

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

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## INTRODUCTION

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

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

In 1989 this situation changed radically with the loca-

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

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

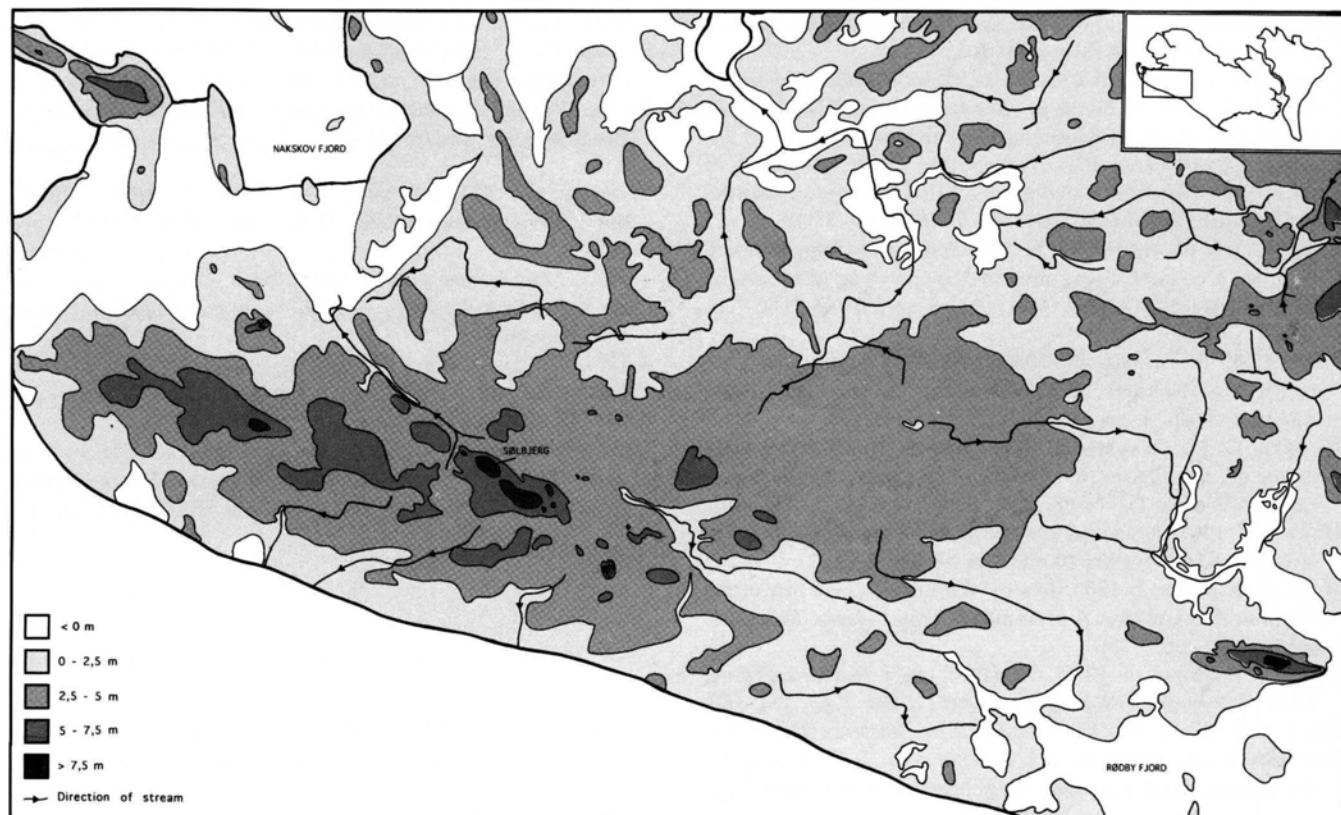


Fig. 1. Relief map of southwestern Lolland showing the location of Sølbjerg. Lykke Johansen *del.*

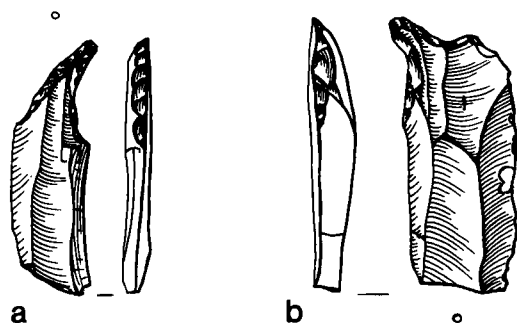


Fig. 2. The first two *Zinken* from Sølbjerg found by amateur archaeologist Hans Chr. Heickendorf. Lykke Johansen del. 3:4.

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

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

## SØLBJERG

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

tanged points, biserial barbed harpoons and clubs made of reindeer antler (Bokelmann 1988, fig. 2–3; Fischer 1991, fig. 9), evidence for Ahrensburgian settlement has previously largely been lacking in Denmark.<sup>5</sup>

### *The Ahrensburgian site – Sølbjerg I*

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

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

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

Including fragments, 18 examples of tanged points were recovered (fig. 4a–p). The length of the points varies from 2.4 – 4.6 cm, and two of them (11%) have the tip located at the proximal end of the blade (fig. 4m–n).<sup>7</sup> Twelve of the points have the tang worked from the ventral side, one is propel retouched on the tang (fig. 4e), and four are of the Hintersee type (Taute 1968:5) with the tangs formed by “reverse” retouche (fig. 4d, h, l and p). The percussion bulb on all the points has either been removed by retouche or has been broken off, and the majority of the points have oblique retouche at the tip. Several of the points are fragmented and small chips, probably damage from use, can be seen on some of them. Four obliquely-retouched blade fragments (fig. 4q–r) are

