central pillar house was SSW-NNE. No dating material was found in the post-holes belonging to it. In a sand layer covering the northeastern wall and gable, a fragment of a Late Neolithic type I dagger was found. In addition, decorated sherds of Funnel Beaker pottery of the Virum group were found in a post-hole cut by a wall post probably belonging to the house. An independent dating of the house is not possible, but a cautious dating based on the above-mentioned observations and finds points to the Middle Neolithic. Settlement traces from the remaining investigation area could be dated to the Late Bronze Age and the early Iron Age. – *Sydsjællands Museum*, Vordingborg, 5/86. [Lars Buus Eriksen]

12. GRØDBYGÅRD, Åker s., Bornholm.
Settlement. At a large Neolithic settlement with among other things Middle Neolithic houses, parts of an extensive Early Neolithic occupation layer (Early Neolithic B/C) and traces of several houses from both Early Neolithic and Middle Neolithic Funnel Beaker culture were excavated. The houses are of the same type as those previously investigated at this site in 1984 and 1985, but manifested almost only as rows of post-holes belonging to the central roof-bearing posts (cf. *JDA* vol. 4, pp. 87–100). A very large find material derives partly from the houses and partly from the surrounding occupation layers. Also inve-

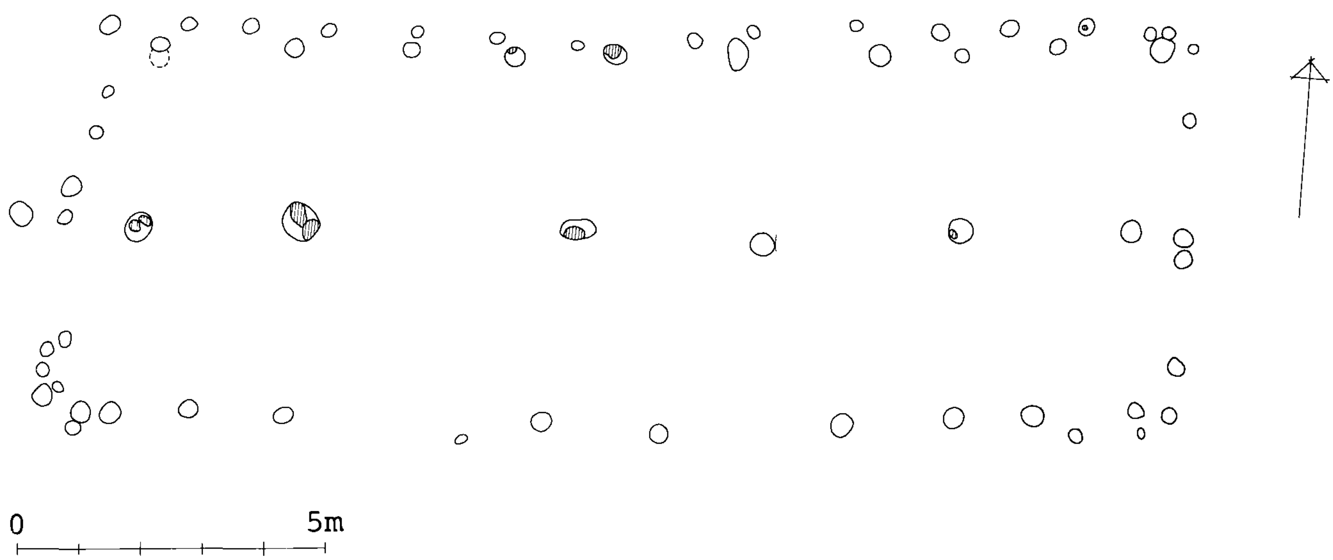


Fig. 3. Plan of Late Neolithic long-house from Øster Nibstrup, north Jutland (no. 15). After *Danmarks længste Udgravning*.

stigated were two large, three-aisled long-houses from the Bronze Age, the larger 8.5 m wide and at least 33 m long; the smaller (only partly excavated) at least 20 m long. In addition, three urn graves (Late Bronze Age) and several Iron Age houses were found. As very intensive ploughing is still going on in parts of the area, 617 m of sounding-trenches were driven in the area, which just under the plough-soil revealed three more Middle Neolithic settlements, a Bronze Age house, at least 25 Iron Age houses, two houses from the Viking Period and Middle Ages (?) and 177 inhumation graves, being a small part of a Viking Age cemetery. – *Bornholms Museum* 948, and *Nationalmuseet*, Prehist. Dept. 6404/86. [Finn Ole Nielsen, Poul Otto Nielsen, Margrethe Watt]

13. STRANDBY MARK, Hårby s., Odense a.
Dolmen. Completed excavation of 12 × 34 m long barrow originally marked by 79 kerb-stones. A chamber erected on a black culture layer with charcoal and few artefacts measured 2.5 × 2.8 m and was constructed of seven orthostats and a 2.5 m long passage to the east constructed with three sets of orthostats. The bottom 30 cm of the chamber fill was undisturbed and contained heaps of bones, battle-axe and club, amber bead, etc. – dated to the Middle Neolithic I-II. At the passage entrance there was a layer of potsherds with a rich variation of Middle Neolithic Ib vessel types, on the north side layers of sherds with large funnel beakers from the early Middle Neolithic I. Altogether, 3,439 artefacts were recovered. The two potsherd layers are coeval with the two causewayed camps at the nearby Sarup site. – *Forhistorisk Museum*, Moesgård, 3081. [Niels H. Andersen]

14. HYGIND, Husby s., Odense a.
Causewayed enclosure. Pilot excavation of a low-lying peninsula, 4½ ha. in extent, which pokes out into a drained area of Tybrind Vig. On this spit, a well-preserved causewayed enclosure consisting of a system of ditches with and without palisades was found. The ditches have been reemptied many times and are dated to the Middle Neolithic. Calcareous and waterlogged soil means that organic material is very well preserved (including wood). The area bounded by the ditches yielded 54 pits with artefacts, only one of which was excavated. This excavated pit, dated to Middle Neolithic II, contained two whole flint axes, pottery, flint, ten bone implements, red-deer antler and many bones. Other pits had on the surface finds from Middle Neolithic I, II, III-IV or V. – *Forhistorisk Museum*, Moesgård, 3246. [Niels H. Andersen]

