

THE MIDDLE PALAEOLITHIC OCCUPATION OF EUROPE

edited by
Wil Roebroeks and
Clive Gamble



UNIVERSITY OF LEIDEN 1999

Wil Roebroeks
Alain Tuffreau

7 Palaeoenvironment and settlement patterns of the Northwest European Middle Palaeolithic

1. Introduction

The area at stake in this paper, continental northwestern Europe, has its earliest traces of occupation going back to Oxygen Isotope Stage (OIS) 13 to 15 (Roebroeks and Van Kolfschoten 1994; Tuffreau and Antoine 1995). Middle Palaeolithic industries, as characterised by the occurrence of fully developed Levallois technology, seem to start about 300,000 years ago, in OIS 8 and continue up into OIS 3, thus encompassing a period of roughly 250,000 years (Tuffreau 1992).

Many sites from both the Lower and the Middle Palaeolithic are known in the area which played a pioneering role during the early development of prehistoric archaeology. Fieldwork in caves near Liège led Schmerling to the conclusion that humankind had co-existed with now extinct animals long before the Earth had assumed its 'modern' form, but it was many years of work by Boucher de Perthes, in the Somme valley, that eventually convinced the wider scientific community of such a co-existence.

Since the days of these pioneers much research has been done on the Palaeolithic archaeology of the area, and on its geological context. As a result, the various loess- and river terrace sequences from main river valleys, such as the Somme, Meuse and Rhine, are known in quite some detail. Palaeolithic archaeologists working in this area can use these sequences to correlate sites within time slices. These are, in general, finer than those at disposal in, for instance, the classical Aquitaine-caves area (Turq, this volume). But despite many advances in the stratigraphy of loess- and river deposits, and despite improvements in, for instance, biostratigraphy (Van Kolfschoten 1990a) and chronometric dating methods (Aitken 1990, 1995), the structure of the regional archaeological record nevertheless makes working with fine 'ethnographic' time slices impossible: assigning Middle Palaeolithic sites to time units finer than 20,000-30,000 years is currently not feasible, with the exception of the Eem interglacial, where palaeoenvironmental data give us a finer chronological resolution, of about 10,000 years. Parallel to this low chronological resolution on a regional level (cf. Stern 1993 for the East African Lower Palaeolithic record), our region contains many sites where we can observe ethnographic 'snapshots' of five minutes of

flintknapping or of a short butchering episode: Biache-Saint-Vaast and Maastricht-Belvédère are just two examples, both from (respectively the end and the beginning of) OIS 7 (see below). Both site complexes are also time averaged accumulations of material remains, of minutes, days, years, up till thousands of years, depending on the specific excavation areas, find levels and/or the geological positions one is referring to.

In this paper we will present evidence on the environmental backgrounds in which people were present and sites were formed in the Middle Palaeolithic (Section 3). We will try to distill some information from the former use of these landscapes in the Middle Palaeolithic (Section 4), bearing in mind that the low chronological resolution mentioned sets serious limits to studies of the ways former groups moved through the various landscapes. The sites that yield the primary data are present in sedimentary envelopes, and any consideration of their evidence needs a critical evaluation of such sedimentary contexts (cf. Mussi, this volume). We will start our paper therefore with a brief evaluation of sedimentary contexts and the chronological positioning of sites (Section 2).

2. The sedimentological setting

Middle Palaeolithic sites have been recovered from various sedimentary settings in this area, each with individual histories of site preservation, and hence with specific consequences for interpretation of the archaeology. Fine-grained river and lake deposits are ideal envelopes for a good preservation of flint- and bone scatters. This is exemplified by the intra-Saalian (OIS 7) river-valley sites of Maastricht-Belvédère and Biache-Saint-Vaast, or the last interglacial (OIS 5e) lakeshore locale Lehringen, one of a series of Eemian lakes in the northern part of Germany, in a landscape 'bulldozed' by the Saalian inland-ice in OIS 6. Travertine springs encase archaeological finds, leading to a very good preservation of organic remains at sites such as Ehringsdorf and Stuttgart-Bad Canstatt. More common are sites in a loessic matrix, such as at Biache-Saint-Vaast (upper levels), Riencourt-les-Bapaume and Beauvais in northern France, Rheindahlen, Ariendorf and the Neuwied Basin volcano sites in Germany, and Maastricht-Belvédère Site J in the

Netherlands. Karstic envelopes are especially well known from Germany (e.g., the Feldhofer Grotte with the Neanderthal remains) and from Belgium, where a large number of cave sites, including the famous one at Spy, were excavated during the nineteenth century. In northern France, such caves are only rarely visible, as a result of the thickness of the loessic cover (the Abri de la Grande Chambre near Hydrequent (Boulonnais, Pas-de-Calais) being an exception). Finally, head sediments preserved traces of occupation at sites as La Cotte de St. Brélade (Jersey), Cotentin and Le Mont Dol (Brittany).

The various sedimentary settings have implications for the character of the archaeology preserved at different locales, as the rate of sedimentation is an important factor in the genesis of (stratigraphically defined) assemblages. A low sedimentation rate may for instance lead to the formation of palimpsest assemblages, such as seems to be the case in many caves, whereas a high sedimentation rate can result in a stratigraphic isolation of short depositional events. At multi-level sites, such as Biache-Saint-Vaast for instance, the differences in artefact densities documented throughout the sequence are at least to some degree related to changes in rates of sedimentation, with high rates of sedimentation creating 'poor' find levels, and low sedimentation rates or phases of stability causing an accumulation of cultural materials and thus 'richer' levels. Environments with a high degree of semi-continuous sedimentation can be expected to yield highly variable assemblages because of the resulting *stratigraphic isolation* of events. In the open air, such environments are also more suitable for *horizontal isolation* of depositional events, such as those recorded at Maastricht-Belvédère, which are less likely to occur in spatially constrained locations such as caves and abris.

Sediments furthermore differ in terms of climatic biases, i.e. in the range of climatic conditions that they are bound to document. Loess, a sediment deposited under dry and generally cold climatic conditions, generally will not preserve any interglacial occupation in a form that will be recognisable as such, whilst head and karstic settings have a greater range. The greatest range of climatic documentation is provided by fine-grained fluvial deposits. Well-preserved sites dating to temperate periods can only be found in such deposits, whereas travertines exclusively date from warm-temperate settings (OIS 7 and OIS 5e) in our working area. In actual fact, the last interglacial (OIS 5e) here is virtually only known from travertine and lacustrine sediments, and hardly from any river deposits, in contrast to earlier interglacials. In the case of the Netherlands, this may be related to the specific sea level rise history of the Eemian. As a result of this, major rivers only reached an equilibrium profile late in the Eemian, and thus only little sediment was deposited as

compared to earlier interglacials. Such factors have to be dealt with when charting the presence and absence of Palaeolithic hominids over Pleistocene landscapes.

It is also worthwhile stressing here that the majority of terrestrial sedimentary sequences are dominated by *hiatuses*, and that in general only small parts of Pleistocene time are represented by deposits in such terrestrial settings. This may sound like a trivial observation, but judging from the way sections of archaeological sites are often interpreted, many workers still seem to assume that sedimentary sequences were formed very gradually and that they represent Pleistocene time in an almost linear way. In actual fact, many studies suggest that terrestrial sedimentation was rather *episodal*, with short pulses of high sedimentation rates separated from each other by long intervals of stasis and/or erosion (cf. Turq, this volume, for a comparable view on the geological record of the Aquitaine area).

Finally, we have to bear in mind that the largest part of Middle Palaeolithic finds in this area were retrieved from surface scatters, generally believed to be of little relevance for the study of early human behaviour. This kind of evidence has been neglected for a long time, and although systematic studies are in their infancy, preliminary results are very promising in terms of the informative value of surface sites (Kolen *et al.*, this volume).

3. The environmental background to Middle Palaeolithic occupation

3.1 INTRODUCTION

The environmental tolerances of the Middle and Late Pleistocene occupants of northern Europe, where climatic fluctuations of the Pleistocene had a huge impact, have been dealt with in quite some detail by various workers (e.g., Gamble 1986, 1987, 1995; Roebroeks *et al.* 1992a; Tuffreau 1992; Gamble and Roebroeks, this volume). These contributions basically deal with the question of whether 'archaic' hominids were able to survive in interglacial, forested environments, or whether they were limited to open steppe environments, where large herds of prey species afforded a considerable natural 'fall-out' for the scavengers that some workers hold them to have been. The environmental setting of the Palaeolithic occupation of the area reviewed here has been presented and extensively discussed in a review by Roebroeks *et al.* (1992a). That paper, and the comments upon it, treated in considerable detail such topics as the palaeo-ecological assessment of landscapes, the variability of interglacials (e.g., oceanic high sea-level interglacials versus more 'continental' low sea level ones, see Zagwijn 1989) and the relationship between various climatic settings and post-depositional processes. The following survey is based on the Middle Palaeolithic evidence presented in that *Current Anthropology* paper, updated and with some additional

remarks, especially on sites in Northern France (cf. Tuffreau 1992).