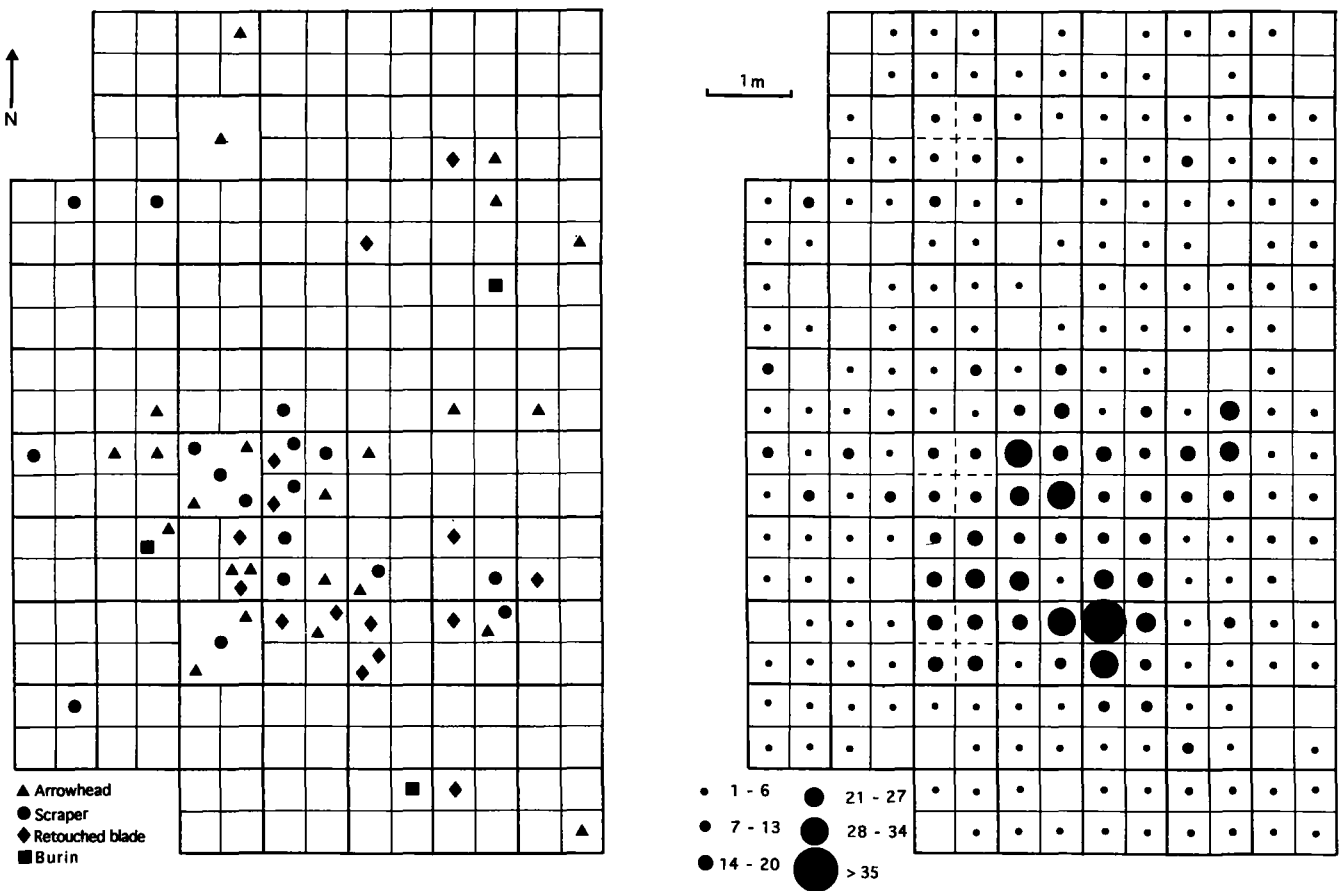


Fig. 3. Sølbjerg I – distribution of flint tools and fragments. Lykke Johansen *del.*

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

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

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

#### *Other Late Glacial occupation at Sølbjerg*

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

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

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

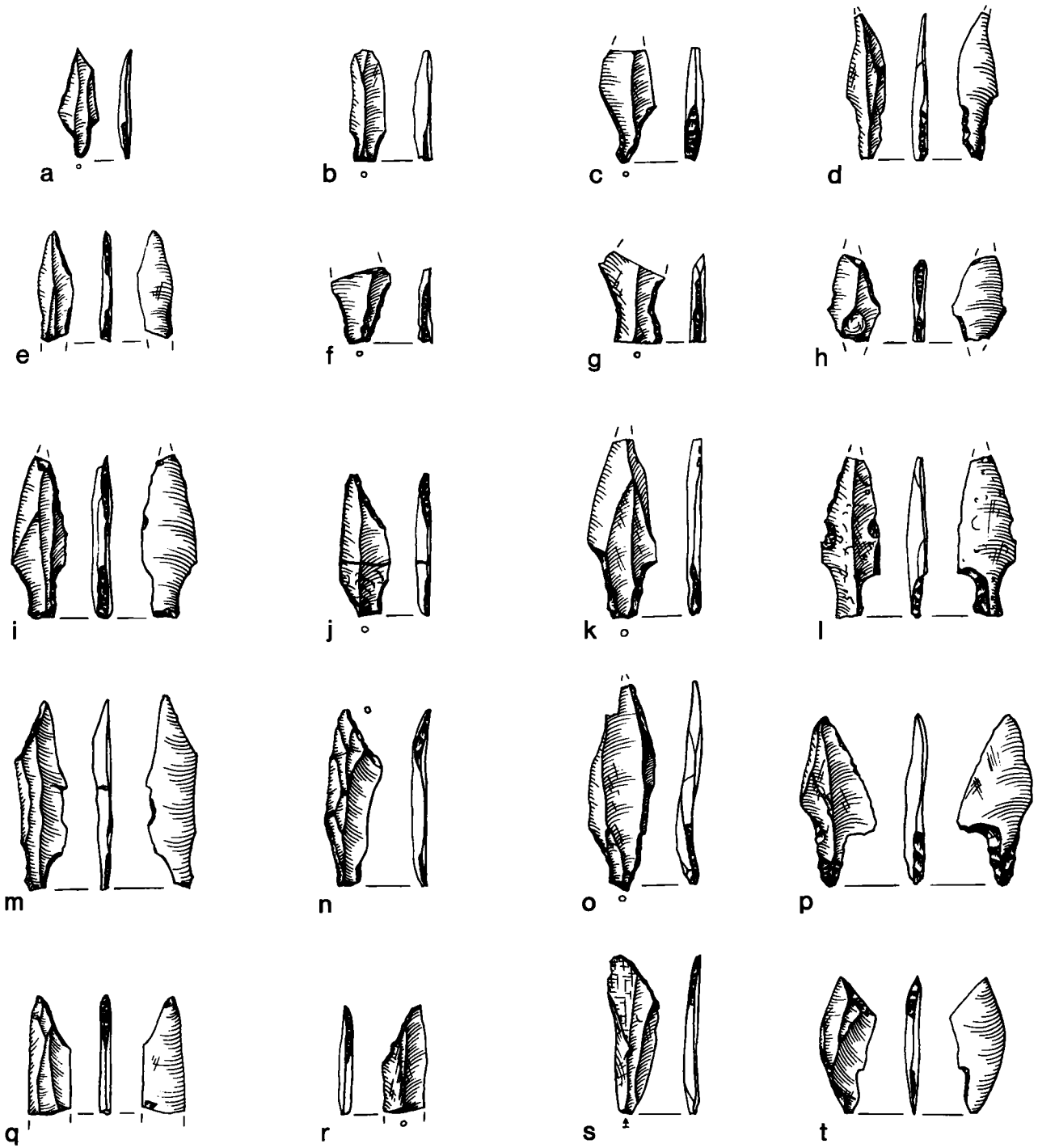


Fig. 4. Sølbjerg I – Ahrensburgian points (a–p), blade fragments with oblique retouche (q, r) and Zonhoven points (s, t). Lykke Johansen *def.* 3:4.