15. ØSTER NIBSTRUP, Brønderslev s., Hjørring a.
Late Neolithic house site. An exploratory excavation in connection with the laying of a gas pipeline resulted in the excavation of a Late Neolithic long-house, fig. 3. The E-W oriented house is 19.5 m long and 7 m wide and contained 60 posts in all. The six internal roof-bearing posts were placed centrally in a two-aisled construction. Post-hole depth varies from 25 to 45 cm under excavation level. An additional central post was placed just outside the west gable, perhaps with a supporting function. An E-W section through the post-hole shows a slight inclination towards the gable. The north wall consists of a row of double post-holes at varying intervals. The south wall is somewhat less in evidence, and it was possible to demonstrate only one row of post-holes. Unambiguous traces of an entrance or entrances were not found. The wall post-holes vary in depth from a few cm to 25–30 cm. With the exception of the northwestern one, all house corners are regular right-angles, giving the house a rectangular shape. A dating must first and foremost rest on two flint daggers, one of them fire-embrittled. They were both recovered from wall post-holes. Typologically, the daggers can be assigned to type I, and a dating to the ear-

liest part of the Late Neolithic is therefore most likely. Altogether, 700 m^2 were investigated. Besides the Neolithic structures, a number of post-holes and pits from the early Iron Age were registered. – *Vendsyssel historiske Museum*, Hjørring, 269/1986. [Karsten Kjer Michaelsen]

16. MØGELVANG, Skjoldborg s., Thisted a.
Remains of long barrow with two chambers. In 1985–86, a 60 m long, trapeze-shaped long barrow, oriented NE-SW, was investigated. Further chambers were not found. The chamber at the south end was trapeze-shaped, oriented approximately E-W, and measured inside 3.5 × 1.7 m. To the east, it continued in a 1.5 m long passage, oriented WNW-ESE. At the junction of passage and chamber a threshold stone was found. The walls were constructed as a combination of true orthostats and a drywall-like stacking of fieldstone and thin moler stones. The chamber had been set in a shallow excavation and surrounded by a packing of broken flint and large and small fieldstones, on top of which were seen the remains of a casing of rough limestone flags. The northern part of the chamber had been disturbed, but in the southern part, on and above a floor layer of fine gravel, a number of human bones, three blades, many amber beads and a little hanging vessel decorated in the Middle Neolithic I style of northern Jutland were found. Immediately north-east of the chamber, three partly stone-lined excavations were found in a row across the barrow – it may have been divided up. In the same region and partly under the chamber was a Funnel Beaker layer with remains of a large funnel beaker with finger impressions under the rim, a little charcoal, and burnt bones. – *Museet for Thy og Vester Hanherred* 2151. [Anne-Louise Haack Olsen]

17. FJELSØ, Fjelsø s., Viborg a.
Earthen long barrow. During excavation in connection with a gas pipeline, a trapeze-shaped structure measuring 50 × 7–15 m, oriented NE-SW, was found. Furthest out was a stone-lined foundation trench, and within this a flat trench, which only reached any depth in the northeastern gable. Centrally in relation to the flat trench was a grave containing a thin-butted axe, a transverse point and an ankle-band, arm-band and necklace of alternately tubular and nodular amber. In the gable pit, three Early Neolithic clay vessels were found. – *Viborg Stiftsmuseum* 445E. [Inge Kjær Kristensen]

18. SVAPKJÆR, Rimsø s., Randers a.
Remains of passage grave with rectangular chamber c. 4 × 2 m, oriented NE-SW, with a c. 5 m long passage to the south-east and surrounded by a border of kerb-stones, c. 9–10 m in diameter. In the chamber were found parts of a little funnel beaker, c. 15 amber beads and a blade knife. The bottom layer of burnt flint and raw clay was preserved in patches. Especially up to the rear wall of the chamber, a large patch was intact. Here it was seen to consist of a flat layer of large potsherds placed on the original surface. Directly above the potsherds was a layer of raw clay, and after this a layer of burnt flint. The sherds from the floor could be re-assembled to make ten different large storage vessels, some undecorated, some funnel beakers with belly striping. It is thought that these vessels were deliberately placed as a floor, which is very unusual. The storage vessels from the chamber floor can be dated to Middle Neolithic I–II. The offering layer pottery is for the most part contemporaneous with this, but a few sherds belong to Middle Neolithic III. – *Djurslands Museum*, Grenå, 2113. [Lisbeth Wincentz]

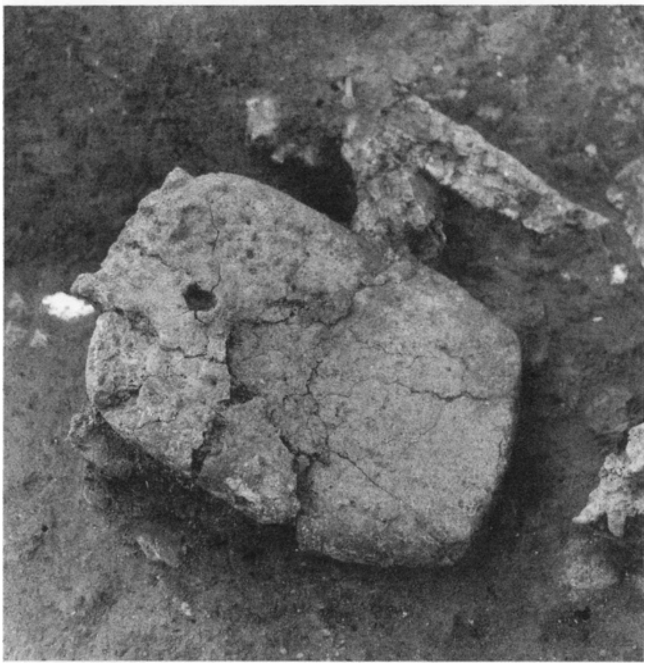
BRONZE AGE

19. POULSTRUPGÅRD, Sudrup s., Ålborg a.
Settlement. In connection with the laying of a gas pipeline, parts of a settlement from the beginning of the Early Bronze Age were excavated. Among other finds was a 15.5 m long and 7 m wide long-house. This house was constructed with three roof-bearing posts in a row. The wall had posts set into the ground and rounded gables. – *Aalborg historiske Museum* 2052. [Peter Birkedahl]

20. HERSLEV, Herslev s., Vejle a.
Tumulus. Only the central grave was preserved, with parts of the kerb-stone chain. There were no grave-goods, but the construction of the grave differed from the ordinary grave forms of the Early Bronze Age. The grave was shaped like a regular house, where the wall had stood in a foundation trench. The size of the grave was 2.5 × 1.1 m. In the foundation trench were very distinct impressions of up to 35 cm wide, edge-trimmed posts. Within this trench were four very large holes from sturdy posts which must have borne the roof. The floor of the grave itself consisted of a fine cobbled paving. Under the barrow were very distinct ard-marks, showing ploughing in only one direction. – *Vejle Museum* 1276 [Lone Hvass]