3.2 THE SAALIAN 'MIDDLE PALAEOLITHIC' (OIS 8 TO 6) Early Saalian artefacts have been recovered from deposits in the Karl Schneider quarry at Ariendorf (Middle Rhine area, Germany). Silty deposits in the top part of Rhine Middle Terrace sediments yielded a small lithic assemblage associated with fauna dominated by horse, woolly rhinoceros and large bovids (Ariendorf 1), comparable to fauna recovered from loess deposits in the Neuwied Basin (Turner 1986, 1989). The mega- and micro-mammalian fauna indicate an open environment with herbaceous vegetation during a very cold climatic phase. Among the Ariendorf 1 small mammals, ground squirrel (*S. cf. undulatus*), hamster (*C. cricetus cf. praeglacialis*), and the lemmings *D. guillemi* and *Lemmus lemmus* are present. These species live in either open tundra or steppe biotopes (Van Kolfschoten 1990a, b) today. On the basis of the loess stratigraphy and the biostratigraphy of the small mammals, the site may date to the first cold phase of the Saalian (OIS 8), and the Ariendorf fauna is one of the first occurrences of the mammoth-steppe fauna (Gamble and Roebroeks, this volume; Guthrie 1990).

Evidence for relatively early 'cold period' settlement of Northern Europe also comes from a site in south-central Belgium, Mesvin IV, near the city of Mons (Cahen and Michel 1986). This site within the Mesvin terrace has yielded a concentration of Middle Palaeolithic artefacts and bones. Both the flints and the bones have been subjected to lateral displacement, but the large number of refitted artefacts, the freshness of the artefacts, and taphonomic study of the bones (van Neer 1986) indicate that disturbance was minimal. Mammoth, woolly rhinoceros, horse, reindeer, bison, and Arctic fox, among other species, comprise this early Saalian fauna, indicating that the hominid occupation took place in a cold and open, probably steppe-like, environment.

Since 1980, a series of well-preserved archaeological sites have been excavated at the Maastricht-Belvédère loess and gravel pit (Roebroeks 1988; Roebroeks *et al.* 1992b). The pit is located at the southern tip of the Netherlands, in the northern zone of the European loess belt. The main find layer is situated in fine-grained fluvial deposits of the River Maas that have been dated by several independent lines of evidence (e.g., biostratigraphy, electron spin resonance (ESR) and thermoluminescence (TL). The interglacial Middle Palaeolithic industry, sometimes associated with faunal remains, has a TL date on burnt flints of $250,000 \pm 22,000$ years bp (Huxtable 1993). The conjoining studies of the lithic assemblages have yielded spectacular results, clearly pointing to the *in situ* character of the assemblages. The interglacial character of the hominid occupation is well attested by the vertebrates, with *Ursus* sp., straight-tusked

elephant, steppe rhinoceros, red deer, roe deer, and giant deer present, together with the garden dormouse *E. quercinus*, *C. glareolus* and *E. orbicularis*, and alongside more than 70 species of molluscs, and charcoal of ash (*Fraxinus* sp.) and oak (*Quercus* sp.) (Van Kolfschoten and Roebroeks 1985; Roebroeks 1988; Vandenberghe *et al.* 1993). According to the results of the malacological analyses, hominid occupation took place in the climatic optimum of the interglacial (Meijer 1985).

The travertine quarries at Ehringsdorf, near Weimar, have been producing large amounts of faunal remains for almost two centuries (Steiner 1979). The age of the lower and upper travertines has been repeatedly debated (e.g., Steiner 1979; Cook *et al.* 1982; Mania 1988). Judging from the small mammals (Van Kolfschoten 1990a), the lower travertines seem to pre-date the Eemian interglacial and may correlate with the interglacial deposits at Maastricht-Belvédère. Uranium-series dating of the occupation layers with ash and charcoal in the lower travertines seems to support this OIS 7 interpretation, giving ages in the range of 200 to 250 Kyr bp (Brunnacker *et al.* 1983; Blackwell and Schwarcz 1986; Schwarcz *et al.* 1988). Excavations in the lower travertines revealed six *in situ* archaeological horizons associated with cranial and post-cranial remains of several hominid individuals. The large amounts of floral and faunal remains overwhelmingly point to fully interglacial conditions for the lower travertines. More specifically, studies of the floral remains have placed the occupation layers in the climatic optimum of this interglacial, the mixed-oak forest phase (Steiner 1979).

The travertines from Stuttgart-Bad Cannstatt are probably comparable in age to the lower travertines at Ehringsdorf. Leaves and fruits of *Buxus sempervirens* and remains of *E. orbicularis* are only two indicators of the interglacial character of the travertines and their enclosed archaeological remains. We can furthermore mention the presence of *Quercus robur*, *C. betulus*, *Ulmus* sp., cf. *Pterocarya fraxinifolia* and *Fraxinus excelsior* among the floral remains and *D. kirchbergensis* and *E. antiquus* among the fauna (Wagner 1984, 1990; Adam *et al.* 1986).

The end of Stage 7 and beginning of the following cold stage, of the Saale complex (OIS 6), are documented at the important site of Biache-Saint-Vaast, between Arras and Douai in Northern France. This multilevel site was excavated during the seventies, in a series of rescue operations (Tuffreau and Sommé 1988). The fluvial deposits of a lower terrace of the Scarpe River, and the lower part of its loessic cover, yielded a very rich Middle Palaeolithic industry and large amounts of faunal remains, among which two fragmentary human skulls were identified. The mammalian fauna is dominated by bovids, rhinoceros, and bear, altogether representing 90% of the identified remains (Auguste 1988). Auguste's study of the faunal assemblage from level II base

(the upper part of the fluvial deposits) shows that the majority of the animals were adults, and represented by all body parts, which is interpreted as evidence for hunting activities. Biache could constitute one of the few Palaeolithic sites with evidence for bear hunting (Auguste 1992). Cut marks are frequent on the bones of rhinos, bovids and especially bears, where cutmarks on the metapodes could indicate that the hominids were after their furs. The stratigraphy of the site indicates a Saalian age, which agrees well with the results of absolute dating: a TL date on burnt flints places the site at 175 ± 13 Kyr bp (Aitken *et al.* 1986), while one of the human skulls has been dated by non-destructive gamma-ray spectrometry at $253 \pm 53/37$ Kyr bp (Yokoyama 1989). Studies of the biological remains recovered from the Biache sediments (vertebrates, molluscs, and pollen) show that hominids were there during an interglacial phase (IIA, fine-grained fluvial deposits), and just after the end of an interglacial. This would be during 'cool-temperate' or 'boreal-continental' early glacial conditions, intermediate between the full interglacial conditions at Maastricht-Belvédère, Ehringsdorf, and other sites discussed above and the cold period sites described below (cf. Tuffreau *et al.* 1982).

The site of Beauvais (La Justice) may be one of the rare northern French sites that possibly testifies to human occupation in a steppic context during OIS 6 (Locht *et al.* 1995), although recent dating studies seem to position this site in OIS 4. Flint artefacts were recovered in association with remains of reindeer, woolly rhinoceros, horse (*Equus cf. germanicus*), mammoth and bison (*Bison priscus*). The site is at the foot of a tertiary hill, below aeolian sands with possible traces of last interglacial (Eemian) and Early Weichselian soils.

Above the Ariendorf 1 find level mentioned above is a second archaeological level (Bosinski *et al.* 1983; Turner 1986) in a Saalian loess unit, Ariendorf 2. Here, a small, partially conjoinable lithic assemblage, consisting of simple flakes made from local raw material, was associated with a dense concentration of bone, also dominated by horse, woolly rhinoceros, and large bovids. This fauna again indicates occupation in an open environment with herbaceous vegetation during a cold climatic phase. The biostratigraphy of the assemblage points to a late Saalian age, possibly OIS 6.

In the Neuwied Basin, just to the south of Ariendorf and across the Rhine, there is a group of Middle Pleistocene volcanoes whose loessic crater in-fillings often contain stone artefacts and humanly modified faunal remains (Bosinski *et al.* 1986). Although the taphonomic context of these sites is not always very clear, three of them, the Schweinskopf-Karmelenberg, Tönchesberg 1, and Wannan volcanoes, have yielded clear evidence for occupation of a cold and open steppic environment during the penultimate glaciation (Justus *et al.* 1987; Conard 1990; Schäfer 1990). Woolly rhinoceros,

mammoth, reindeer, and Arctic fox are among the faunal remains at these sites, while find horizon 5 at Schweinskopf and the loess at Wannan and Tönchesberg I contained fossils of *D. guillemi* and *L. lagurus*.

For decades, the loess sections in a pit near Achenheim, in the French Upper Rhine Valley, have yielded, among the many find horizons, important evidence for cold period habitation during the penultimate glaciation (Wernert 1957; Heim *et al.* 1982). Excavations in the 1970s uncovered new archaeological finds from 'Sol 74', also dating to the penultimate glaciation (Thévenin and Sainty 1974), including the remains of mammoth, reindeer, and horse.