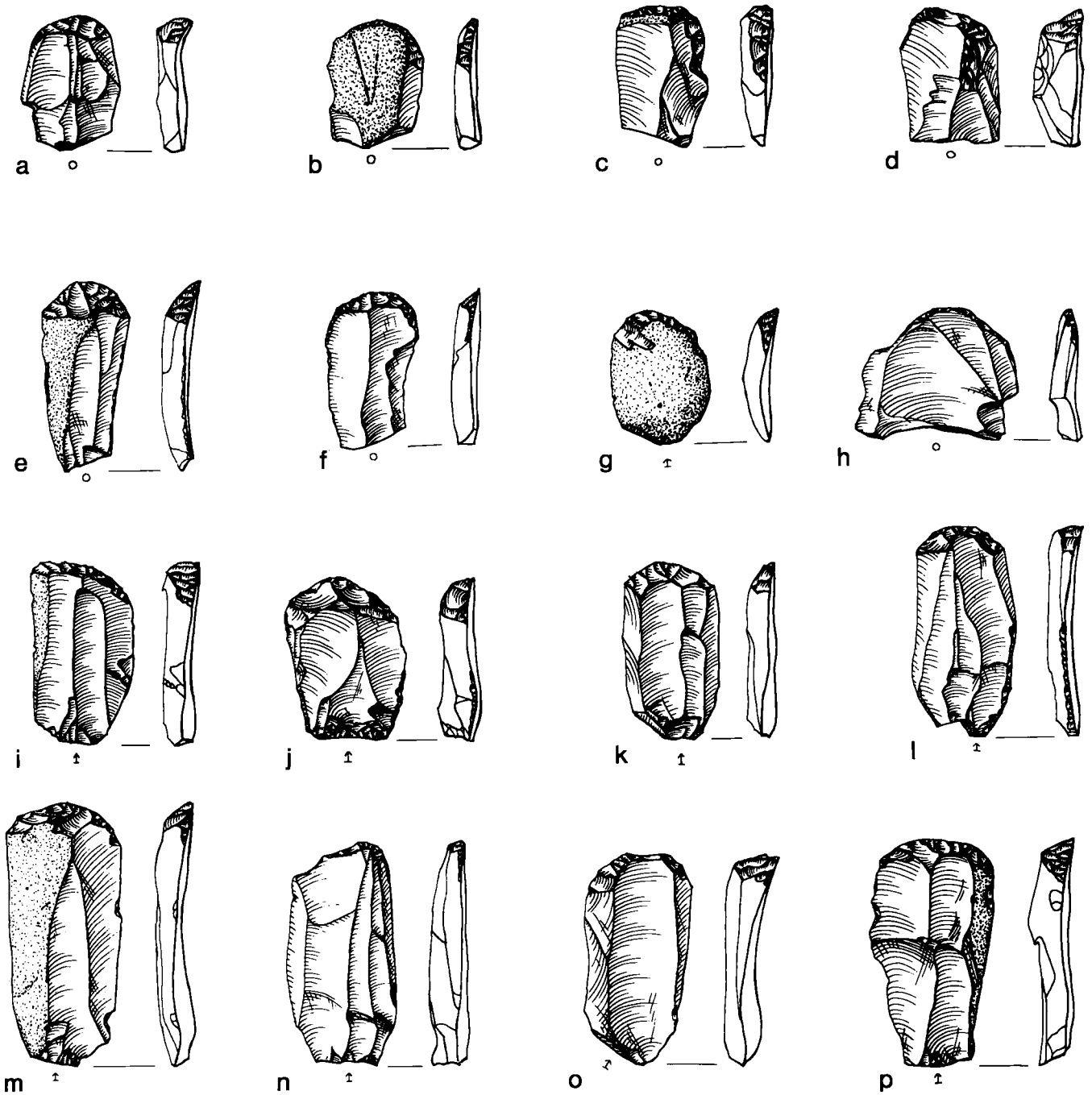


Fig. 5. Sølbjerg I – scrapers. Lykke Johansen *del.* 3:4.

The Late Glacial finds from Sølbjerg are dominated by Hamburgian and Ahrensburgian types. The Hamburgian Culture appears on present evidence to date to the relatively mild Bølling Period (Usinger 1975), before the forest became established in southern Scandinavia. The Ahrensburgian Culture belongs primarily to the substan-

tially colder Younger Dryas, when most of the forest which developed during the Allerød Period disappeared again.

The Late Glacial occupation of Sølbjerg therefore seems to be linked to tree-less phases, when reindeer were the overwhelmingly dominant game animal. Sølbjerg lies

in very flat terrain,<sup>9</sup> and a position on the hilltop gave the reindeer hunters the best possible view of the animals' movements over Lolland's flat glacial plain.

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

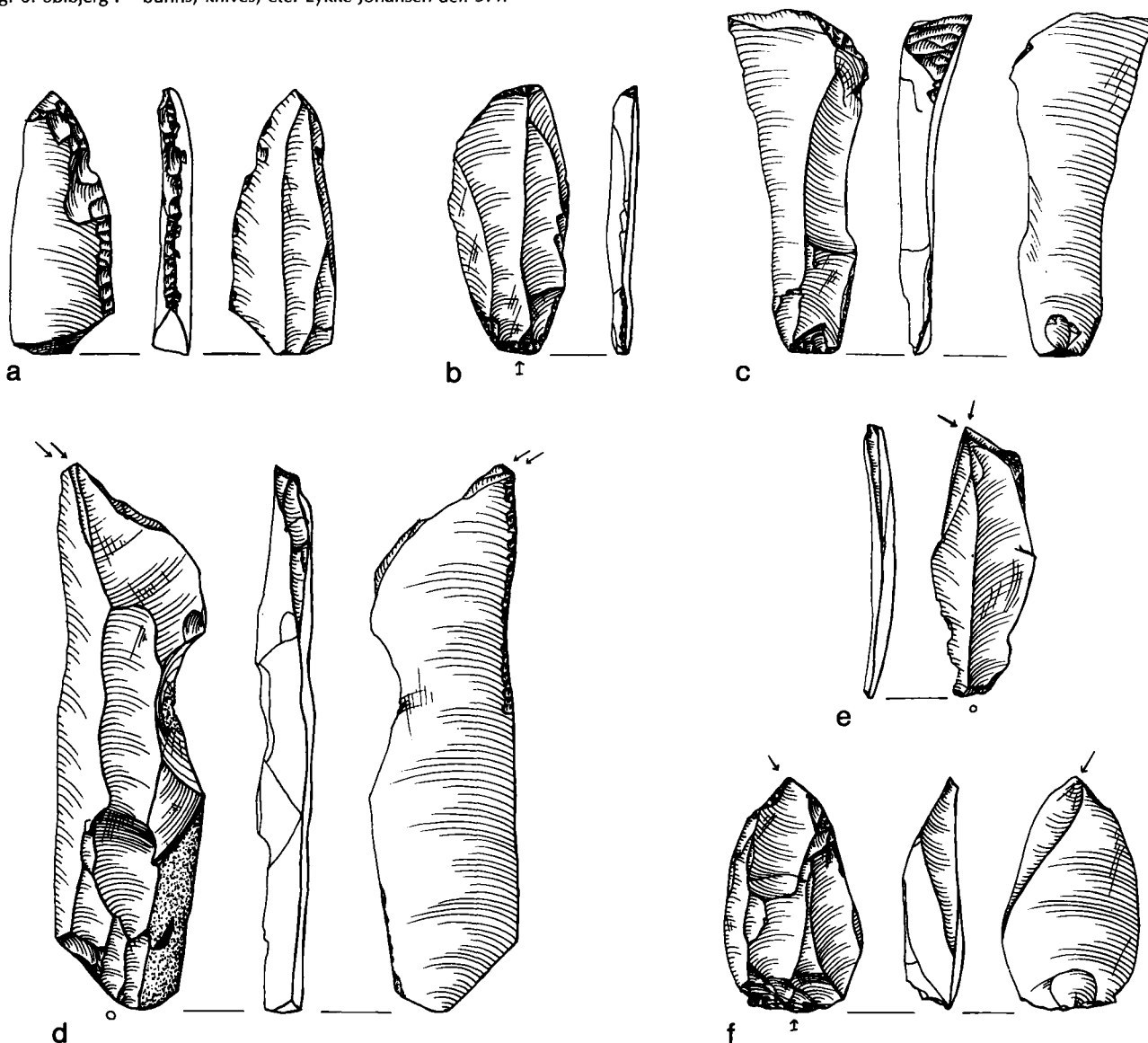
The preliminary investigations at Sølbjerg show that the site was subject to repeated occupation during the Hamburgian and Ahrensburgian phases. Finds from the two cultures lie at different levels on the hill, with the Ahrensburgian sites lying highest.