PRE-ROMAN AND ROMAN IRON AGE

21. ESPEVEJ, Boeslunde s., Sorø a.
Iron-smelting furnace. In connection with the laying of a gas pipeline, an iron-smelting furnace of the early, slightly subterranean type was found. Pottery finds date it to the early Roman Iron Age. It consisted of a semicircular oven casing forming a U-shaped space c. 25 cm deep, with an opening c. 25 cm wide. This casing was preserved to a height of 45 cm and was c. 40 cm thick where the innermost c. 10 cm were baked by the heat from the furnace. The inside of the casing was seen to have been frequently refurbished with applied coatings of clay, so the furnace must have been used several times. In front of it was a likewise partly dug out working area, where nearest the furnace and connected to it was a c. 10 cm deep depression of baked clay, forming a kind of basin. In and in front of the furnace were two almost intact slag-blocks, the upper parts of which taper slightly downwards, forming a "bowl" which probably reveals an inner construction which has contributed to separating the dross from the iron. In the working area in front of the furnace, five parts of rounded nearly square clay



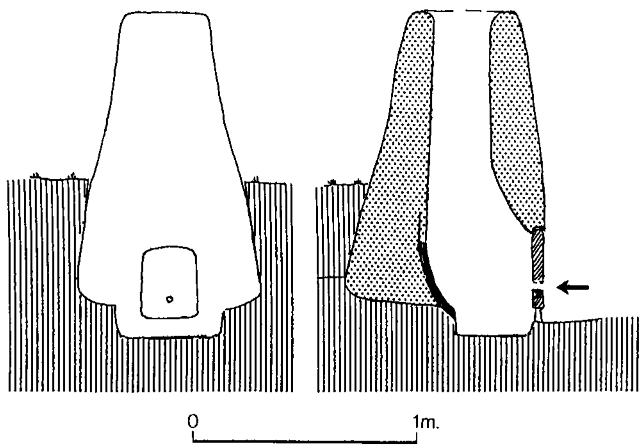


Fig. 4. Espevej (no. 21). Excavation of iron-smelting furnace. Top: Lower part of clay funnel during excavation. Photo: A. H. Andersen. – Middle: Fore-plate from furnace in situ. Photo: F. Kaul. – Bottom: Reconstruction of iron-smelting furnace based on the finds from Espevej (no. 21) and Skydebjerggård (no. 22). O. Voss del.

plates were found. The fully preserved one measures 30 × 25 × 5 cm and is furnished with a 2 cm wide hole. These plates must be front-plates or doors for the furnace, which during smelting stood upright in its opening, air entering through the hole. Cf. fig. 4. – *Nationalmuseet*, Prehist. Dept. 6458/86. [Arne H. Andersen]

22. SKYDEBJERGGÅRD, Eggeslevmagle s., Sorø a.
Iron-smelting furnace, found in connection with the laying of a gas pipeline. The furnace was set slightly into the ground and consists of a c. 40 cm thick clay casing which forms a small, U-shaped furnace cavity with a depth of c. 25 cm and an opening with the same dimensions. The casing was preserved to a height of 30 cm. The innermost c. 10 cm had been baked by the heat of the oven. It could be seen that repeated applications of clay had been made to the inside, showing that the furnace was used several times. In front of the furnace, a shallow semicircular depression in baked clay formed a kind of basin. The furnace and the working area in front of it yielded only a few finds: some pieces of slag and a little charcoal. The latter yielded the radiocarbon dating 105 BC (cal.), in accordance with the dating of the pottery from the neighbouring pits (Pre-Roman Iron Age period III). The furnace is of the same type as the one investigated at Espehøj (no. 21). Cf. fig. 4. – *Nationalmuseet*, Prehist. Dept. 6461/86. [Flemming Kaul]

23. TVEDEMOSEGÅRD, Snesere s., Præstø a.
Settlement. A section of a settlement covering c. 11,000 m^2 was investigated on account of impending motorway construction. The main settlement falls in the early Roman Iron Age. At the top of the prominent hill is an over 34 m long and over 6 m wide house, with six sets of roof-bearing posts, incidentally the only one at the site with partly preserved walls. Grouped around this down the slopes of the hill are a total of 17 long-houses of "standard Zealand type", i.e. with a skeleton of four sets of roof-bearers in straight rows, with bay lengths of 5.5 m and cross-spans of almost 2.0 m (cf. Bellingegård, *JDA* 4, type 1). The long-houses were partly placed in groups with up to three generations of houses at more or less the same spot. It was not possible to delineate farm complexes due to the lack of identi-

fiable fences. Of smaller houses, one definite four-post house and one house with three sets of posts (cf. Runegård, *JDA* 2) were found. A large number of pits, with a smaller number of cooking-pits, were grouped together in the open areas. A pit with a large number of superimposed red-burnt layers of stamped clay, separated by thin strips of charcoal, is seen as a pot clamp cleaned out several times, with frequent refurbishing of the floor before firing, the red-baking obviously having occurred from above and down. The pottery is relatively abundant. No elements have been demonstrated outside the 2nd century AD, which is therefore the principal time of settlement. An unambiguous and a more ambiguous house of the type with three sets of roof-supports in curved rows (Bellingegård type 3) are considered to represent a sparse settlement in the Germanic Iron Age. – *Nationalmuseet*, Prehist. Dept. 6464/86. [Jens-Aage Pedersen]

24. LUNDEBORG, Hesselager s., Svendborg a.
Settlement. During excavation for a drain, an occupation layer from the late Roman Iron Age was found. It stretches c. 300 m along the coast of the Great Belt, with its origin at the mouth of the River Tange. The mouth of the river served in the Iron Age as a natural harbour. The width of the occupation layer was 10–20 m and the thickness up to 80 cm. The layer contained large quantities of glass beads, amber beads, broken glass, iron objects, bronzes, bone and antler, coins, weights, and many other things. Part of the material is workshop waste and tools from the workshops. Thus the find contains the only four plane blades from the Iron Age. The layer's content of several hundred clinker rivets and rivet plates from ships is remarkable. Under the occupation layer and in its lowest horizons are several structures, the most important of which were remains of floors with fireplaces. It was possible to isolate an earthen floor measuring 4 × 5 m, with undressed stakes forming a wall. Finds and structures furnish a picture of a trading-centre from the late Roman Iron Age, with workshops housed in small huts. The connection to the harbour and navigation testify to the strategic position of the site. In larger perspective, the find can be linked to the very rich finds from Gudme and Møllegårdsmarken, 3–5 km from the coast. – *Svendborg Museum* A 2–86. [Per O. Thomsen]