Another site, on the western fringe of Europe, also contains evidence of human occupation under cold conditions: La Cotte de St. Brélade on Jersey (Callow and Cornford 1986). The site is on an island now, but in colder periods, the low sea levels allowed the island to connect to the main European continent. Rich occupation debris was found in the loessic matrix of late Saalian (Stage 6) layer A, in association with a fauna including mammoth, woolly rhinoceros, horse, and reindeer. At the base of the overlying loess deposit (layer 3), excavators found a concentration of bones, from several rhinos and mammoths, associated with flint artefacts. A similar situation is seen in layer 5, where occupation debris was present at the base of a second boneheap. Loess (layer 6), deposited under extremely cold climatic conditions, immediately follows the bone concentration in the stratigraphic sequence. In layer 5 as well as in layer 6, *Dicrostonyx* and *M. gregalis* are present, leading Chaline and Brochet (1986) to infer that these layers were formed when the area was covered by a cold windswept steppe, 'a typical environment of the periglacial zone'. Scott's (1986) study of the boneheaps indicates that the bones of each level accumulated during single occasions, and were covered by loess soon after deposition. The bones must have been blanketed with loess while their surfaces were still in excellent condition, with some elements remaining articulated. This clearly indicates, independent of the faunal species, that human occupation occurred under cold and dry conditions immediately preceding considerable loess deposition. Scott mentions several instances of bones that must have been buried by loess while there still was muscle or ligament holding them together (Scott 1986: 169).

3.3 THE EEMIAN MIDDLE PALAEO-LITHIC (OIS 5E) Zagwijn (1989) describes the Eemian vegetation of large parts of western and central Europe as a broad-leaved forest dominated by hornbeam (*Carpinus*). The climate was oceanic far into central Europe; the Eemian sea had invaded many coastal lowlands and occupied the entire Baltic Basin, connecting the North Sea with the White Sea and the Arctic Ocean (cf. Van Andel and Tzedakis 1996). The forest

succession during the Eemian interglacial was remarkably uniform over large parts of the continent, and the vegetational gradient was very gradual. The archaeological evidence demonstrates that this environment supported a human population.

The travertine sites in the region of Weimar have been known since the end of the 18th century. Here a series of Pleistocene travertines is present, of which the Eemian are the youngest. The Taubach travertines have traditionally been assigned an Eemian age on the basis of their stratigraphical position and the enclosed floral and faunal remains. U-series age determinations have confirmed this assessment (Brunnacker *et al.* 1983; Blackwell and Schwarcz 1986). These fully interglacial deposits, with an *E. antiquus* fauna, contain evidence for the presence of hominids, including many flint artefacts and some human teeth (Behm-Blancke 1960; Toepfer 1970; Mania 1988). The neighbouring Eemian travertines of Weimar provide a similar palaeontological and archaeological picture. To the west of these two sites, the travertines of Burgtonna yield, alongside many plant remains, 102 mollusc species, indicating that the few flint artefacts found there were deposited in the climatic optimum of the Eemian interglacial (Schäfer 1909; Mania 1978; Toepfer 1978). The travertines of Veltheim, near Halberstadt, are about 100 km north of the sites just mentioned. They too yield interglacial fauna and floral remains characteristic of a mixed oak forest, together with a small flint assemblage (Toepfer 1970).

The Lehringen site, in the northern lowland area of western Germany, is well known for a yew spear found amidst bones of *E. antiquus*, and the 25 flint artefacts associated with these faunal remains (Adam 1951; Thieme and Veil 1985). Again, the finds were present in Eem-interglacial lake sediments, deposited in a sedimentary basin that came into existence after the retreat of the Saalian glaciers. The sediments of the basin have yielded a rich fauna indicative of full interglacial conditions. Pollen analyses of the deposits indicated that human occupation took place in the lime-elm-hazel period of the Eem-interglacial forest (see Thieme and Veil 1985).

A site that shows some striking similarities to the Lehringen one has been excavated in a pit at Gröbern, near Leipzig, in Eem-interglacial lake deposits (Litt 1990; Erfurt and Mania 1990). The excavators recorded 195 well-preserved bones of *E. antiquus*, lying together in an area of 20 m² and forming an almost complete skeleton. Among the bones, 27 flint artefacts were found. Some of the artefacts show traces of use, and the flake inventory closely resembles the one from Lehringen (Heussner and Weber 1990). The elephant bones belonged to an adult individual with an estimated age of 35 to 40 years. The skeleton displayed traces of osteitis and may represent the remains of a scavenged animal. Pollen analysis of the deposits indicates

that humans visited the site in the Eem interglacial, around the transition between the hazel-yew-lime period (pollen zone 4b) and the hornbeam period (pollen zone 5), that is, under full interglacial conditions.

The Gröbern site is situated in one of the three Eemian sedimentary basins with archaeological remains, on the older moraine belt of the Halle-Leipzig area, near the southern limit of the Saale glaciation (see Eissmann *et al.* 1988). These basins are confined to depressions carved by the advance of the Saalian glaciers that became effective as sediment traps with the disintegration of the glacial ice. The basin fill consists of Eemian interglacial and Weichselian glacial deposits. The basins were discovered in large-scale exposures in brown coal quarries.

The basin of Rabutz was already well known for its mammalian fossils in the 19th century. It has yielded rich interglacial floral and faunal remains (with, for example, *E. antiquus*, *D. kirchbergensis* and *E. orbicularis*), associated with a Middle Palaeolithic flint industry (Toepfer 1958). The majority of these artefacts come from full interglacial deposits, in which oak dominates among the 69 species of plant remains represented, with hazel, alder, lime and ash also present (cf. Toepfer 1958, 1970).

The Grabschutz basin, 10 km northeast of Rabutz, contained *E. antiquus*, *Cervus elaphus* and *Capreolus capreolus* among its vertebrates, together with pollen evidence indicating full interglacial conditions. The presence of man is attested by a few flint artefacts (Eissmann *et al.* 1988; Eissmann 1990).

A very important site is Neumark-Nord, in the valley of the Geisel, near Halle (Mania and Thomae 1989; Mania *et al.* 1990). From 1985 onwards, an important series of archaeological occurrences has been recovered from interglacial sediments in the brown coal quarry of Neumark-Nord. The sediments were deposited in a flat basin formed by coal diapirism following the retreat of the Saalian glacier. The age of this interglacial sequence has been the subject of some discussion between those favouring an Eemian age (e.g., Eissmann 1990; Zagwijn 1991b) and proponents of an intra-Saalian interglacial age (Mania *et al.* 1990). In the interglacial sequence, two shore levels are especially conspicuous from an archaeological point of view. Excavations of these shore regions have yielded remains – sometimes nearly complete skeletons – of large mammals (rhinoceros, giant deer, red deer, auroch, and especially fallow deer) that are occasionally associated with Middle Palaeolithic flint assemblages dominated by unmodified flakes. The full interglacial character of the hominid occupation on the shores of a small lake is demonstrated by the abundant floral remains, with *Quercus*, *Corylus*, *Carpinus*, *Taxus*, *Tilia*, *Buxus*, and *Ilex* present. *E. orbicularis* is again one of the species present here.

3.4. THE WEICHSELIAN MIDDLE PALAEOLITHIC (OIS 5D-3) Excavations in the East Eifel (Bosinski *et al.* 1986) have also yielded evidence relevant to our understanding of the Late Pleistocene settlement of Northern Europe. Although many of the find horizons from the craters of the East Eifel are not pristine contexts, finds from the Early Weichselian humic colluvium of layer 2B at Tönchesberg demonstrate occupation of the region during a period immediately following the Eemian interglacial. Here, a diverse lithic assemblage is associated with a warm period fauna including *Bos primigenius* and *D. dama*, and molluscan species indicative of relatively warm, but not fully interglacial, conditions (Tinnes 1987; Conard 1990; Van Kolfschoten 1990c; Roth 1990).

The site of Wallertheim in the drainage area of the Wiesbach, 20 km southwest of Mainz, also provides evidence for the occupation of the Rhine valley between the Eem and the first glacial maximum of the last glacial cycle. The major excavations of 1927 and 1928 (Schmidtgen and Wagner 1929), and current excavations (Conard *et al.* 1995), recovered faunal remains and lithic artefacts from a thick series of stream deposits that probably post-date the Eem and pre-date the main Weichselian loess of Wallertheim (Bosinski *et al.* 1985). The rich molluscan fauna from the stream deposits indicate an open landscape with cool temperatures (Brunnacker in Bosinski *et al.* 1985). Bison dominates among the large mammals, with the remains of at least 59 individuals which appear to have been butchered at the site (Gaudzinski 1995).

A series of well-preserved Middle Palaeolithic find levels was excavated in the 1970's and 1980's at Seclin, near Lille in northern France (Tuffreau *et al.* 1985, 1994). Early Weichselian (Brorup interstadial?) humic sediments yielded a flint industry that is the result of various reduction sequences, especially Levallois debitage and Upper Palaeolithic blade technology. The large number of refits (Révillon 1988) indicates the primary-context character of this site. Pollen analyses showed that human occupation (D7) took place in a boreal context (*prairie boisée*), with pine, spruce, hazel and alder (Leroi-Gourhan *et al.* 1978). More recent occupation (D4) took place in a more steppic environment, with a gallery forest, in which pine and alder were present, but spruce was absent. Burnt flints from the site yielded a TL age of 95 ± 10 Kyr bp for level D7 and 91 ± 11 Kyr bp for level D4 (Aitken, in Tuffreau *et al.* 1994).

The site of Le Mont-Dol (Ille-et-Vilaine, France) testifies, according to Monnier (1980), to an early Weichselian occupation (Stage 5b?). The archaeological assemblage was recovered below a head that sealed off a former beach. A Ferrassie industry was associated with remains of amongst others mammoth, woolly rhino, horse, reindeer, and giant deer. Study of the microfauna indicates occupation in a rather

marshy environment close to the site, with dry steppic conditions on higher terrain.