At Deimern (Taute 1968, fig. 4) and Ahrensburg (Bo-

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

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

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



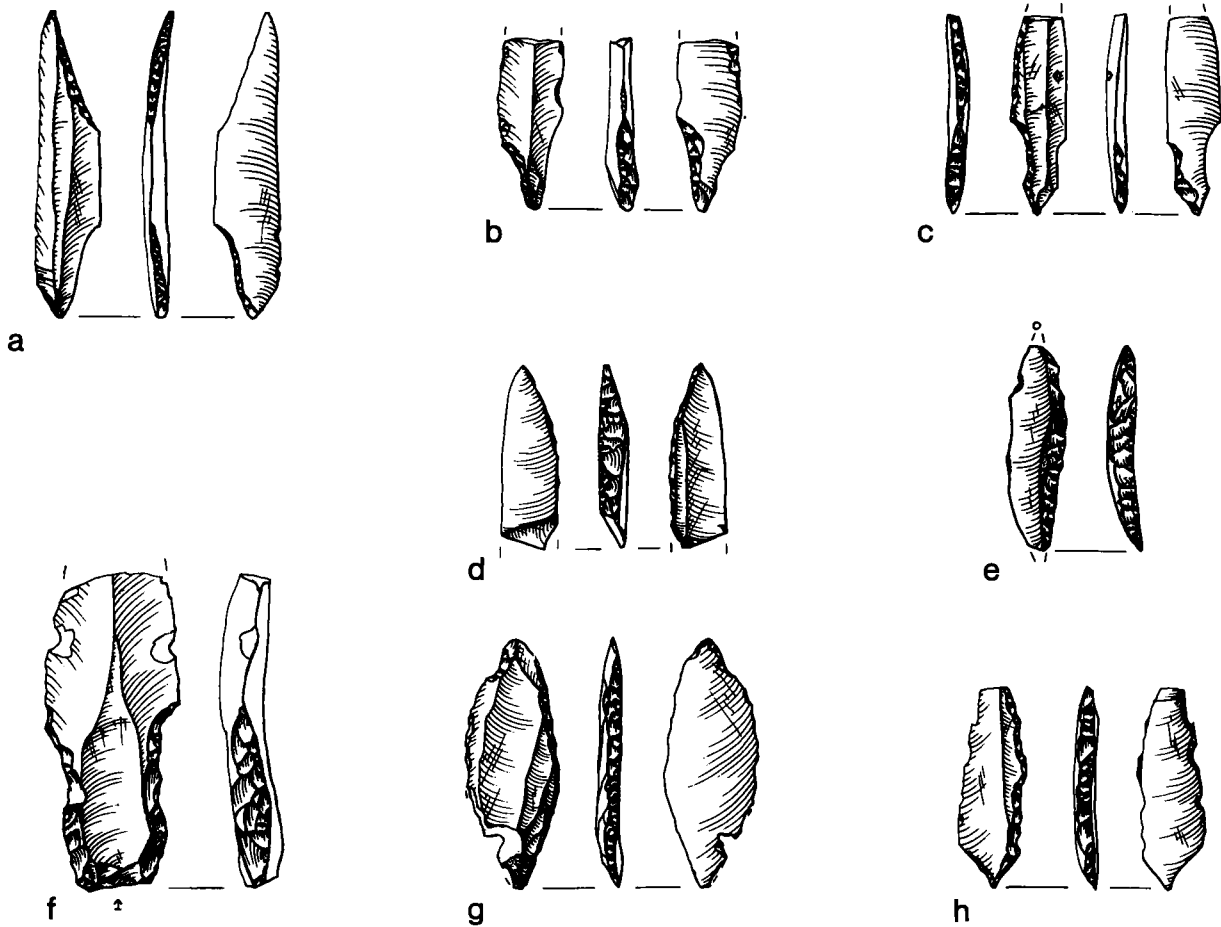


Fig. 7. Finds from survey on Sølbjerg – shouldered point (a), Havelte points (b–c), Federmesser (d–e, g–h) and Brommian point (f). Lykke Johansen del. 3:4.