25. JELLING, Jelling s., Vejle a.
Settlement. Just north of Jelling, and in connection with building construction, a settlement from the early Roman Iron Age was completely excavated. Due to the presence of fences, the settlement could be delimited to all sides. It covered an area of 75 × 50 m and consisted of only two farms, separated by fences. The houses were preserved only in the form of post-holes for roof-supports and holes for entrance posts. Each farm had a long-house in the centre, c. 20 m long, and several small buildings with two, three or four sets of roof-bearing posts. Several of the smaller buildings replaced each other. The larger farm covers an area measuring 50 × 40 m and has besides the 20 m long long-house had at least six contemporaneous outhouses with lengths of 6–12 m. The fence around this farm consisted of a row of large post-holes. The other farm has covered an area of 23 × 40 m and has in addition to the 20 m long long-house had at least five contemporaneous small houses with lengths of 4.5–9 m. The fences around this farm consisted of a double row of post-holes. Just outside the fences of the two farms were several large pits with a copious pottery material. The larger farm is the largest from the early Roman Iron Age so far excavated in Denmark. – *Vejle Museum* 1262. [Dorthe Mikkelsen]

26. STÆRKÆRVEJ (GUDME 3), Gudme s., Svendborg a.
Settlement. Continued investigation of settlement area with house remains from the end of the late Roman and early Germanic Iron Age. In 1986 an area of 2050 m^2 was cleared. The investigation brought the number of houses up to 19, in 10 of which parts of gables and walls set with double posts were preserved. Fences are only fragmentarily preserved. A systematic reconnaissance of the plough-soil with a metal-detector brought the number of melt-lumps and clippings of noble metals up to over 300 g silver and 7 g gold, to which must be added the Roman coins (two denarii and fragments of siliquae), bronze fibulas, weights and a bronze patrix for pendants in animal style A. – *Nationalmuseet*, Prehist. Dept. 6320/85. [Peter Vang Petersen]

27. HJEMSTED BANKE, Skærbæk s., Tønder a.
Settlements, wells and graves. Continued excavation of settlements from 3rd–6th centuries AD with well-preserved timber wells, urn grave cemeteries from the 1st–2nd centuries AD and 3 cemeteries with inhumation graves from the 3rd–4th centuries AD. On the basis of the well timbers, a local dendrochronological sequence of 257 years, covering the transition from the Roman to the Germanic Iron Age, has been established. – *Haderslev Museum* 1004. [Per Ethelberg]

GERMANIC IRON AGE

28. SORTE MULD, Ibsker s., Bornholm.
Gold plaquettes. Continued investigations of a large settlement area occupied from the Pre-Roman Iron Age (or earlier) to the late Viking Period. The excavation was occasioned by the finding of a large number of *Guldgubber* – gold plaquettes. The investigation involved both wet-sieving a tilth layer containing a great many finds and layered excavation and sieving of parts of the underlying occupation layer within an area of almost 400 m^2. This brought the number of gold plaquettes (entire or large fragments) to around 1300 pieces (ultimo 1986). The finds from the tilth and underlying parts of the occupation layer span a period from the end of the late Roman Iron Age to the Viking Age and comprise, besides the plaquettes, a number of smaller pieces of currency gold, denarii, weights, fibulas, fragments of gold cloissoné work, sherds of Frankish glass, beads, bone combs, pottery (including tin-foil pottery) and animal bones (from large domestic animals to fish). The investigation continued in 1987, bringing the number of gold plaquettes to c. 2,300. – *Bornholms Museum*, Rønne, 1191 [Margrethe Watt]

Fig. 5. Relief fibula of gilt silver from Biskopsenge, Bornholm (no. 29). Photo: L. Larsen, 1:1.

29. BISKOPSENGE, Ibsker s., Bornholm.
Relief fibula. Large, ornamental relief fibula of gilt silver from the early Germanic Iron Age, fig. 5. Surface find, handed over as treasure trove by Bornholms Museum. – *Nationalmuseet*, Prehist. Dept. 6393/86.

30. BÆKKEGÅRD, Østerlars s., Bornholm.
Grave find. The cemetery at Bækkegård was investigated in 1876–77 by E. Vedel. It consists of over 200 small tumuli with inhumations from the late Germanic Iron Age and early Viking Period. In 1986, a supplementary investigation was carried out of 9 barrows in order to ascertain details of grave construction. In one of these, an undisturbed grave from the late Germanic Iron Age was found. The grave was oriented NNW-SSE. A woman lay on her right side in a sleeping position, with her head to the north. A rich set of jewelry comprised three tortoise brooches with style D animal ornament, two massive armrings with wave ornaments, to peltate pendants with stamped circle ornament, two plain finger-rings, all of bronze. There was also a necklace of 120 beads, most of them of glass with inlaid gold and silver foil. Finally, the grave contained an iron knife. Its furnishings date the grave to the second half of the 8th century AD. A minor surface clearance of the cemetery resulted in 11 cremation graves with marker-stones. A few sherds in two graves indicate an early Iron Age date, probably the Pre-Roman Iron Age. – *Nationalmuseet*, Prehist. Dept. 6388/86. – Lit.: *Nationalmuseets Arbejdsmark* 1987, pp. 75–85. [Lars Jørgensen]

31. HEDEVANG, Kobberup s., Viborg a.
Settlement. Investigation of an area covering c. 2,500 m^2 at Lake Tastum revealed parts of a large settlement from the early Germanic Iron Age. Ten E-W oriented long-houses were exposed, the largest of which is 6 m wide and 28 m long. They are all three-aisled with straight sides and rounded gable-ends. In addition, ten E-W oriented, rounded-oval and slightly subterranean pit-houses with a deep post-hole at each gable were exposed. – *Skive Museum* 331A. [Agner Nordby Jensen]