The deposits of the Ascherleben lake at Königsauwe yielded a Middle Palaeolithic industry with abundant faunal remains, deposited in an early part of the Weichselian period. The fauna includes reindeer, mammoth, woolly rhinoceros, horse and red deer, together with palaeo-botanical evidence which points to the existence of a steppic environment with scattered woods (Mania and Toepfer 1973).

In the loess pit at Ariendorf, a small assemblage (Ariendorf 3) was found in a humic soil horizon at the base of the last glacial loess. The larger mammal remains indicate an open herbaceous environment, with mammoth, woolly rhinoceros, and horse. Temperate elements, such as those recorded at the nearby site of Tönchesberg 2B, are absent (Turner 1989).

An important site is Salzgitter-Lebenstedt, located in the southern part of the northern German plain, about 20 km southwest of Braunschweig. The site was discovered in 1952, when artefacts and faunal remains were found during digging operations 4 m below the groundwater level (Tode *et al.* 1953; Tode 1982). The combination of the well-preserved organic remains and the presence of a rich Middle Palaeolithic flint industry was one of the reasons for further excavation in 1977 (Grote 1978; Grote and Preul 1978). The excavators are of the opinion that the archaeological material was deposited in an earlier part of the Weichselian, an interpretation supported by several ^{14}C dates, which point to a minimum age of 58 Kyr bp for the site (Grote and Thieme 1985). Bosinski (1963), however, on typological grounds, considers the site to date from an earlier glacial cycle. During the formation of the archaeological assemblage, the site was situated at the mouth of a wide glacial valley. The environment has been described as a 'grassy tundra', with scattered coniferous trees, the dwarf birch *B. nana* and cold-adapted willows (*Salix polaris* and *S. herbacea*). In this subarctic environment, reindeer, mammoth, woolly rhinoceros, bison and horse were present. The faunal remains from the 1952 and 1977 excavations are dominated by reindeer, which represents about 80% of all identified remains (Staesche 1983).

From a comprehensive study of over 300 sites and archaeological layers of the Middle Palaeolithic from west-central Europe, Bosinski (1967: 68) concluded that the Mousterian of the region is, when faunal remains are preserved, always associated with a cold fauna that invariably includes horse, reindeer, mammoth, and woolly rhinoceros. Evidence from numerous cave sites in southern Germany also testifies to Middle Palaeolithic adaptation to cold and open landscapes that were not very different from the ones occupied by their Upper Palaeolithic successors. Bockstein-schmiede and the adjacent cave of Bocksteinloch in the Lone Valley are two of these sites (Wetzel and Bosinski 1969). The

Middle Palaeolithic find levels in the Upper Danube region contain faunal assemblages with horse, woolly rhinoceros, mammoth, musk-ox, bison and reindeer. The microfauna also indicates cold conditions, with typical representatives of arctic tundras in association with, and in some levels dominating, steppe elements. The mega- and micro-mammalian fauna furthermore indicates that in protected valleys, some gallery forests may have been present, in an otherwise open environment (Hahn and Kind 1991). Müller-Beck (1988) has focused on this topic, concluding that Late Middle Palaeolithic groups had adjusted to the same environmental conditions as aurignacian ones – mainly a *Mammuthus-Rangifer-Equus* fauna, with additional remains of *Cervus* – and that earlier Middle Palaeolithic occupation was marked by even colder and more extreme conditions.

3.5 DISCUSSION

The data presented above give a rather static description of the environments in which archaeological sites are situated, without us being able to specify the ecological structure of these environments, let alone to indicate which parts were actually exploited by Middle Palaeolithic hominids. The degree of resolution of the methods at our disposal is simply not sufficient to answer such questions, so that a simple presence/absence analysis of species considered to be key markers in this discussion is all that is possible. Additionally, we hardly have any idea about the *size* of the area that the data informs us about: only when various kinds of environmental evidence (molluscs, micromammals and pollen for example) co-occur can one, at least partially, come to terms with such questions.

Nevertheless, as discussed at length elsewhere (Roebroeks *et al.* 1992a), the evidence very clearly shows that Middle and Late Pleistocene hominids lived in a wide range of environments. These included not just the more open environments between full glacial and full interglacial extremes, that accounted for more than 60% of Pleistocene time in the last 700 Kyr (Gamble 1986), but also environments that can be classified as full interglacial on all accounts. There were surely differences *between* interglacials, as stated above. Furthermore, the Eemian interglacial vegetation, like that of *any* interglacial period, certainly did not consist of one dense forest only: for instance, grazing activities of large herbivores may have created large open areas along the interglacial rivers (Lock 1972; Turner 1975). These open corridors through forested areas must have acted as a kind of highways for Pleistocene hunter-gatherers (cf. Gamble and Roebroeks, this volume). All archaeological sites, that on basis of palaeoecological evidence can be ascribed to full interglacial phases, are from either river- or lakeshore contexts, i.e. the relatively open areas within interglacial forested environments.

While the environmental tolerance of Middle Palaeolithic foragers was quite large, this does not imply that the northern parts of Europe saw continuous occupation. Glacial maxima seem to have led to a depopulation of these regions, as there are no finds that can unambiguously be attributed to the phases of glacial maxima. This is comparable to the situation during the Last Glacial Maximum (OIS 2) when modern humans temporarily gave up this area. Furthermore, our lack of resolution does not allow us to infer how the 'archaics' handled the short and dramatic climatic fluctuations that might have occurred, as suggested by the analysis of ice-core data: the Greenland ice-core (Dansgaard *et al.* 1993; GRIP 1993) suggests that within the Eemian (OIS 5e) temperature drops of up to 10°C were possible within 10 to 20 years, – contested – rapid changes that we are unable to monitor in our archaeological settings.

It is finally worthwhile mentioning that, at first sight, the number of sites that can be assigned to the Eemian *s.s.* (5e) is low: only nine have been listed in the review. It is worthwhile pointing out that this low number might be an artefact of the *fine chronological resolution* that we have in the Eemian. The Eemian is a unique case as, for the first time in 2.5 million years of human prehistory, we are able to assign a set of sites to a time slice of 10,000 years! (Mussi and Roebroeks [1996] mention that a comparable resolution in the Gravettian (30 to 20 Kyr bp) also yields an image of an 'empty Europe'). And indeed, if we count the total number of sites listed in our review with the presence of good palaeoenvironmental evidence, we end up with about 20 for the total Middle Palaeolithic (excluding the Eemian), i.e. less than one for every 10,000 years of Middle Palaeolithic time! In that sense, the number of Eemian sites is surprisingly high, especially in view of the short duration of this interglacial.

4. Some aspects of Middle Palaeolithic land use

The foregoing section showed that at least some aspects of the former natural environment of the area at stake here can be described in some detail. Using some of these environmental parameters and combining them with data collected in ethno-archaeological research, one could try to develop general models for earlier settlement systems, starting from the assumption that the distribution of natural resources determines to a high degree the way people move through landscapes. This is the 'common sense' approach in Palaeolithic archaeology (certainly as far as one is dealing with 'modern humans'): the environment is exploited by means of a highly varying set of mobility strategies, that have to compensate for various spatial and chronological incongruencies in the distribution of key resources. The outcome of this interaction between environment and human mobility strategies has been described by Binford in terms of

two different sets of settlement systems, the well-known *foragers vs. collectors* distinction (1980). This dichotomy forms the conceptual framework within which the majority of discussions on former land use take place (cf. Lieberman and Shea 1994).

There are a few problems with this 'common sense' approach though, one from a cultural-anthropological point of view, and two others from the perspective of archaeologists. Firstly, while the above-mentioned cultural-ecological approach towards people's spatial behaviour dominates Palaeolithic archaeology, it is in striking contrast to the approach in cultural anthropology, which suggests that hunter-gatherer organisation may be motivated by relationships other than those of people to land in the sense mentioned above, for instance by relations with other groups, and by a fundamentally different perception of nature, as exemplified in the well-known 'dreaming' view of the Australian landscape (cf. Myers 1986; see also Ingold 1986; Descola 1992). Needless to say, such ways of life are ultimately rooted in the capacity to symbolize, and for many researchers therefore out of the question for the time period at stake at the Arras-workshop.

Furthermore, we have already indicated above that it is not easy to translate the data on the environmental background of Middle Palaeolithic occupation into data on the structure, productivity and accessibility of former food resources in northern Europe. And finally the most important problem here is that both approaches – the '*Walking Stomachs*' and the '*Talking Heads*' approaches, as they were called at the Arras-meeting, are very hard to work with in an archaeological context because of the structure of archaeological data at our disposal (although the first one is appealing because of its many links to environmental variables). The difference between actually observing people moving through landscapes, and interpreting time-averaged material remains of former activities (encased in various forms in a variety of sedimentary envelopes) make for a big discrepancy between the two levels of analysis, i.e. ethnographical observations and syntheses, and archaeological practice. In archaeological practice, we have to deal with problems such as the contemporaneity of sites, their horizontal and vertical integrity and other aspects of site- and landscape formation (cf. Rensink 1995). Together with the very patchy exposure of sediments, the scarcity of well-studied sites and the absence of a solid chronological framework, these factors seriously limit the value of any 'ethnographic' approach of the Middle Palaeolithic record.