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

#### REINDEER MIGRATION TOWARDS SØLBJERG (FIG. 8)

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

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

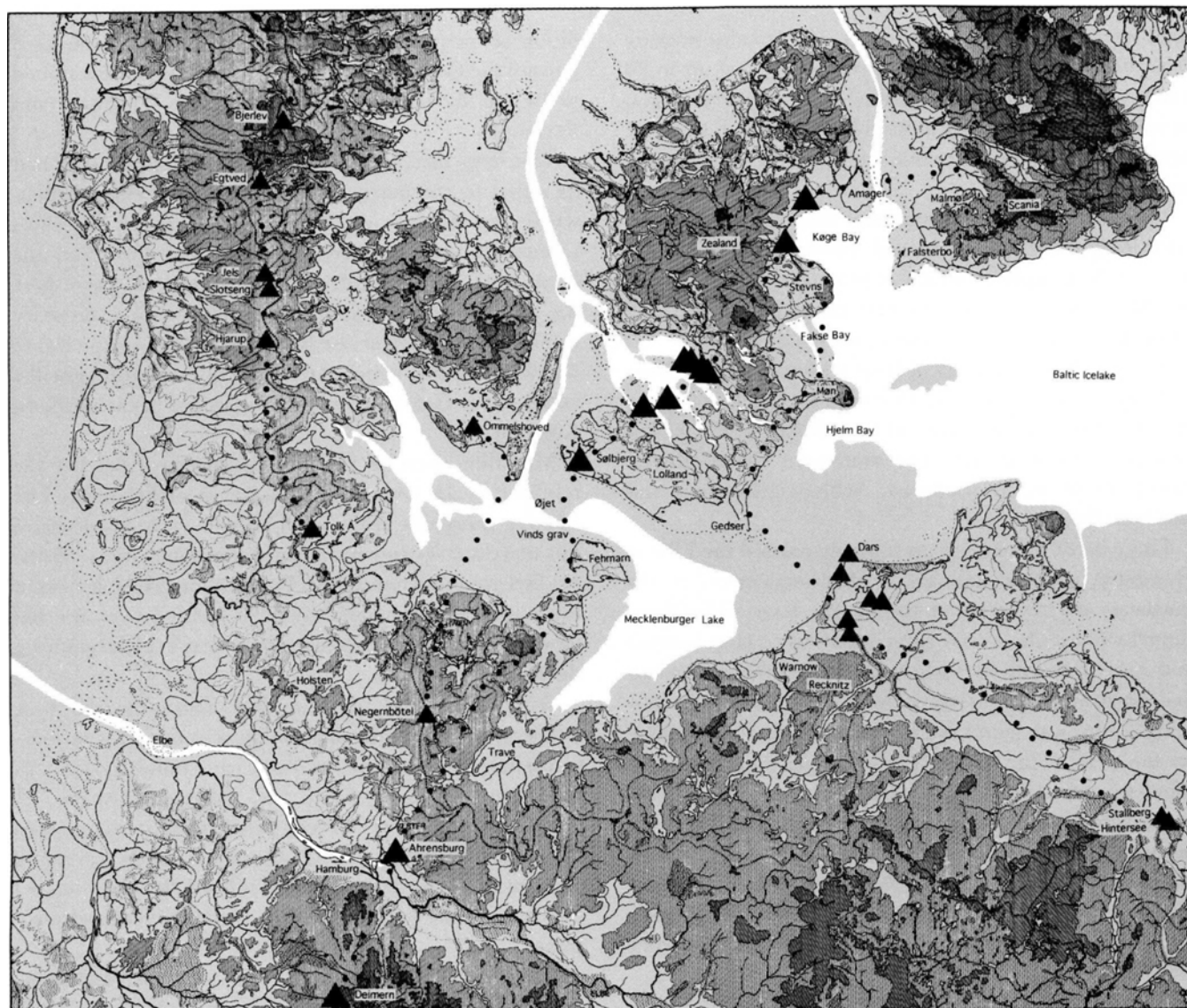


Fig. 8. Northern Germany and southern Scandinavia in Late Glacial times. Important settlement concentrations and suggested migration routes for reindeer.

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

In support of the theory that part of the European reindeer population spent the winter in southern Scandinavia is the fact that the animals, in this way, avoided swarms of irritating insects. In summer these would have had optimal growth conditions in the innumerable small pools and lakes in the moraine landscape. In winter the

reindeer could forage on the extensive frozen wetlands; exposed freeze-dried bog vegetation such as Bogbean (*Menyanthes trifoliata*) and Mare's Tail (*Hippuris vulgaris*) could have provided an important supplement to the reindeers' winter fodder.

In the early autumn, before the rut, reindeer are in prime condition and during the migration to their winter territory the animals were particularly exposed to attacks from hunters. In the autumn the males and females migrate together and the migration is more concentrated



than in the spring when the males and females migrate separately. The animals can run at a speed of up to 70 km/h, and in open terrain hunting is best between lakes, in valleys, and near other natural barriers which force the herd into narrow passages thus reducing the opportunities for escape.

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

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

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

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

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

Meltwater clay, gyttja and peat layers on the sea bed show that the water level in the Mecklenburger Lake lay 19–23 m under present sea level (Kolp 1965, figs. 18–19). In the first stages of deglaciation the basin was filled up with meltwater which deposited varved clay. Further ad-

dition of meltwater stopped when the icefront retreated beyond the Gedser-Dars moraines, but the lake continued to be fed by small rivers – the Trave, Warnow, and Recknitz.

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

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

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

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

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

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

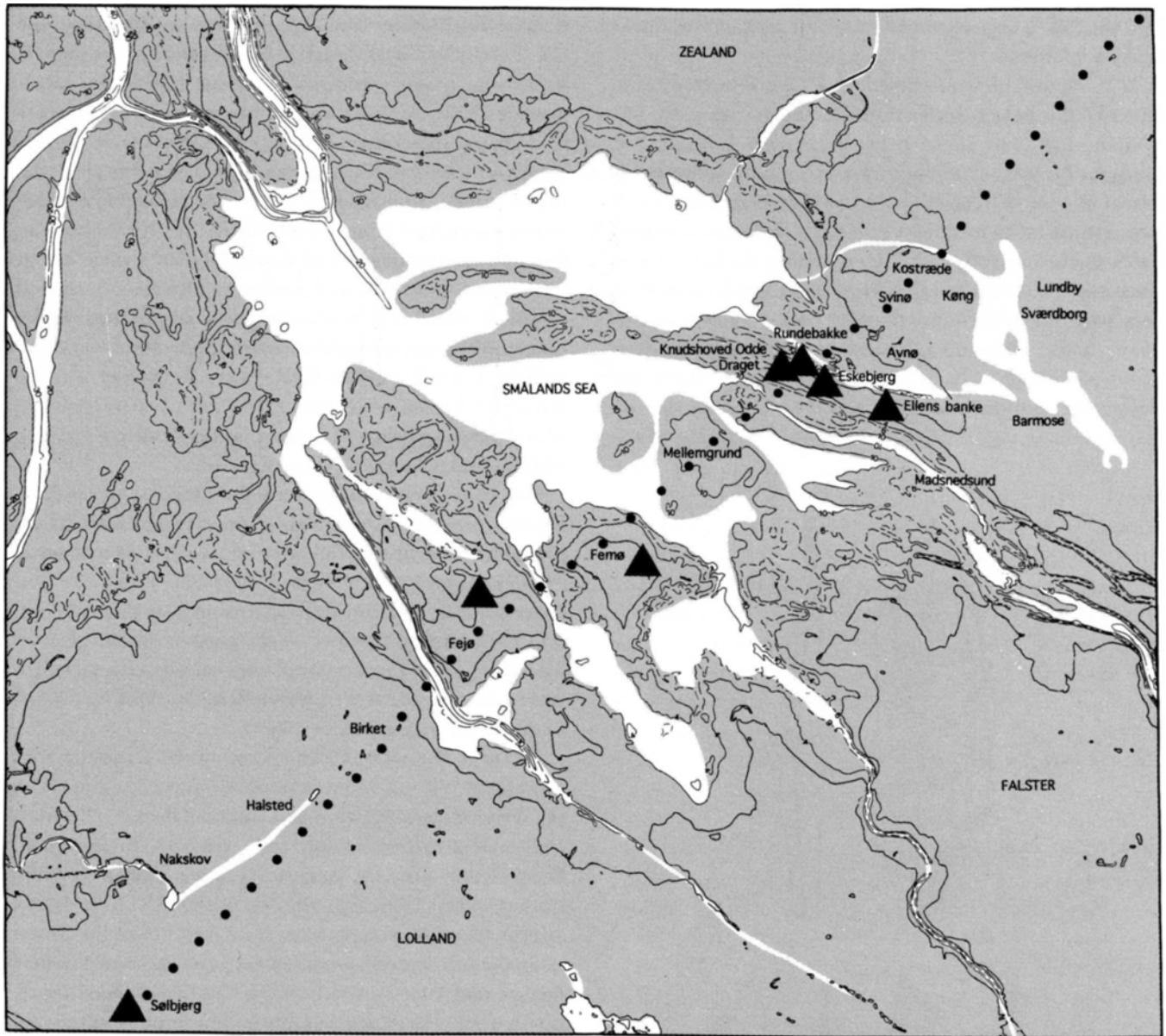


Fig. 9. Model for the Late Glacial landscape in the present day Smålands Sea with prehistoric finds and the suggested migration route for reindeer.

sea floor, supplemented by information about Late Glacial and Post-Glacial deposits from sea bed surveys,<sup>12</sup> we can reconstruct a landscape (fig. 9). This was penetrated by SE-NW oriented valleys and streams which flowed to the northwest, past Fejø and Femø and the submarine bank Mellemgrund, which were the highest points in the landscape. To the southwest of the islands there are several large submarine basins containing peat and clay sediments. In the Late Glacial Period these basins could have contained lakes or bogs. Drainage of these wet areas

was by way of streams which flowed to the northwest. The streams' narrow passages between the present-day islands and Mellemgrund offered obvious crossing-places for game, and the numerous stray finds of Brommian points from Femø and Fejø show that the hunters followed the movements of the animals from vantage points on higher ground. The finds<sup>13</sup> have mostly been collected by local inhabitants. It is possible that new systematic survey will bring the more insignificant Ahrensburgian and Hamburgian points into view. A stray find of a *Zinken* from

Fejøl (fig. 10)<sup>14</sup>, suggests in any case the presence of Hamburgian hunters.