32. NØRRE SNEDE, Nørre Snede s., Skanderborg a.
Settlements. In 1986 the remaining 5,000 m^2 of the village complex, covering the period from the 3rd to the 6th–7th centuries AD, were excavated (cf. *JDA* vol. 1, p. 181). The last part of the investigation was concerned with the latest part of the settlement from the 6th–7th centuries. Several long-houses with associated small houses, and with the usual well-preserved fences were found, comprising a whole farm and parts of seven others, the other parts of which have been previously excavated. This brings to an end the total excavation of this complex. Altogether it covers c. 70,000 m^2 and has been in progress since 1980. A total of c. 500 houses have been excavated from 1980 till 1986, from 40 m long main buildings to small and simple huts. – *Vejle Museum* 211. [Torben Egeberg Hansen]

33. VORBASSE, Vorbasse s., Ribe a.
Settlements. Continued excavation of a settlement from the 5th/6th–7th centuries AD (cf. *JDA* vol. 2, pp. 127–136). 16 long-houses and 28 smaller houses have been excavated, all with very well preserved fences which clearly show how big each farm has been, and how holdings have changed during the lifetime of the village. 3 pit-houses were also found. C. four phases in the existence of the individual farms in the village can be demonstrated in this interval. At one of the latest farms, which has been completely excavated, the long-house closely resembles one of the oldest long-houses previously excavated at the older Viking Period settlement found 400 m away, with its origin in the 8th century. Contemporaneous with this oldest long-house, a fence enclosing a space measuring up to 130 m from side to side has been found, with several small houses lying inside the farm fence – a structure corresponding to that of the early Viking Period farms. – *Vejle Museum* A114. [Steen Hvass]

34. SNORUP SYD, Tistrup s., Ribe a.
Settlement, graves and iron-smelting. Within a large area with traces of iron smelting, a hoard of axe-shaped iron bars was found with a total weight of 15 kg. It consists of 160–180 iron bars in two sizes, 25–32 and 15–18 cm long, respectively.

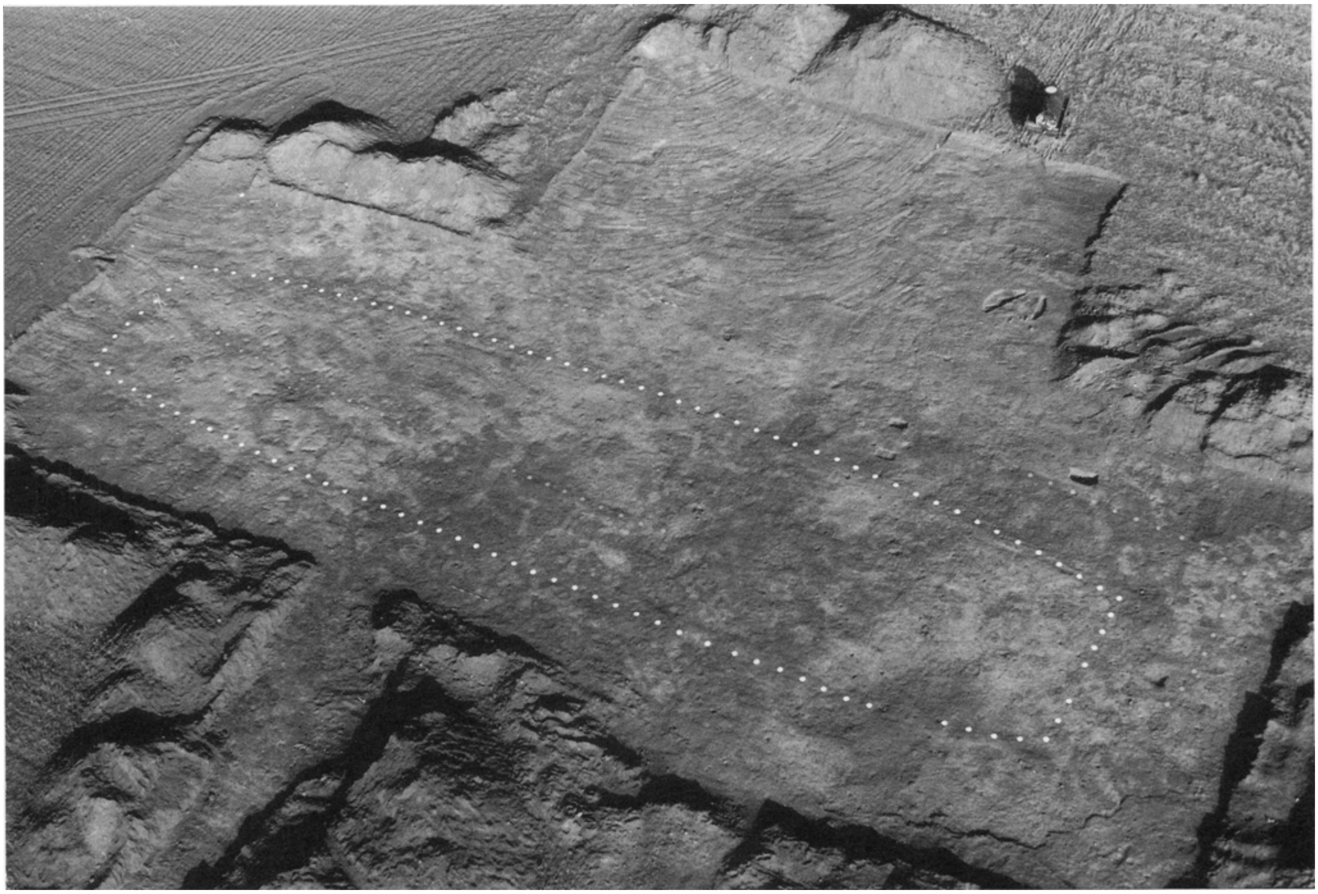


Fig. 6. Aerial photograph of the 48 m long house at the Viking Period settlement of Gl. Lejre, Zealand (no. 35). Photo: Roskilde Museum.