As stated before, on the level of individual sites, *locales*, it is sometimes possible to document short-term events, where one can actually 'see' a Levallois-core being reduced or an animal butchered. In that sense, occasional ethnographic 'snapshots' are possible, as for instance well-documented at

one of the Maastricht-Belvédère-sites (Site C, Roebroeks 1988; Schlanger 1996). But even within such locales (clusters of clusters), it is impossible to relate the individual clusters/snapshots to each other in a behaviourally meaningful way: one can only guess at the character of their relationship, as far as chronology and association are concerned (Roebroeks 1988, Site C). Even such well-preserved sites are taphonomically very complex, and in the end one has to agree with Binford that the "archaeologist must realize that a buried deposit is not a preserved 'moment of the past' but is in fact a buried surface collection" (Binford 1987: 20).

With only a little exaggeration, one could say that the Middle Palaeolithic record from this, and from any, region is caught between 'five minutes at the locale' and 20,000 years (or more) at the regional level. These two extremes will serve as starting point to distill some information on Middle Palaeolithic use of the northern landscapes.

Ethnographic snapshots, though rare, are documented within various sedimentary contexts in our working area, mostly in water-laid deposits from river- and/or lake contexts. Here, one can document the occasional single skeleton surrounded by a few flakes (e.g., Lehringen and Gröbern), or uncover series of flakes that can be conjoined to reconstruct the original flint block and hence the resulting reduction process. Though the relationships between such small clusters are difficult if not impossible to disentangle (see above), detailed studies of such clusters have yielded information on the spatial behaviour of their makers at the local level. At Belvédère, refitting and study of the 'missing' elements showed that flint cores and flakes were constantly being carried around in this former river valley, and that highly visible flint rich 'sites' were present against a very low-density background of artefacts all over the quarry. The fact that these low density scatters contained different sets of artefacts than the rich 'patches' led Roebroeks *et al.* (1992b) to differentiate between places where technology was maintained and places where it was used, e.g., direct subsistence activities were away from the rich sites. Such a spatial separation of activities, within the overall presence of lithic artefacts, has also been documented at other sites where fieldwork has been directed towards a study of the low density scatters in which the flint rich sites are present, e.g., at the much earlier Ferme de l'Épinette (Cagny) location (Tuffreau *et al.* 1997).

These 'five minute' sites often display a quite spectacular preservation of archaeological remains, but nevertheless the complete Middle Palaeolithic database from the area at stake here has not yielded solid indications for a longer and consistent use of one spot, e.g., in terms of a camp out of which one group operated for some time. Short term, episodic and highly mobile indeed seem to be key words in characterising the spatial behaviour of Middle Palaeolithic

hominids. Although some physical structures are claimed for the later phases of the Middle Palaeolithic (cf. Kolen, this volume), their extreme rarity¹ is striking in contrast to their more common occurrence in the later phases of the Upper Palaeolithic, a pattern that can not be explained in terms of differential site preservation only. And although burnt flints are very common at Middle Palaeolithic sites (yet more striking, in view of their virtual absence in Lower Palaeolithic contexts), hearth structures are conspicuously absent, as are sites where one can observe that concentrations of burnt material acted as a kind of focus for the discard of other forms of artefacts.

In the last decade, raw material studies shifted some of our attention towards the study of the former use of landscapes rather than sites, e.g., by studying raw material transfers in the Middle and Upper Palaeolithic (Geneste 1985, 1988; Roebroeks *et al.* 1988; Rensink *et al.* 1991; Féblot-Augustins 1993 and this volume). While the evidence from our area suggests that the Middle Palaeolithic use of raw materials was predominantly local, it also shows that early Middle Palaeolithic groups were moving over areas with maximum dimensions of 80 to more than 100 km. These distances are measured as the crow flies, with lines drawn between the original flint sources and the excavations where artefacts were recovered. Such a flint connection runs from the Dutch/Belgium flint area near Maastricht to the Neuwied Basin in Germany. This connects the southern boundary of the north European plain with the *Mittelgebirge* (even longer connections between two geographical entities are known in Central Europe, for example between the margins of the Polish plain and the northern mountains of Hungary [Roebroeks *et al.* 1988; Féblot-Augustins 1993 and this volume]).

Such transfers give us a vague idea of the size of areas known to Middle Palaeolithic hominids. Within these areas, various locations seem to have been visited regularly, sometimes over periods of thousands of years. La Cotte de St. Brélade, Biache-Saint-Vaast and Seclin are but some examples of sites with several find levels. Interestingly, the site of Bagarre-Etapes (Pas-de-Calais) documents the production of blade-like flakes over a very long period of time. These finds have been recovered from the terrace gravels as well as from the overlying fine-grained river deposits, a sequence covering a period of several thousands of years (Tuffreau and Zuate Y Zuber 1975). One could *speculate* whether such frequently visited places were fixed points in settlement systems: locations that were very well known and regularly visited for reasons that elude us. This certainly seems to have been the case at La Cotte de St. Brélade, where the many levels show striking consistencies in human responses to changes in local raw material availability. These were caused by sea level variations: 'wasteful' reduction strategies in periods when high sea

levels eroded good quality flint nearby, continuous resharpening of tools and import of non-local materials in low sea level periods. Such imports must have been based on previous knowledge of the raw material situation at La Cotte, suggesting that knowledge of various aspects of the natural environment was transmitted from generation to generation. This is not surprising as there are many sites where discrepancies between the number of cores and the number of large flakes struck from them suggest that these locations were workshops, where large amounts of flakes were produced for use elsewhere. Such quarries, Etouvies in the Somme valley, Ault-Onival at the French coast or Sains-en-Amiénois are but some examples, must have been fixed points on the mental maps of Middle Palaeolithic foragers. Interestingly, Féblot-Augustins (this volume) also makes a comparable point by stressing that the recurrence of provenances of raw materials cannot be fortuitous, and might indicate transmission of shared knowledge relative to particular landmarks.

5. Discussion

The area reviewed in this paper is certainly among the most well-researched of Palaeolithic Europe, but despite all that went into it, the structure of the record sets serious limits to the resolution of our data, and thus to any simple and straightforward 'ethnographic' analysis of the rich database. Some general conclusions, however, can be drawn. All evidence suggests that Middle Palaeolithic groups were highly mobile, and ranged over the northern areas over distances sometimes exceeding 100 km. Recurrent patterns, in both raw material procurement and the specific use of locations, over very long periods of time indicate that knowledge on specific landmarks was transmitted over many generations, probably including knowledge necessary for coping with a wide range of environments. Despite all the resolution problems discussed throughout the paper, it is clear that Middle Palaeolithic groups were able to cope with a wide range of environments, from cold and open, wind-swept, mammoth steppes to the more forested interglacial environments, where open river valleys may have formed the main focus of their wanderings (Gamble and Roebroeks, this volume). We must, however, not forget that their presence in a wide range of environments also carries implications for our view on the subsistence strategies of these 'archaics': while a scavenging-based way of northern survival seems feasible in more open environments with large herds of prey species and a resulting high natural mortality, this is more difficult to envisage in more closed environments, where hunting must have played a key role in dietary strategies. Independently, faunal studies of various Middle Palaeolithic assemblages – including rich ones from our area, such as Biache-Saint-Vaast – strongly suggest that Middle Palaeolithic hominids were indeed capable hunters of large

game animals (e.g., Gaudzinski, this volume), a suggestion made plausible by evidence from other disciplines, e.g., comparative anatomy (e.g., Aiello and Wheeler's 'expensive tissue hypothesis' [1995]). The recent finds of at least 350,000 year old wooden hunting weapons from Schöningen in Germany (Thieme 1997) show that hunting may have been an integral part of early human behaviour from the earliest occupation of Europe onwards.

notes

1 One interesting (but contested, cf. Kolen, this volume) case has been described by Stapert, who recently presented a simple method for analysing Stone Age sites of a special type: those characterised by the presence of a hearth closely associated in space with an artefact scatter (Stapert 1992). He developed his 'Ring and Sector' method to simply describe the spatial patterns in the distribution of flint artefacts relating to hearths. The idea behind this feature-oriented spatial analysis is that such 'domestic' hearths were focal

points in the daily life of Pleistocene hunter-gatherers, attracting many activities, including those that did not require the direct use of fire or heat. Most of his studies focused on Upper Palaeolithic artefact scatters, but three Middle Palaeolithic sites were analysed too: Buhlen and Rheindahlen-Westwand (B1) in Germany, and Maastricht-Belvédère Site C in the Netherlands. At the first two sites, archaeologists have postulated dwellings, although only Buhlen had a visible archaeological structure. At Belvédère, the presence of a dwelling was considered highly unlikely. Stapert could only find indications for the former existence of a dwelling structure at Buhlen: Layer 4 of the lower site yielded a late Middle Palaeolithic assemblage, associated with a circle of dolomite boulders with a diameter of about 5 m. At the centre of this stone circle, a large hearth was present, which was thought to have been in use during the occupation of the original dwelling. Stapert's analysis of the flint scatter indicates that the circle indeed was a dwelling structure: in the ring distribution of stone artefacts, a first peak is present 1-1.5 m from the hearth (the drop zone *sensu* Binford), and a second peak 2-2.5 m from the hearth roughly coincides with the ring of large stones: "The ring distribution as a whole is remarkably similar to several diagrams obtained for the site of Gönnersdorf" (Stapert 1992: 200; but see Kolen, this volume).

