

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

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

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

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

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

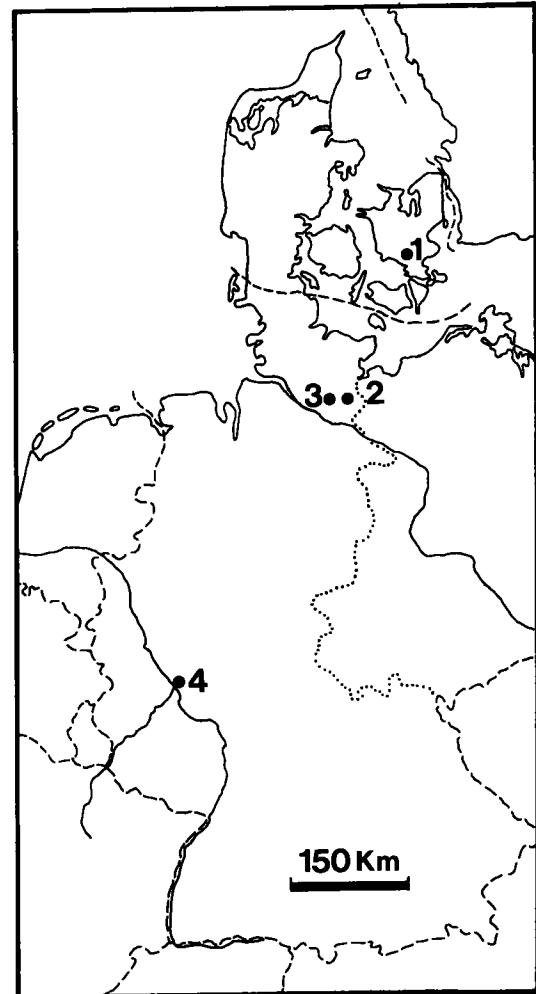


Fig. 1. C-14 dated Danish and German sites mentioned in the text. 1. Trollesgave, 2. Duvensee 8, 3. Stellmoor, Meiendorf and Poggenwisch, 4. Gönnersdorf.

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

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

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

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

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

At the time of excavation, attempts were also made to date the Late Glacial sites in the Stellmoor valley by pollen analysis. In this way the sites representing the Hamburgian Culture were placed in the Oldest Dryas (Schütrumpf 1937, 1943, 1958). Later investigations (Usinger 1975) have shown that the habitation layers

more likely belong to the Bølling period. However, the synchronism, and therefore the absolute age, of the early Late Glacial pollen zones in northwestern Europe is still under discussion, and correlation with C-14 dated pollen zone borders at other localities may therefore be somewhat uncertain.

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

New samples for C-14 dating

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

found at Stellmoor, and from the finds of Hamburgian industry at Stellmoor, Meiendorf, and Poggenwisch.

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

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

C-14 dating of the Ahrensburgian and Hamburgian Cultures

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

Stellmoor, Ahrensburgian Culture

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

Stellmoor, Hamburgian Culture

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

Meiendorf, Hamburgian Culture

K-4329	Antler of reindeer attached to cranial bone. Meiendorf, "Md.2. 34 U14". Provenance cat. 1. $\delta^{13}\text{C} = -18,3\%$	12360 \pm 110 b.p.
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K-4330 Marrow split bone (humerus) of reindeer. Meiendorf, "341 ~ humerus". Provenance cat. 2.
 $\delta^{13}\text{C} = -18,3\text{‰}$

Poggenwisch, Hamburgian Culture

K-4331 Bone of reindeer (epistropheus). Poggenwisch, "J₂ H₂". Provenance cat. 2.
 $\delta^{13}\text{C} = -18,8\text{‰}$

K-4332 Bone of reindeer (atlas). Poggenwisch, "J₁ H₁". Provenance cat. 2.
 $\delta^{13}\text{C} = -18,6\text{‰}$

K-4577 Bone of reindeer (vertebra) with butchering traces and marks of gnawing by carnivore. Poggenwisch, "L". Provenance cat. 2.
 $\delta^{13}\text{C} = -17,4\text{‰}$

Evaluation of the C-14 dates

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

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

only previous C-14 date from this layer (W-262, 9500 ± 200 b.p.), and somewhat younger than expected from the pollen analytical dating, although the new C-14 dates are not in disagreement with the pollen analytical evidence.

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

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

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

Such an interpretation can be supported by ethnographic parallels. During the Younger Dryas the partly

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

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

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

Perspectives for cultural relations

The new C-14 dates of the Hamburgian Culture sup-

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

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

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

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

The new C-14 dates indicate that the Hamburgian

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

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

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

The new C-14 dates of the Ahrensburgian layer at Stellmoor demonstrate that only a surprisingly short

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

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

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

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