In addition, excavation revealed the base of a charcoal stack and a place with traces of iron-smelting, where a total of 32 slag-pits were investigated. Also excavated were parts of a settlement with two houses with rounded gable-ends, one of which was 22 m long, and four inhumation graves. There were also traces at the periphery of a no longer extant barrow. The grave-goods – pottery, spear and knives – date the graves to the early Germanic Iron Age. – *Varde Museum.* [Olfert Voss]

VIKING PERIOD

35. GL. LEJRE, Allerslev s., København a.
Settlement. In 1986, excavation of a magnate farm was started just west of the village of Gl. Lejre, where investigations of a ship-setting with associated Viking Period cemetery have previously taken place (cf. *Nationalmuseets Arbejdsmark* 1960, pp. 13–35). The farm, which covers an area of c. 150 × 150 m, is part of a larger settlement complex under and west of the present village, with finds from the 7th and 8th centuries to after 1000 AD. So far, a large central hall (48 × 11 m) has been excavated, fig. 6, constructed in the same way as the classical Trelleborg halls, although at Lejre there are internal roof-supporting posts. There are also a number of smaller buildings and what is at present interpreted as an enclosing fence. The nature of the structure, its size, and a number of exclusive finds lift this locality above the usual run of settlements. – *Roskilde Museum* 641/85. [Tom Christensen]

36. BØGELUND, Varpelev s., Præstø a.
Settlements. C. 1 km from the present-day village of Varpelev is a settlement area from the Viking Period, covering c. 100,000 m^2. Occasioned by building activity, 20,000 m^2 have been investigated. Three concentrations of house remains were revealed, thought to represent three different farms. The first farm complex, which was excavated in 1985, comprises three long-houses and is presumed to derive from the early Viking Period. The second farm complex consists of two long-houses, one of which has superseded the other, the younger one being a "Trelleborg house", 30 m long and 7 m wide. In this complex three small houses were investigated. In the post-holes were found pottery of "Baltic" type, a bronze finger-ring, a pair of iron shears, iron knives, loom weights and spindle-

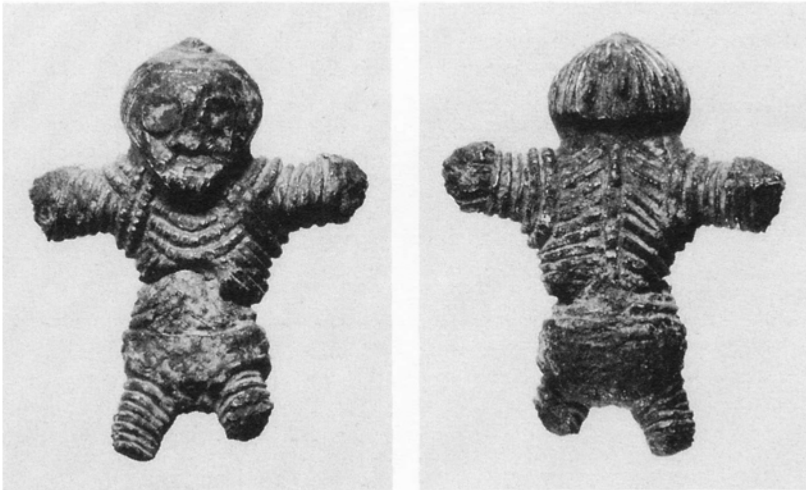


Fig. 7. Gilt bronze figure of Christ from Gudme 2, Funen (no. 37). Photo: L. Larsen, 2:1.

whorls. The third farm produced a long-house 30 m long and 6.5 m wide and parts of two other long-houses. In addition, three wells without any timber construction and a couple of smaller houses, including a smithy, were investigated. This farm yielded a little "Baltic" pottery and pottery from the early Viking Period. – *Køge Museum* 1200. [Svend Åge Tornbjerg]

37. GUDME 2, Gudme s., Svendborg a.
Figure of Christ. Among numerous stray finds from the 4th–11th centuries is a 2.8 cm high gilt bronze figure of Christ from the Viking Period, fig. 7. Surrendered as treasure trove by Fyns Stiftsmuseum. – *Nationalmuseet*, Prehist. Dept. 4620/82.

38. BJERRINGHØJ, Mammen s., Viborg a.
Grave. Re-excavation of a chamber grave found in 1868 (cf. *Acta Archaeologica* VII p. 106), with one of Denmark's most prominent grave finds from the late Viking Period. The new excavation documented the original size and steepness of the barrow, and the dimensions of the plunder-hole, which coincides more or less with the original Viking Period excavation, which was only sporadically seen in the west gable. All the remaining woodwork from the coffin was very well preserved: altogether four corner posts (of a total of six posts) and 23 boards (of a total of c. 35). A dendrochronological dating has given a felling date of winter 970–971. Only a few remains of the grave-goods were left: a couple of nuts, a handful of feathers, a few pieces of cloth and a single gold thread. – *Viborg Stiftsmuseum* 545E [Mette Iversen]

39. GJERRILD KLINT, Gjerrild s., Randers a.
Silver hoard. During the excavation of a long barrow, the remains of a cache of silver from the Viking Period, which was probably concealed in or near the dolmen. The find comprises a total of 81 pieces of silver, mainly Kufic coins, both entire and clippings, and broken silver from rings and bars. In time, the coins span the period from the beginning of the 9th century to 954, and they were probably encached shortly afterwards. – *Djurslands Museum*, Grenå, 1995. [Pauline Asingh]

40. OMGÅRD, Nr. Omme s., Ringkøbing a.
Watermills. Continuation of investigations in the years 1974–85 of a Viking Period settlement with a magnate farm. In 1986 parts of two watermills from the Viking Period were excavated. Under and over this complex, several other structures were found, *i.a.* two roads. Each watermill consists of a mill-pond with a dam, a mill-race, a mill with a vertical wheel, a quern and a backwater canal. The investigation concentrated in particular on the two mill-races, the wheel itself and the plateau with the mill. Both mill-races are artificial canals dug along the southern edge of a shallow lake. The older mill-race and backwater canal were constructed of timber and stone, the later one mainly of timber. This contains a mass of piles mainly fashioned from young oak trees. Two wheel paddles and a quernstone derive from the two mills. Quantities of discarded wood, used to fill out the canal walls, a spade, a shovel, a wheel felloe, two wooden bowls, the shaft of an axe, a round disc and many other objects have also been found. Pottery was found and comprised an older and a younger group, each stratigraphically linked to its own mill-race. The mill structures contained vast amounts of timber and this material is now being subjected to dendrochronological analysis. The timber of the older watermill is from trees felled in the winter of 840–841. The later mill remains to be precisely dated. A piece of re-utilized wood has been found to belong to a tree felled between 897 and 900. On the basis of the embedded pottery it can be ascertained that the later mill was demolished before 979. Its successor is also known, but has so far been only superficially investigated. – *Nationalmuseet*, Prehist. Dept. 1140/75. – Lit.: Acta Archaeologica 57, 1986 (1987), pp. 177–210. [Leif Chr. Nielsen]