Table 1. Schematic survey of the main Middle Palaeolithic sites discussed in this paper, with a rough indication of their ecological and chronological setting.

	Interglacial Environments	Intermediate Environments	'Cold Steppic' Environments
Late Pleistocene	Neumark-Nord	Seclin	Bocksteinschmiede
	Grabschutz	Wallertheim	Balve
	Rabutz	Tönchesberg	Kartstein
	Gröbern	Königsau	Salzgitter-Lebenstedt
	Lehringen		Ariendorf 3
	Veltheim		Beauvais La Justice
	Taubach, Weimar, Burgtonna		
Late Middle Pleistocene	Stuttgart-Bad Cannstatt	Biache-Saint-Vaast	Achenheim 'Sol 74'
	Ehringsdorf		La Cotte de St. Brélade
	Maastricht-Belvédère		Schweinskopf/Wannen
			Ariendorf 2

references

- Adam, K.D. 1951 Der Waldelefant von Lehringen - eine Jagdbeute des diluvialen Menschen, *Quartär* 5, 79-92.
- Adam, K.D., W. Reiff, E. Wagner 1986 Zeugnisse des Urmenschen aus den Cannstatter Sauerwasserkalken, *Fundberichte aus Baden-Württemberg* 11, 1-100.
- Aiello, L.C., P. Wheeler 1995 The Expensive-Tissue Hypothesis. The Brain and the Digestive System in Human and Primate Evolution, *Current Anthropology* 36, 199-221.
- Aitken, M.J. 1990 *Science-based Dating in Archaeology*. London/New York: Longman.
- 1995 Chronometric techniques for the Middle Pleistocene. In: W. Roebroeks and T. van Kolfschoten (eds), *The Earliest Occupation of Europe*, 269-277, Leiden: Leiden University Press.
- Aitken, M.J., J. Huxtable, N.C. Debenham 1986 Thermoluminescence dating in the Palaeolithic: burned flint, stalagmitic calcite, and sediment, *Bulletin Association Française Etude Quaternaire* suppl. 26, 7-14.
- Andel, T.H. van, P.C. Tzedakis 1996 Palaeolithic landscapes of Europe and environs, 150,000 - 25,000 years ago: an overview, *Quaternary Science Reviews* 15, 481-500.
- Auguste, P. 1988 Apports paléontologiques et archéozoologiques de l'étude de la faune des grands mammifères de Biache-St-Vaast (Pas-de-Calais), *Actes du Colloque International 'Cultures et industries paléolithiques en milieu loessique'*, *Revue Archéologique de Picardie* 1-2, 63-68.
- 1992 Etude archéozoologique des grands mammifères du site pléistocène moyen de Biache-Saint-Vaast (Pas-de-Calais, France): apports biostratigraphiques et palethnographiques, *L'Anthropologie* 96, 49-70.
- Behm-Blancke, G. 1960 Altsteinzeitliche Rastplätze im Travertingebiet von Taubach-Weimar-Ehringsdorf, *Alt-Thüringen* 4, 1-246.
- Binford, L.R. 1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement and Archaeological Site Formation, *American Antiquity* 45, 4-20.
- 1987 Searching for Camps and Missing the Evidence? Another Look at the Lower Paleolithic. In: O. Soffer (ed.), *The Pleistocene Old World. Regional Perspectives*, 17-29, New York: Plenum Press.
- Blackwell, B., H.P. Schwarcz 1986 U-Series Analysis of the Lower Travertine at Ehringsdorf, D.D.R., *Quaternary Research* 25, 215-222.
- Bosinski, G. 1963 Eine mittelpaläolithische Formengruppe und das Problem ihrer geochronologischen Einordnung, *Eiszeitalter und Gegenwart* 14, 124-140.
- 1967 *Die mittelpaläolithischen Funde im westlichen Mitteleuropa*. Köln: Böhlau Verlag.
- Bosinski, G., K. Brunnacker, E. Turner 1983 Ein Siedlungsbefund des frühen Mittelpaläolithikums von Ariendorf, Kreis Neuwied, *Archäologisches Korrespondenzblatt* 17, 419-427.

- Bosinski, G., 1985 Das Frühwürm im Lössprofil von Wallertheim/Rheinhausen, *Geologisches Jahrbuch Hessen* 113, 187-215.
K. Brunnacker,
K. Krumsiek,
U. Hambach,
W. Tillemanns,
B. Urban-Kittel
- Bosinski, G., 1986 Altsteinzeitliche Siedlungsplätze auf den Osteifel-Vulkanen, *Jahrbuch des Röm.-Germ. Zentralmuseums Mainz* 33, 97-130.
K. Kröger,
J. Schäfer,
E. Turner
- Brunnacker, K., 1983 Radiometrische Untersuchungen zur Datierung mitteleuropäischer Travertinvorkommen, *Ethnographisches-Archäologisches Zeitschrift* 24, 217-266.
K.-D. Jäger,
G.J. Hennig,
J. Preuss
- Cahen, D., 1986 Le site Paléolithique moyen ancien de Mesvin IV (Hainaut, Belgique), *Bulletin Association Française Etude Quaternaire* suppl. 26, 89-102.
J. Michel
- Callow, P., 1986 *La Cotte de St. Brélade, Jersey. Excavations by C.B.M. McBurney 1961-1978*. Norwich: Geo Books.
J.M. Cornford (eds)
- Chaline, J., 1986 The rodent fauna. In: P. Callow and J.M. Cornford (eds), *La Cotte de St. Brélade 1961-1978: excavations by C.B.M. McBurney*, 139-144, Norwich: Geo Books.
G. Brochet
- Conard, N.J. 1990 *Tönchesberg and its Position in the Paleolithic Prehistory of Northern Europe*. Dissertation Yale University.
- Conard, N.J., 1995 Preliminary archaeological results from the 1991-1993 excavations in Wallertheim, *Archäologisches Korrespondenzblatt* 25, 13-27.
D.S. Adler,
D.T. Forest,
P.J. Kaszas
- Cook, J., 1982 A Review of the Chronology of the European Middle Pleistocene Hominid Record, *Yearbook Physical Anthropology* 25, 19-65.
C.B. Stringer,
A.P. Currant,
H.P. Schwarcz,
A.G. Wintle
- Dansgaard, W., 1993 Evidence for general instability of past climate from a 250-kyr ice-core record, *Nature* 364, 218-220.
S.J. Johnsen,
H.B. Clausen,
D. Dahl-Jensen,
N.S. Gundestrup,
C.U. Hammer,
C.S. Hvidberg,
J.P. Steffensen,
A.E. Sveinbjörnsdottir,
J. Jouzel,
G. Bond
- Descola, P. 1992 Societies of nature and the nature of societies. In: A. Kuper (ed.), *Conceptualizing society*, 107-126, London/New York: Routledge.
- Eißmann, L. (ed.) 1990 *Die Eemwarmzeit und die frühe Weichseleiszeit im Saale-Elbe-Gebiet: Geologie, Paläontologie, Paläökologie* (= Altenburger Naturwissenschaftliche Forschungen, Heft 5). Altenburg.

- Eißmann, L.,
T. Litt,
T. Weber,
D. Hentschel,
R. Wimmer,
S. Wansa 1988 Bemerkenswerte Eemvorkommen in glaziären Becken der Saaleeiszeit südlich der "Warthe-Linie" im Raum Halle, *Leipzig. Z. Geol. Wiss.* 16, 543-555.
- Erfurt, J.,
D. Mania 1990 Zur Paläontologie des jungpleistozänen Waldelefanten von Gröbern, Kreis Gräfenhainichen. In: D. Mania et al. (eds), *Neumark-Gröbern, Beiträge zur Jagd des mittelpaläolithischen Menschen*, 215-244 (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle, Band 43), Berlin: Deutscher Verlag der Wissenschaften.
- Féblot-Augustins, J. 1993 Mobility Strategies in the Late Middle Palaeolithic of Central and Western Europe: Elements of Stability and Variability, *Journal of Anthropological Archaeology* 12, 211-265.
this volume *Raw material, transport patterns and settlement systems in the European Lower and Middle Palaeolithic: continuity, change and variability.*
- Gamble, C. 1986 *The Palaeolithic Settlement of Europe*. Cambridge: Cambridge University Press.
1987 Man the Shoveler: Alternative Models for Middle Pleistocene Colonization and Occupation in Northern Latitudes. In: O. Soffer (ed.), *The Pleistocene Old World. Regional Perspectives*, 81-98, New York: Plenum Press.
1995 The earliest occupation of Europe: the environmental background. In: W. Roebroeks and T. van Kolfschoten (eds), *The Earliest Occupation of Europe*, 279-295, Leiden: Leiden University Press.
- Gamble, C.,
W. Roebroeks this volume *The Middle Palaeolithic: a point of inflection.*
- Gaudzinski, S. 1995 Wallertheim Re-visited, *Journal of Archaeological Science* 22, 51-66.
this volume *The faunal record of the Lower and Middle Palaeolithic of Europe: remarks on human interference.*
- Geneste, J.-M. 1985 *Analyse lithique d'industries moustériennes du Périgord: une approche technologique du comportement des groupes humaines au Paléolithique moyen*. Doctoral thesis, University of Bordeaux, Bordeaux.
1988 Systèmes d'approvisionnement en matières premières au Paléolithique moyen et au Paléolithique supérieur en Aquitaine. In: M. Otte (ed.) *L'Homme de Néandertal*, vol. 8, M. Otte and J. Kozłowski (eds), *La mutation*, 61-70, Liège: Université de Liège (ERAUL 35).
- GRIP (Greenland Ice-core Project Members) 1993 Climate instability during the last interglacial period recorded in the GRIP ice core, *Nature* 364, 203-207.
- Grote, K. 1978 Salzgitter-Lebenstedt. Die Grabung 1977 in der mittelpaläolithischen Freilandstation, *Archäologisches Korrespondenzblatt* 8, 155-162.
- Grote, K.,
F. Preul 1978 Der mittelpaläolithische Lagerplatz in Salzgitter-Lebenstedt. Vorbericht über die Grabung und die geologische Untersuchung 1977, *Nachrichten aus Niedersachsens Urgeschichte* 47, 77-106.
- Grote, K.,
H. Thieme 1985 Eiszeitliche Jagdtiere und Jäger der mittleren Altsteinzeit am Beispiel der Freilandstation Salzgitter-Lebenstedt. In: K. Wilhelmi (ed.), *Ausgrabungen in Niedersachsen. Archäologische Denkmalpflege 1979-1984*, 51-57, Stuttgart.