This remarkable concentration of Late Glacial sites is undoubtedly linked to the migration of the animal herds over the low-lying areas between western Lolland and southern Zealand. The clay-rich end-moraine hills, which form the core of Knudshoved Odde, blocked the route from southwest to northeast in exactly the same way that the Sølbjerg sandhills did. We know that the area was of great importance for hunting from, for example, a series of sites with finds of robust tanged points.<sup>15</sup> These Brommian finds undoubtedly represent hunting stations (Fischer 1991:6). The settlement sites from which the Brommian hunters came apparently did not lie on

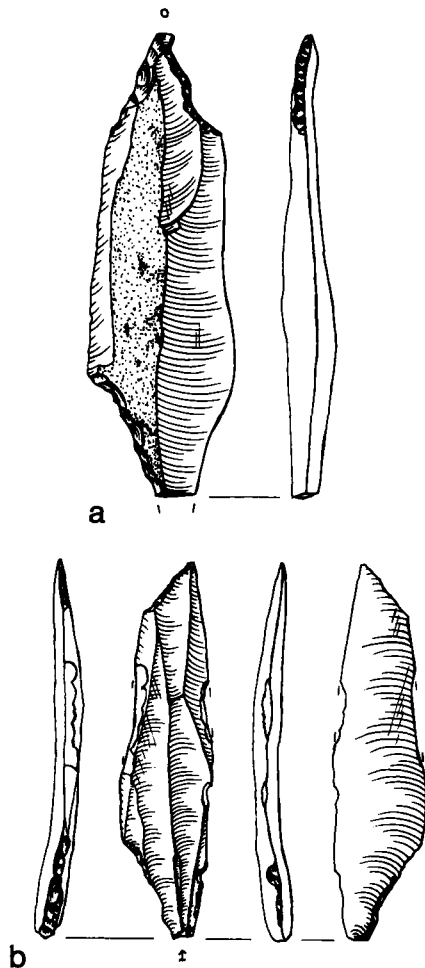


Fig. 10. Isolated finds of Hamburgian character from eastern Denmark – Zinken from Femøl (a) and point from Holmegårds Mose (b). Lykke Johansen del. 3:4.

Knudshoved Odde. The highest point on the Odde, the hill Eskebjerg, has though, in addition to numerous Brommian points, produced domestic refuse flint (Rasmussen 1972). A closer look at this material reveals that in addition to scrapers and burins there are retouched blades and five small tanged points of Ahrensburgian type (fig. 11c,f-i). A small trial excavation which John Rasmussen and Axel Johansson carried out on Eskebjerg in 1970, gave no further Brommian points, but instead a flint concentration was located under the plough soil, the full extent of which was not established. In addition to debitage, the concentration contained fragments of very thin blades, a small bipolar blade core, fragments of edge retouched blades, a scraper, a flake with scalene retouch, plus three fragments of small points, of which one is a certain Ahrensburgian point (fig. 11c).

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

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

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

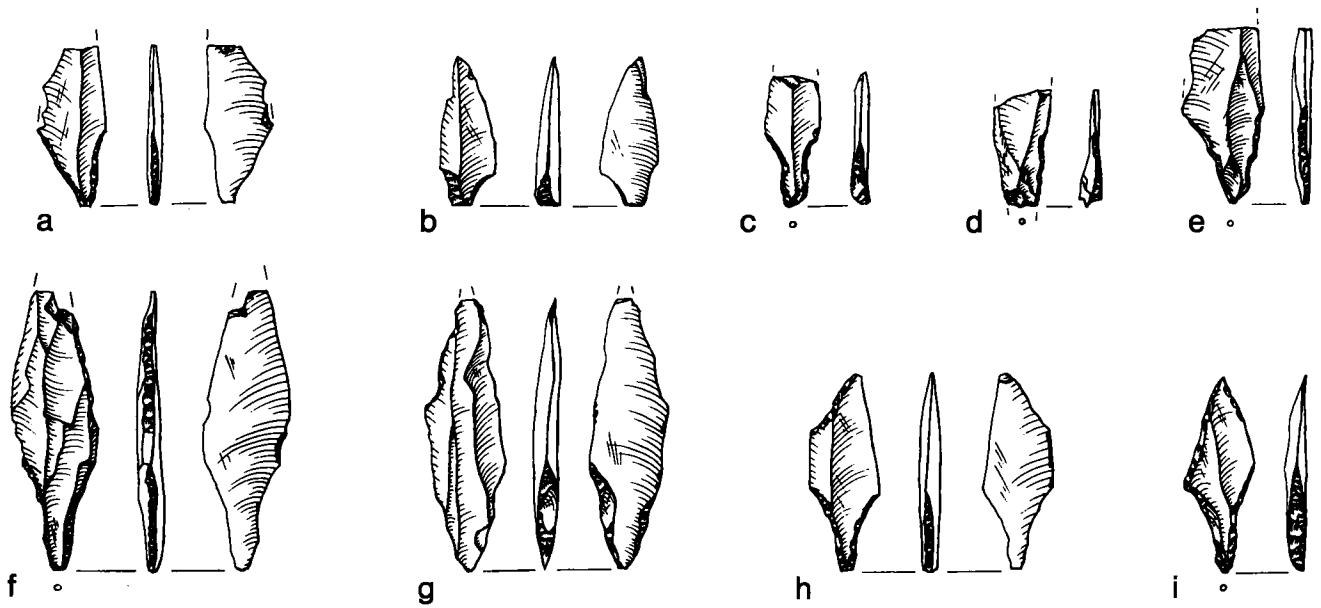


Fig. 11. Knudshoved Odde, southern Zealand – Ahrensburgian points from the site Draget (a, e), Paradiset (b) and Eskebjerg (c–d, f–i). Lykke Johansen *del.* 3:4.