41. GL. HVIDING, Hviding s., Tønder a.
Settlement, found by aerial reconnaissance. A long-house of Trelleborg type was investigated. The site was monitored with a metal detector while the plough-soil was removed layer by layer, demonstrating a concentration of metal objects, viz. weights and casting remains of lead, in and around one of the rooms of the house, which could therefore be interpreted as a lead-founder's workshop. Three wells were excavated, two of which yielded wooden objects. Two roof shingles of oak could be dendro-dated to 804 and 840 AD respectively. The other wooden objects comprise *i.a.* the felloe of a wagon wheel and a ploughshare. Among the other finds from the settlement is pottery, including some of Pingsdorf type, and three metal ornaments with enamel inlay. – *Den antikvariske Samling i Ribe* 440. – Lit.: *Mark og Montre* 1986–87, pp. 5–17. [Stig Jensen]

VIKING AGE AND MEDIEVAL

42. EJBY MØLLE, Odense.
Settlement. Investigation of a Viking Period settlement covering more than 50,000 m^2, on the bank of the River Odense. Nearest the river, an up to 1 m thick occupation layer containing cooking-stones, charcoal, pottery and animal bones has been investigated. Just above the occupation layer a total of 13 pit-houses have been investigated, placed in a practically straight line parallel to the river-bank. Finally, in a gently sloping terrain north of the river valley, an area with traces of settlement has been exposed, which has so far yielded five E-W oriented long-houses. The finds comprise a quantity of pottery, both globular pots and Baltic ware, although not in contemporaneous context. Three fragments of soapstone vessels have been found, one of which had been refashioned into a spindle-whorl. Metal is represented in the form of two gilt bronze pendants, showing a man's mask and a gripping beast, respectively, and of melted-down ornament fragments. In addition there were two bronze weights, a fragmented Arabic coin, a partly melted coin of English origin and several Danish silver coins. Iron is represented by knives, deposited in the house's post-holes, and by three leister prongs. The main part of the finds dates to the mid- and late 10th century, while the later finds, including the three Danish coins, are from the beginning of the 12th century. – *Fyns Stiftsmuseum*, Odense. [Jørgen A. Jacobsen]

43. VILSLEV, Vilslev s., Ribe a.
Settlement. In the summer of 1986, during aerial reconnaissance, a row of house remains with the typical curved walls of the Viking Period, and with their east gables close to the old river bed, were registered in a cornfield south-west of Vilslev Church. The investigation showed that the row consisted of houses at least 25–30 m long – all with the gable-end only a few yards from the river bank. On the basis of the house types and the artefacts found in them, the settlement can be dated to the 11th century. One of the houses contained a bronze buckle in Urnes style. – *Den antikvariske Samling in Ribe.* – Lit.: *Mark og Montre* 1986–87, pp. 17–24. [Stig Jensen]

MEDIEVAL AND LATER

44. AHLGADE 15–17, Holbæk.
Churchyard and urban deposits. Excavation of c. 450 m^2 of St. Nicolai Churchyard, relinquished in 1573, and of about 100 m^2 of the settlement east of the churchyard. Altogether, about 600 graves were excavated. The graves were in up to six layers. Four grave/coffin types were represented: a coffin with sides, base and lid; a wooden lid covering the grave; a slatted bottom; stone-set graves. In a few graves, objects were recovered: belt buckles, a bead and no less than ten scallop shells, five of which were found in a single grave. In the eastern part of the churchyard, eight clay-pits were found, which were older than the churchyard. They were full of rubbish, including a lot of pottery. They seem to have been filled in from about 1250 to the beginning of the 14th century. The oldest house structure has been preliminarily dated to the beginning of the 13th century, the latest to the 15th. This is an area of backyards with houses of light construction, rubbish-pits, a stone-lined sewer from the 13th century and an oven of very light construction from around 1350. The excavation yielded many finds. The pottery was both of local type and imported ware from Holland, Germany and France. – *Holbæk Museum* 71/85. [Hanne Dahlerup Koch]

45. LUNDSBJERGGÅRD, Boeslunde s., Sorø a.
Settlement. In connection with the laying of a gas pipeline, an area with settlement remains from the Early Middle Ages, about 1300 AD, was investigated. At least three post-built houses were found, but only one was excavated in its entirety. It was of the type without inner roof-bearing posts, where the walls have carried the whole weight of the roof. The houses were oriented E-W. The totally excavated house was 31 m long, and 5 m wide at the eastern end and in the middle, whereas the western gable-end tapered to only 4 m. The gables were straight. The other houses seem to be of the same width. All three houses are dated to the Early Middle Ages. *Nationalmuseet*, Prehist. Dept. 6385/86 [Arne H. Andersen]

46. TÅRNBORGGÅRD, Tårnborg s., Sorø a.
Urban settlement. Continued excavation of an area covering c. 9 hectares down to Korsør Nor. Here a copious material, mainly from the period 1240–1425, has been brought to light by metal-detector. The structures found so far, in the form of foundations, clay and stone floors, paved roads, wells, etc., indicate a settlement of urban character. It is tempting to see the settlement as a precursor to Korsør, whose oldest borough charter is from 1425. – *Nationalmuseet*, Med. Dept. 117/86. [Henning Nielsen/Niels Engberg]

47. TVEDEMOSEGÅRD, Snesere s., Præstø a.
Pit-house. In connection with the excavation of a settlement from the Roman Iron Age, a well-preserved pit-house from the Early Middle Ages was found. It measured 6 × 4 m, and was built with walls of horizontally laid oak(?) planks around a skeleton of four corner-posts and a central post in each wall. A rounded pit in the southwestern corner must be the cleared

fireplace. The house floor was covered with mats of wattle. A 3 m long and 1 m wide downward-sloping entrance with stave-built walls and planked floor led into the house. After the house burned down, the fire layer was disturbed, leaving a number of sherds from the same pot strewn all over the site. The inventory left behind is restricted to a handful of iron objects, including a knife and key, and sherds of two pots, one a local vessel with inturned rim and incised wavy line, the other a vessel of Weisdin type with horizontal ornament belts of undulating rouletted bands, separated by applied impressed mouldings. Whether this was imported or of local origin is not known, although the rarity of Weisdin in Danish finds would suggest the former. A post construction, corresponding exactly to the skeleton of the pit-house, probably represents another pit-house, ploughed down to under floor level. – *Nationalmuseet*, Prehist. Dept. 6464/86 [Jens-Aage Pedersen]