- Guthrie, R.D. 1990 *Frozen Fauna of the Mammoth Steppe. The Story of Blue Babe*. Chicago/London: The University of Chicago Press.
- Hahn, J.,
C.-J. Kind 1991 *Urgeschichte in Oberschwaben und der mittleren Schwäbischen Alb*. Stuttgart.
- Heim, J.,
J.P. Lautridou,
J. Maucorps,
J.J. Puisségur,
J. Sommé,
A. Thévenin 1982 Achenheim: une séquence-type des loess du pléistocène moyen et supérieur, *Bulletin Association Française Etude Quaternaire* 19, 147-159.
- Heußner, K.-U.,
T. Weber 1990 Das archäologische Inventar-Spezielle Untersuchungen zu den Feuersteinartefakten. In: D. Mania *et al.* (eds), *Neumark-Gröbern, Beiträge zur Jagd des mittelpaläolithischen Menschen*, 225-236 (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle, Band 43), Berlin: Deutscher Verlag der Wissenschaften.
- Huxtable, J. 1993 Further thermoluminescence dates for burnt flints from Maastricht-Belvédère and a finalised thermoluminescence age for the Unit IV Middle Palaeolithic sites, *Mededelingen Rijks Geologische Dienst* 47, 41-44.
- Ingold, T. 1986 *The appropriation of nature: essays on human ecology and social relations*. Manchester: Manchester University Press.
- Justus, A.,
K.H. Urmersbach,
A. Urmersbach 1987 Mittelpaläolithische Funde vom Vulkan "Wannen" bei Ochtendung, Kreis Mayen-Koblenz, *Archäologisches Korrespondenzblatt* 17, 409-417.
- Kolen, J. this
volume *Hominids without homes: on the nature of Middle Palaeolithic settlement in Europe*.
- Kolen, J.,
D. De Loecker,
A.G. Groenendijk,
J.P. de Warrimont this
volume Middle Palaeolithic surface scatters in Southern Limburg (The Netherlands): How informative?
- Kolfschoten, T. van 1990a The evolution of the mammal fauna in the Netherlands and the Middle Rhine area (Western Germany) during the late Middle Pleistocene, *Mededelingen Rijks Geologische Dienst* 43(3), 1-69.
- 1990b Die Kleinsäuger von Ariendorf. In: W. Schirmer (ed.), *Rheingeschichte zwischen Mosel und Maas. DEUQUA-Führer 1*, 117-120, Hannover: Deutsche Quartärvereinigung.
- 1990c Die Kleinsäuger von Tönchesberg 2. In: W. Schirmer (ed.), *Rheingeschichte zwischen Mosel und Maas. DEUQUA-Führer 1*, 52, Hannover: Deutsche Quartärvereinigung.
- Kolfschoten, T. van,
W. Roebroeks (eds) 1985 Maastricht-Belvédère: stratigraphy, palaeoenvironment and archaeology of the Middle and Late Pleistocene deposits, *Mededelingen Rijks Geologische Dienst* 39, 1-121. (= *Analecta Praehistorica Leidensia* 18).
- Leroi-Gourhan, A.,
J. Sommé,
A. Tuffreau 1978 Weichsélien et Paléolithique moyen de Seclin, *Bulletin Association Française Etude Quaternaire* 15, 69-80.
- Lieberman, D.E.,
J.J. Shea 1994 Behavioral Differences between Archaic and Modern Humans in the Levantine Mousterian, *American Anthropologist* 96, 300-332.

- Litt, T. 1990 Stratigraphie und Ökologie des eeminterglazialen Waldelefanten - Schlachtplatzes von Gröbern, Kress Gräfenhainichen. In: D. Mania et al. (eds), *Neumark-Gröbern, Beiträge zur Jagd des mittelpaläolithischen Menschen*, 193-208, Berlin: Deutscher Verlag der Wissenschaften.
- Locht, J.-L., C. Swinnen, P. Antoine, P. Auguste, M. Patou-Mathys, P. Depaepe, Ch. Falguères, M. Laurent, J.-J. Bahain 1995 Le gisement paléolithique moyen de Beauvais (Oise), *Bulletin de la Société Préhistorique Française* 92, 213-226.
- Lock, J.M. 1972 The effects of hippopotamus grazing on grasslands, *Journal of Ecology* 60, 445-467.
- Mania, D. 1978 Die Molluskenfauna aus den Travertinen von Burgtonna in Thüringen, *Quartärpaläontologie* 3, 69-85.
- 1988 Le paléolithique ancien et moyen de la région de la Saale et de l'Elbe, Allemagne de l'Est, *L'Anthropologie* 92, 1051-1092.
- Mania, D., V. Toepfer 1973 *Königsau* (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle, Band 26). Berlin: Deutscher Verlag der Wissenschaften.
- Mania, D., M. Thomae 1989 Neumark-Nord in the valley of the Geisel near Halle/S. (GDR). A new middle palaeolithic site with killing and butchering areas, *Anthropologie* 27, 1-4.
- Mania, D., M. Thomae, T. Litt, T. Weber (eds) 1990 *Neumark-Gröbern. Beiträge zur Jagd des mittelpaläolithischen Menschen* (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle, Band 43). Berlin: Deutscher Verlag der Wissenschaften.
- Meijer, T. 1985 The pre-Weichselian nonmarine molluscan fauna from Maastricht-Belvédère (Southern Limburg, the Netherlands), *Mededelingen Rijks Geologische Dienst* 39, 75-103.
- Monnier, J.-L. 1980 *Le Paléolithique de la Bretagne dans son cadre géologique*. Rennes (Travaux Laboratoire d'Anthropologie préhist., Protohistoire et Quaternaire armoricains).
- Müller-Beck, H.J. 1988 The Ecosystem of the "Middle Paleolithic" (Late Lower Paleolithic) in the Upper Danube Region. In: H.L. Dibble and A. Montet-White (eds), *Upper Pleistocene Prehistory of Western Eurasia*, 233-253, Philadelphia: University Museum.
- Mussi, M. this volume *The Neanderthals in Italy: a tale of many caves*.
- Mussi, M., W. Roebroeks 1996 The Big Mosaic, *Current Anthropology* 37, 697-699.
- Myers, F. 1986 *Pintupi Country, Pintupi Self. Sentiment, Place and Politics among Western Desert Aborigines*. Berkeley: University of Chicago Press.
- Neer, W. van 1986 La fauna saalienne du site paléolithique moyen de Mesvin IV (Hainaut, Belgique), *Bulletin Association Française Etude Quaternaire* suppl. 26, 103-111.
- Rensink, E. 1995 On Magdalenian mobility and land use in north-west Europe, *Archaeological Dialogues* 2, 85-119.