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

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

#### REINDEER AND HUNTERS ON THE BALTIC ICE LAKE

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

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

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

A reindeer antler with a piece of skull attached, dredged from Fælleskov Rev south of Rødvig on Stevns (Degerbøl & Krogh 1959, pl. 1.) is the only evidence

for reindeer movement along the Baltic Ice Lake's now-submerged coast in Fakse Bugt. Further to the north however, in Køge Bugt, sand pumping has produced a remarkable number of Late Glacial finds of animal bones, in particular reindeer but also giant deer, elk and horse. The bones were pumped up from sand and gravel deposits at the edge of submarine bogs lying at a depth of 6–10 m.<sup>19</sup>

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

The level from which the gravel has been pumped up (a depth of 6–10 m) corresponds to the level of the hard chalk deposits between Amager and Malmø, over which the Baltic Ice Lake had its outlet. The apparent difference in level of 3–5 m between the Ice Lake's coastline in Køge and Fakse Bugt is presumably due to isostatic changes at the end of the Late Glacial. At this time the land rose considerably in the northern part of the Ice Lake's area, whereas the southern part is thought to have sunk. Surveys of the sea floor in the area east of the Gedser-Dars

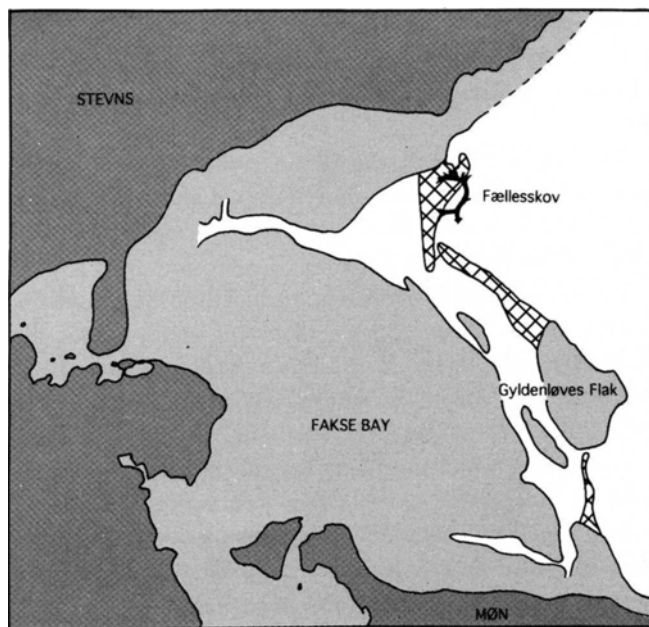


Fig. 12. Model for the Late Glacial landscape in the present day Fakse Bugt with find of reindeer antlers, islands, lagoons and beach ridges (after Jørgen Bo Jensen 1992).

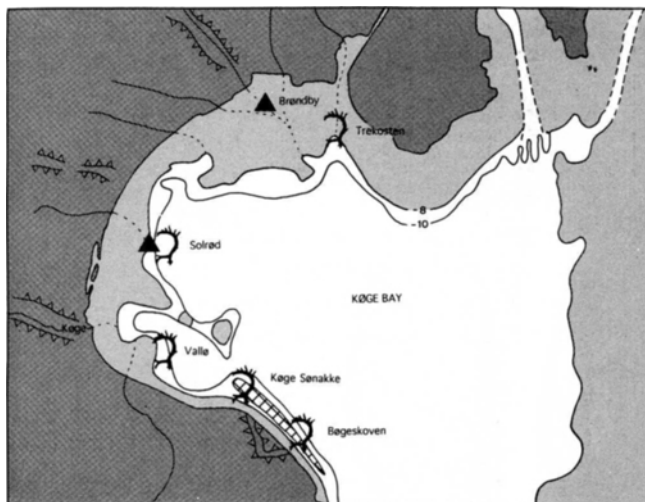


Fig. 13. Model for the Late Glacial landscape in the present-day Køge Bugt with finds of reindeer bones and flint from settlements. The most probable coastline for the Baltic Ice Lake lies at a depth of 8–10 m.

threshold, which the Ice Lake never transgressed (Kolp 1965, fig. 19), suggest that the maximum height of the Baltic Ice Lake in this region lay as much as 19 m below present sea level.

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

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

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

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

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

Despite the fact that this find of marrow-fractured reindeer bones<sup>23</sup> and an antler fragment worked in the “groove and splinter” technique characteristic of the Hamburgian Culture,<sup>26</sup> was unique in Denmark, the remains from Køge Bugt were forgotten and the material was never published.<sup>27</sup>

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

From the site “off Solrød Strand” there is a water-rolled piece with retouche, which with some reservation can be classified as an atypical Brommian point (fig. 15d). From



Fig. 14. Marrow-fractured reindeer bones and reindeer antler with “groove and splinter” technique from the locality “off Solrød Strand”. The antler has been dated to  $12140 \pm 110$  b.p. (Late Bølling).<sup>28</sup> Photo: Gerd Brovad.

the site “off Brøndby Strand” there is a small one-sided blade core (fig. 15e) with alternating platforms of a typical Late Glacial type (Taute 1968: 172; Fischer 1982, fig. 8). A few heavy blades and core waste show the careful preparation of the flaking edge and the hard, direct knapping technique which is particularly characteristic of the Brommian Culture. Amongst the few tools from the site “off Brøndby Strand” there are three scrapers of Late Glacial type made from irregular blades (fig. 15a–c).