48. FARVERGADE 7–9, Næstved.
Urban deposit. Under a Late Medieval cellar, a number of 14th century pottery kilns have been found. One further kiln can be dated to the Early Middle Ages. In the western part of the site, a land reclamation project from the Early Middle Ages was investigated. By means of a withy fence parallel to the river and fill dumped behind it, the low periodically flooded riverbank area at the north side of the Suseå was reclaimed. The fill contained among other things traces of four crafts: bronze-casting, blacksmithing, shoe-making and comb-making. From the 13th century, the area was built on. Under the Medieval culture layers along the south side of Farvegade is found an up to 1 m thick horizon of uniform occupation layer, which on the basis of thermoluminescence dating can be dated to the Germanic Iron Age. – *Næstved Museum* 86:200 [Palle Birk Hansen/ Jens Erik Petersen]

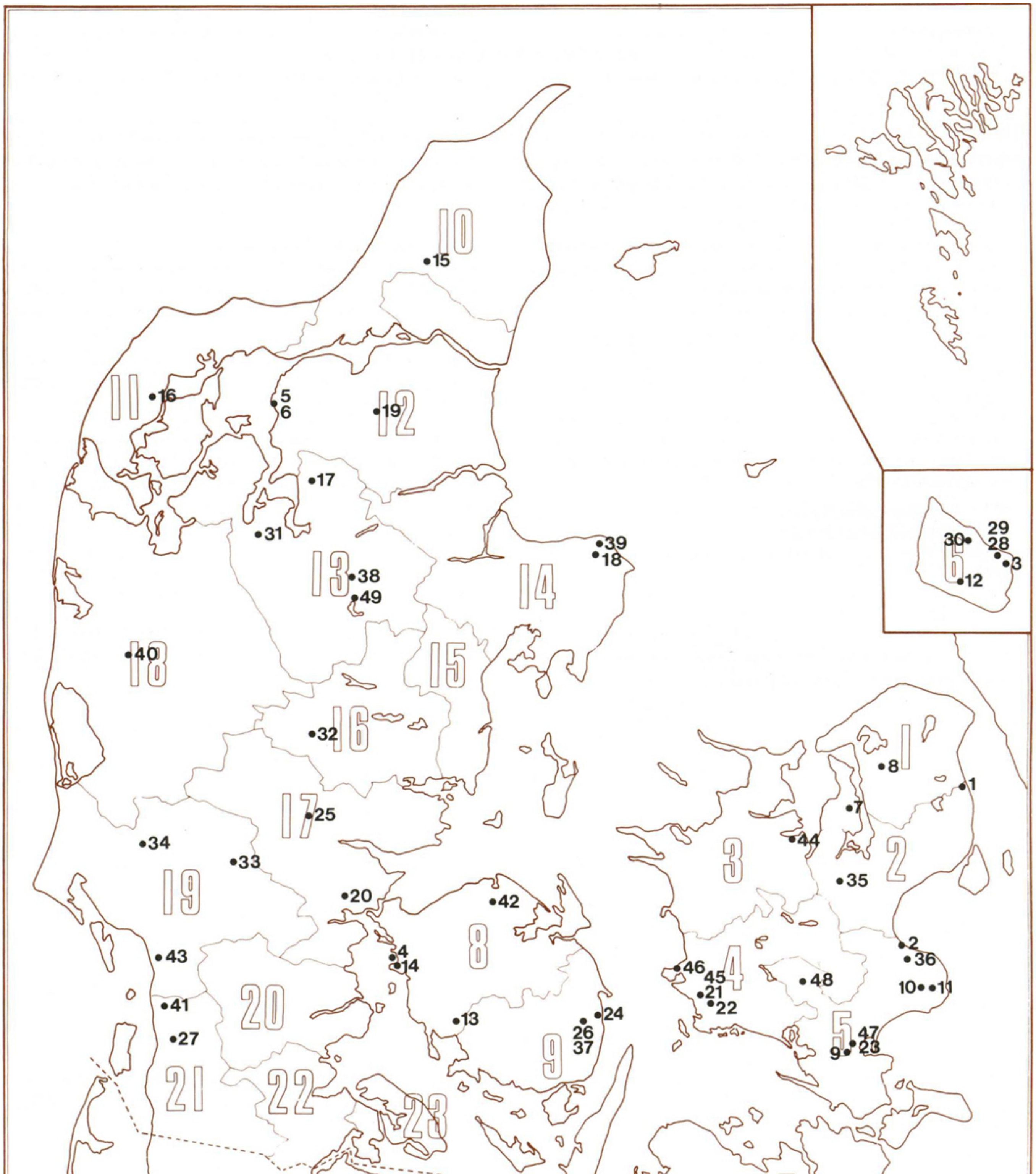
49. VEJERSLEV, Vejerslev s., Viborg a.
Watermill. An exploratory excavation revealed an over 40 m long mill-dam, strengthened inside with sturdy sheet piling of oak board (dendro-dated to about 1185). In addition, parts of the mill building itself were found, located c. 25 m below the dam. The preliminary investigations seem to show that the building may have been destroyed in a strong flood, which simultaneously ensured that its timbers are unusually well preserved. – *Silkeborg Museum* 88/1981. [Chr. Fischer/Knud Bjerring Jensen]

50. DANNEBROGE, Køge Bugt.
Wreck of Danish man of war. In 1710, the naval vessel "Dannebroge" exploded and sank almost in the middle of Køge Bugt. Besides the naval hero Ivar Huitfeldt, 500 men lost their lives after a brief battle with the Swedish fleet. In 1711, a number of cannons and an anchor were salvaged, and again in the 1870s cannon pieces and other things were salvaged by the Switzer Company, who proceeded energetically with explosives. In 1985, the wreck was searched again by amateur skin divers, who in collaboration with the Orlogsmuseet recovered a few pieces of the famous cannons, "The Hundred Kings", and 450 silver coins. Rumours of treasure resulted in plundering of the wreck despite prohibition. The Museum was therefore compelled to start a salvage operation in 1986, in which several members of the National Museum participated, and diving clubs. The transportable items were recovered from the wreck area, which was found to be about 6,000 m^2 and contain a 25 m long and 3 m high part of the forebody. – *Orlogsmuseet* and *Nationalmuseet*. [Jørgen Christoffersen]

Translated by Peter Crabb

Map showing the location of sites mentioned in the section 'Recent Excavations and Discoveries'. The counties (Danish *amter*) are numbered in the following way:

1. Frederiksborg	9. Svendborg	17. Vejle
2. København	10. Hjørring	18. Ringkøbing
3. Holbæk	11. Thisted	19. Ribe
4. Sorø	12. Ålborg	20. Haderslev
5. Præstø	13. Viborg	21. Tønder
6. Bornholm	14. Randers	22. Åbenrå
7. Maribo	15. Århus	23. Sønderborg
8. Odense	16. Skanderborg	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