- Rensink, E.,
J. Kolen,
A. Spieksma 1991 Patterns of raw material distribution in the Upper Pleistocene of northwestern and central Europe. In: A. Montet-White and S. Holen (eds), *Raw material economies among prehistoric hunter-gatherers*, 141-159, Lawrence Ks.: University of Kansas Publications in Anthropology 19.
- Révillion, S. 1988 Répartition spatiale et technologie de l'industrie lithique du gisement paléolithique moyen de Seclin (Nord): première approche. Actes du Colloque international 'Cultures et industries lithiques en milieu loessique', *Revue Archéologique de Picardie* 1-2, 157-162.
- Roebroeks, W. 1988 From Find Scatters to Early Hominid Behaviour. A study of Middle Palaeolithic River Side Settlements at Maastricht-Belvédère (The Netherlands), *Analecta Praehistorica Leidensia* 21.
- Roebroeks, W.,
T. van Kolfschoten 1994 The earliest occupation of Europe: a short chronology, *Antiquity* 68, 489-503.
- Roebroeks, W.,
J. Kolen,
E. Rensink 1988 Planning depth, anticipation and the organization of Middle Palaeolithic technology: the "Archaic Natives" meet Eve's descendants, *Helinium* 28, 17-34.
- Roebroeks, W.,
N. Conard,
T. van Kolfschoten 1992a Dense Forests, Cold Steppes and the Palaeolithic Settlement of northern Europe, *Current Anthropology* 33, 551-586.
- Roebroeks, W.,
D. De Loecker,
P. Hennekens,
M. van Ieperen 1992b "A veil of stones": on the interpretation of an early Middle Palaeolithic low density scatter at Maastricht-Belvédère (The Netherlands), *Analecta Praehistorica Leidensia* 25, 1-16.
- Roth, G. 1990 Die Mollusken von Tönchesberg 2. In: W. Schirmer (ed.), *Rheingeschichte zwischen Mosel und Maas. DEUQUA-Führer 1. Deutsche Quartärvereinigung* 52, Hannover.
- Schäfer, H.E. 1909 Über die pleistocäne Säugtierfauna und die Spuren des paläolithischen Menschen von Burgtonna in Thüringen, *Zeitschrift deutsch. geol. Ges.* 61, 445-469.
- Schäfer, J. 1990 *Der altsteinzeitliche Fundplatz auf dem Vulkan Schweinskopf-Karmelenberg*, Dissertation, University of Cologne, Cologne.
- Schlanger, N. 1996 Understanding Levallois: Lithic Technology and Cognitive Archaeology, *Cambridge Archaeological Journal* 6, 231-254.
- Schmidtgen, O.,
W. Wagner 1929 Eine altpaläolithische Jagdstelle bei Wallertheim in Rheinhessen, *Notizblatt des Vereins für Erdkunde und der Hessischen Geologischen Landesanstalt zu Darmstadt* 11, 3-41.
- Schwarcz, H.P.,
R. Grün,
A.G. Latham,
D. Mania,
K. Brunnacker 1988 The Bilzingsleben archaeological site: new dating evidence, *Archaeometry* 30, 5-17.
- Scott, K. 1986 The large mammal fauna. In: P. Callow and J.M. Cornford (eds), *La Cotte de St. Brélade 1961-1978. Excavations by C.B.M. McBurney*, 109-138, Norwich: Geo Books.
- Staesche, U. 1983 Aspects of the life of Middle Paleolithic hunters in the N.W. German Lowlands based on the site Salzgitter-Lebenstedt. In: J. Clutton-Brock and C. Grigson (eds), *Animals and Archaeology*, Part I (BAR Series 163), 173-181, Oxford.
- Stapert, D. 1992 *Rings and sectors: Intrasite spatial analysis of Stone Age sites*. Dissertation, Groningen, University of Groningen.

- Steiner, W. 1979 *Der Travertin von Ehringsdorf und seine Fossilien*. Wittenberg: Ziemsen.
- Stern, N. 1993 The Structure of the Lower Pleistocene Archaeological Record. A Case Study from the Koobi Fora Formation, *Current Anthropology* 43, 201-225.
- Thévenin, A., J. Sainty 1974 Une aire de dépeçage préhistorique à Achenheim, *Archéologie* 74, 68-69.
- Thieme, H. 1997 Lower Palaeolithic hunting spears from Germany, *Nature* 385, 807-810.
- Thieme, H., S. Veil 1985 Neue Untersuchungen zum eemzeitlichen Elefanten-Jagdplatz Lehringen, Ldkr. Verden, *Die Kunde* N.F. 36, 11-58.
- Tinnes, J. 1987 Ausgrabungen auf dem Tönchesberg bei Kruft, Kreis Mayen-Koblenz, *Archäologisches Korrespondenzblatt* 17, 419-427.
- Tode, A. 1982 *Der altsteinzeitliche Fundplatz Salzgitter-Lebenstedt I. Archäologischer Teil*. Köln/Wien: Böhlau Verlag.
- Tode, A., F. Preul, A. Kleinschmidt 1953 Die Untersuchung der paläolithischen Freilandstation von Salzgitter-Lebenstedt, *Eiszeitalter und Gegenwart* 3, 144-220.
- Toepfer, V. 1958 Steingeräte und Palökologie der mittelpaläolithischen Fundstelle Rabutz bei Halle (Saale), *Jahresschrift für Mitteldeutsche Vorgeschichte* 41/42, 140-177.
- 1970 Stratigraphie und Ökologie des Paläolithikums. In: H. Richter, G. Hasse, I. Lieberoth and R. Ruske (eds), *Periglazial-Löß-Paläolithikum im Jungpleistozän der Deutschen Demokratischen Republik*, 329-422, Leipzig: Gotha.
- 1978 Die Paläolithischen Funde im Travertin von Burgtonna in Thüringen, *Quartärpaläontologie* 3, 175-178.
- Tuffreau, A. 1992 Middle Paleolithic Settlement in Northern France. In: H.L. Dibble and P. Mellars (eds), *The Middle Paleolithic: Adaptation, behavior and variability*, 59-73, Philadelphia: The University Museum/University of Pennsylvania.
- Tuffreau, A., J. Zuate, Y. Zuber 1975 La terrasse fluviatile de Bagarre (Etaples, Pas-de-Calais) et ses industries: note préliminaire, *Bulletin de la Société préhistorique française* 72, 229-235.
- Tuffreau, A., J. Sommé (eds) 1988 *Le gisement paléolithique moyen de Biache-Saint-Vaast (Pas-de-Calais). Vol. I. Stratigraphie, Environnement, Etudes archéologiques* (Mém. Soc. Préhist. Fr. 21). Paris.
- Tuffreau, A., P. Antoine 1995 The earliest occupation of Europe: Continental Northwestern Europe. In: W. Roebroeks and T. van Kolfschoten (eds), *The Earliest Occupation of Europe*, 147-163, Leiden: Leiden University Press.
- Tuffreau, A., A.V. Munaut, J.J. Puisségur, J. Sommé 1982 Stratigraphie et environnement de la séquence archéologique de Biache-Saint-Vaast (Pas-de-Calais), *Bulletin Association Française Etude Quaternaire* 2-3, 57-61.
- Tuffreau, A., S. Révillion, J. Sommé, M.J. Aitken, J. Huxtable, A. Leroi-Gourhan 1985 Le gisement Paléolithique moyen de Seclin (Nord, France), *Archäologisches Korrespondenzblatt* 15, 131-138.

- Tuffreau, A.,
S. Révillion,
J. Sommé,
B. Van Vliet-Lanoë 1994 Le gisement paléolithique moyen de Seclin (Nord), *Bulletin de la Société Préhistorique Française* 91, 23-46.
- Tuffreau, A.,
A. Lamotte,
J.-L. Marcy 1997 Land-use and site function in Acheulean complexes of the Somme Valley, *World Archaeology* 29, 225-241.
- Turner, Ch. 1975 Der Einfluss grosser Mammalier auf die interglaziale Vegetation, *Quartärpaläontologie* 1, 13-19.
- Turner, E. 1986 The 1981-1983 excavations in the Karl Schneider quarry, Ariendorf, West Germany, *Bulletin Association Française Etude Quaternaire* suppl. 26, 35-42.
- 1989 *Middle and Late Pleistocene Macrofaunas of the Neuwied Basin region of West-Germany (Rhineland-Palatine)*, PhD. Dissertation, University of Birmingham.
- Turq, A. this volume *Reflections on the Middle Palaeolithic of the Aquitaine basin.*
- Vandenberghe, J.,
W. Roebroeks,
T. van Kolfschoten 1993 Maastricht-Belvédère: Stratigraphy, Palaeoenvironment and Archaeology of the Middle and Late Pleistocene Deposits; Part II, *Mededelingen Rijks Geologische Dienst* 47, 1-91.
- Wagner, E. 1984 Ein Jagdplatz des *Homo erectus* im mittelpleistozänen Travertin in Stuttgart Bad Cannstatt, *Germania* 62, 229-267.
- 1990 Ökonomie und Ökologie in den altpaläolithischen Travertinfundstellen von Bad Cannstatt, *Fundberichte aus Baden-Württemberg* 15, 1-15.
- Wernert, P. 1957 Stratigraphie paléontologique et préhistorique des sédiments quaternaires d'Alsace, Achenheim, *Mémoires service Carte Géologique Alsace Lorraine* 14.
- Wetzel, R.,
G. Bosinski (eds) 1969 *Die Bocksteinschmiede im Lonetal (Gemarkung Rammingen, Kr. Ulm)*. Stuttgart: Müller and Gräff.
- Yokoyama, Y. 1989 Direct gamma-ray spectrometric dating of Anteneandertalian and Neandertalian human remains. In: *Hominidae*, Proceedings of the 2nd International Congress of Human Paleontology, Turin.
- Zagwijn, W.H. 1989 Vegetation and climate during the warmer intervals in the Late Pleistocene of Western and Central Europe, *Quaternary International* 3/4, 57-67.
- 1991 Book review, *Geologie en Mijnbouw* 70, 213.

Wil Roebroeks
Faculteit der Archeologie
Rijksuniversiteit Leiden
P.O. Box 9515
2300 RA Leiden
The Netherlands

Alain Tuffreau
ERA 37, du CRA, CNRS
Université Sciences et Technologies de Lille
59655 Villeneuve D'Ascq Cedex
France