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

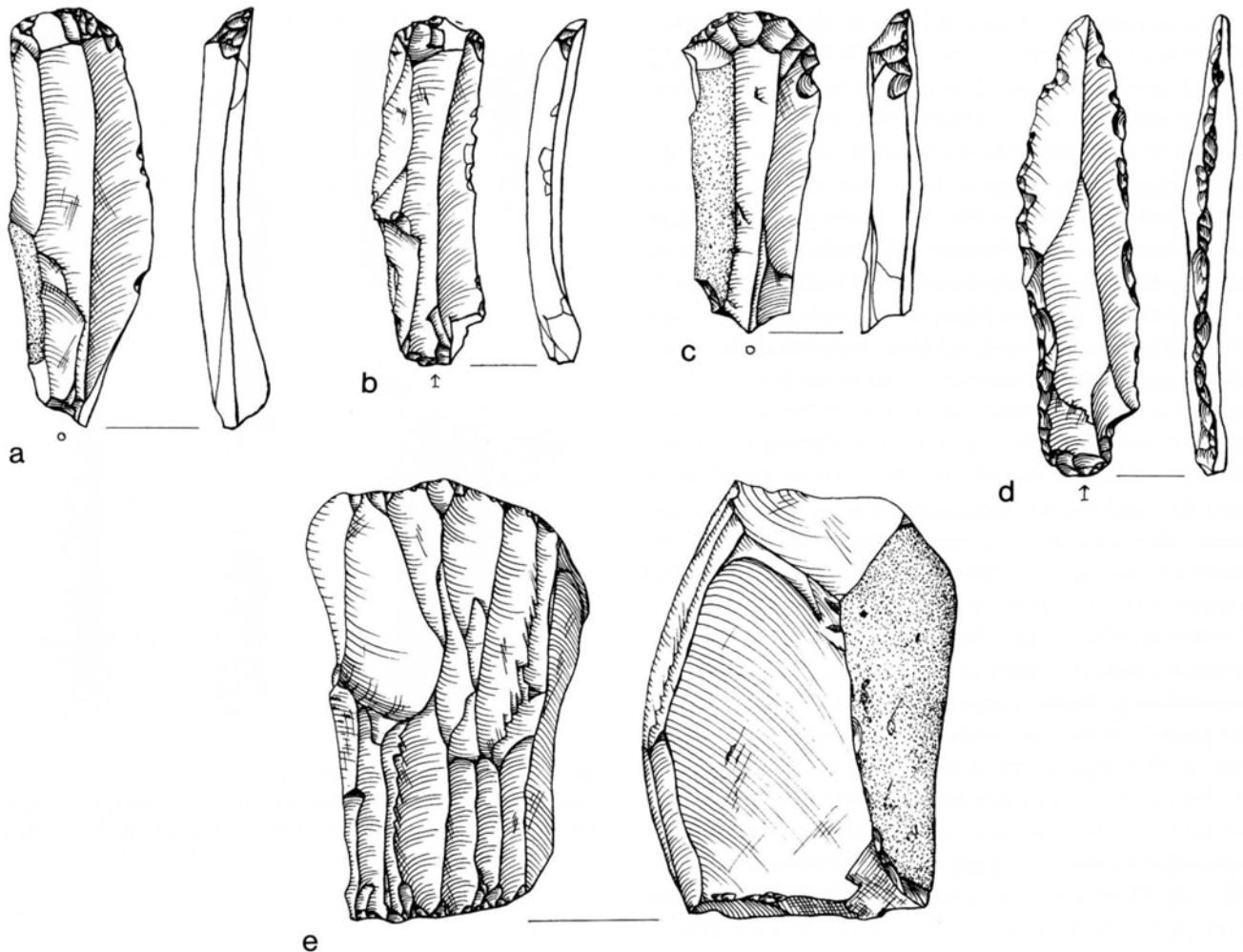


Fig. 15. Flint tools from submarine localities in Køge Bugt: "off Brøndby Strand" (a–c and e) and "off Solrød Strand" (d). Lykke Johansen del. 3:4.

#### THE LOCATION OF LATE-GLACIAL SITES ALONG REINDEER MIGRATION ROUTES

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

It was important for the reindeer hunters to position themselves along the animals' migration routes. Reindeer are normally very faithful to their usual routes and the

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

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

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

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

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#### NOTES

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



- stoffer og fredningsinteresser. SMÅLANDSHAVET. Oversigt" published by the Forestry and Nature Agency (Skov- og Naturstyrelsen), 1987.
18. The point (fig. 10b) was found by Axel Johansson at Trollesgave on the southwestern side of Holmegårds Mose. It is in the finder's private collection.
  19. Information about the circumstances of the find at the most important site "off Solrød Strand" is imprecise. Stoker E. Wagner, who made the first submission, described the find location thus in a letter to the Zoological Museum "A couple of kilometres off Solrød there is a large peat bog at a depth of 5–7 m. At the edge of this bog we pumped some good gravel". As to whether the bones come from the bog or the gravel on the edge of the bog is not stated. After talking to another submitter Captain G. Olafsson, museum curator Hans Norling Christensen noted that the finds were pumped up from 2–3 m under the sea floor and at a point where the water was c. 8 m deep (National Museum file no. 3522/81).
  20. In the report "Køge Bugt. Ressourceundersøgelser. Fase 1. Geoteknisk rapport. Nr. 4. ref. Nr. 4742–183. Dato 1987–02–27. Geoteknisk Institut" The Forestry and Nature Agency (Skov- og Naturstyrelsen) 1987, the results are reported of geological coring and seismic analysis of the sea bed. The Late Glacial landscape (fig. 13) represents a preliminary interpretation based on the report mentioned above.
  21. Bones of Late Glacial animals from the following localities in Køge Bugt (fig. 13) are stored at the Zoological Museum:
    - 1) "Off Solrød Strand". Numerous bones of reindeer, horse, elk, aurochs, roe-deer, wild-boar, sheep, domesticated cow, red deer, grouse – pumped up from the sea bed from a depth of c. 8 m. The Zoological Museum, University of Copenhagen (ZMK), 18/1935, 11/1936, 9/1938, and 5a 1961.
    - 2) "Trekosten" at the approaches to Kalvebod Strand. Bones of reindeer, red deer, roe-deer, cattle and great auk. Pumped up from gravel ridges of limited extent together with endless amounts of wood from a depth of more than 6 m. ZMK 220/1943.
    3. "Off Mosede harbour". Jawbone of giant deer, dredged up in the 1950s. ZMK 24/1987.
    4. "About 3 km off Vallø". Bones of several reindeer, taken up by the sand pumper "Balduur". ZMK 62/1947.
    5. "Off Køge Sønakke". Bones of reindeer, taken up by sand pumper. ZMK 35/1948.
    6. "Køge Sønakke off Bøgeskoven". Bones from at least four reindeer, taken up from a depth of 7–8 m by the sand pumper "Cap Vilano". ZMK 3/1981.
  22. The authors would like to thank Kim Aaris-Sørensen, Director of the Zoological Museum, and Dr. Henrik Tauber, formerly head of the Copenhagen Radiocarbon Dating Laboratory for permission to cite the four radiocarbon dates for the bone material from Køge Bugt.
  23. In June 1947 the newspaper headlines read "10.000 year old settlement on the bottom of Køge Bugt" (Socialdemokraten), "Settlement from Tundra times on the bottom of Køge Bugt" (Roskilde Avis), and "Settlement eight metres under Køge Bugt" (Fyns Stiftstidende).
  24. Norling Christensen wrote the following in a letter to Captain Olafsson on the 11 June 1947: "With regard to the dating of the finds, it is presumed that they belong to the Ertebølle Period".
  25. Jørgen Holm is presently engaged in an investigation on behalf of the National Museum at a Late Glacial settlement complex at Slotseng in southern Jutland. In 1991 a kettle hole was located which contained reindeer antlers and bones (Holm 1993, this volume).
  26. The "groove and splinter" technique is traditionally linked with the Hamburgian Culture, whereas the finds from Stellmoor show that reindeer antler in Ahrensburgian times was normally fractured using coarser methods such as blows and splitting. A few well-dated finds show however that the "groove and splinter" technique was also known in the Younger Dryas (Taute 1968, 206).
  27. The Late Glacial finds from Køge Bugt and their possible relationship to the Baltic Ice Lake's submerged coastline were discussed by Peter Vang Petersen in a lecture "New information about the early Stone Age in the Øresund – results of an interdisciplinary study" given to a meeting of "Det Kongelige Nordiske Oldskriftselskab" on 15 February 1983.
  28. After finishing this manuscript we received from the AMS Laboratory, Institute of Physics and Astronomy, University of Aarhus, the date  $12140 \pm 100$  b.p. (AAR-1036) of the antler with "groove and splinter" technique. This result shows that man operated along the shores of the Baltic Ice Lake in the Late Bølling, and that we can expect to find Hamburgian sites as far northeast as North Zealand and perhaps in Scania.
  29. The finds from Køge Bugt are stored at the National Museum: A 42009–21, A 44452, A 51165, and A 51166. It is clear that the material has undergone significant sorting and large intact pieces are in the majority. The fact that not all flint was collected is revealed by Captain G. Olafsson in a letter to the National Museum dated 15th June 1947, in which he writes "We are still pumping up more small blades but unfortunately no larger ones".
  30. The Hamburgian sites of Jels and Slotseng in Jutland (Holm & Rieck 1987; Holm 1993) lie on opposite sides of Oksenvad Cattleford Parish.
  31. The Ommelshoved find (Holm 1972) is very reminiscent in its composition of the Brommian finds from Knudshoved (Fischer 1991, fig. 13:8 and 22).
  32. See Taute 1968 maps 3–4, localities 177–186 in Kreis Ribnitz-Damgarten.
  33. The drainage of the Baltic Ice Lake through Øresund appears to be unchanged from about 12700 b.p. until about 10300 b.p. (Bergstein & Nordberg 1992).

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