International Journal of Osteoarchaeology
Int. J. Osteoarchaeol. **10**: 286–309 (2000)

Middle Palaeolithic Hunting Economies in the Rhineland

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ABSTRACT Until the 1980s, archaeologists routinely assumed that faunal material found in association with Middle Palaeolithic artifacts represented the remains of animals hunted by Neanderthals. Over the last two decades, most researchers have come to the conclusion that diverse anthropogenic and non-anthropogenic agents can lead to the co-occurrence of lithic artifacts and faunal remains. With this taphonomic problem in mind, this paper considers the evidence for Middle Palaeolithic hunting in the Rhineland. Special attention will be paid to the recent excavations at Ariendorf, Hummerich, Schweinskopf, Tönchesberg and Wannen in the Neuwied Basin, and Wallertheim in Rheinhessen. The analysis of the data from the faunal assemblages themselves form the basis of this paper, but emphasis will also be placed on the taphonomic contexts, the nature of the accompanying lithic assemblages, and the topographic and stratigraphic positions of the sites, in order to address the question of how hominids responded to changing environmental conditions during the Middle Palaeolithic. This paper discusses the diversity in patterns of prey selection, skeletal part transport, seasonality and occupation intensity documented at key sites in the region, and addresses their implications for interpreting Middle Palaeolithic behaviour. Copyright © 2000 John Wiley & Sons, Ltd.

Key words: Middle Palaeolithic; prey selection; skeletal part transport; seasonality; occupation intensity

Introduction

Over the last two decades, establishing past subsistence practices among Palaeolithic hominids has increasingly been viewed as a key means of addressing major trends in human evolution. Given the relative abundance of faunal remains over other indicators of Palaeolithic subsistence practices, the advent of effective hunting has come to be seen as a defining characteristic of human behaviour, relative to other primates and, especially, relative to earlier forms of hominids. In order to investigate Middle Palaeolithic subsistence, researchers have attempted to define criteria for the identification of hunting and scavenging, and to draft hypotheses about hominid behaviour. An in-depth review of these criteria lies beyond the scope of this paper, but reviews of these issues can be found in several recent publications (e.g. Marean, 1998; Klein *et al.*, 1999; Marean & Assefa, 1999).

The current debate over the provisioning capabilities of hominids during the Middle Palaeolithic of Eurasia and the Middle Stone Age of Southern Africa has offered a wide spectrum of interpretations concerning hominid behaviour. While Binford (1984) has presented Middle Palaeolithic and Middle Stone Age hominids as scavengers, Stiner (1991, 1994) concludes that the Middle Palaeolithic people of west-central Italy practised both scavenging and hunting, with the former dominating the Pontinian assemblages before ca. 55 ka, and the latter thereafter. Klein's (1976, 1995, 1998) faunal analyses led him to the conclusion that Middle Stone Age people could hunt with some game-specific limitations. He argues further that Later Stone

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Received 19 December 1999
Accepted 27 February 2000

Age faunal assemblages provide evidence for more complex and intensive exploitation of terrestrial and marine faunal resources, and that these skills, combined with other cultural developments, led to the expansion of modern human populations out of Africa and into Eurasia around 50 ka. On the basis of faunal analyses from Combe Grenal in France, Chase (1984, 1988, 1989) has argued in favour of effective hunting, which did not essentially differ from hunting practices documented in the faunal assemblages of Upper Palaeolithic sites.

Hypotheses in favour of scavenging have recently received significant critique (Marean, 1998; Marean & Kim, 1998; Mussi, 1999), and many new data further support the interpretation of frequent, active hunting by both Neanderthals and their contemporaries outside of Europe (e.g. Conard, 1992, 1997; Farizy & David, 1992; Gaudzinski, 1995a,b, 1996; Conard *et al.*, 1998; Marean, 1998; Milo, 1998). Support for the hypothesis that hominids were active hunters during the Middle Palaeolithic can also be found in the analysis of stone and organic tool technology. Some Middle Palaeolithic lithic assemblages have provided remains of mastic used to haft stone tools (Mania & Toepfer, 1973; Boëda *et al.*, 1996), as well as use-wear and damage patterns consistent with hafted tools and projectile technology (e.g. Shea, 1989, 1997; Meignen *et al.*, 1998; Plisson & Beyries, 1998). Furthermore, the remains of organic technology, such as the wooden spears from Clacton-on-Sea (Oakley *et al.*, 1977) and Lehringen (Jacob-Friesen, 1956; Thieme and Veil, 1985), as well as the discovery of several wooden handles and eight throwing-spears, in association with the remains of 20 horse individuals from primary Middle Pleistocene contexts at Schöningen (Thieme *et al.*, 1993; Thieme, 1995, 1997; Van Kolfschoten, personal communication), demonstrate that Lower and Middle Palaeolithic hominids were competent hunters. Studies of the physiological characteristics of the human digestive tract further indicate that the habitual consumption of carrion is a highly improbable hominid adaptation, ill suited to human dietary needs (Uerpmann, personal communication).

Data from studies of relative skeletal abundance, bone modification and mortality patterns provide three lines of evidence used to investigate both the subsistence strategies of hominids and the activities of other taphonomic agents in the past. These data may be augmented with information on seasonality, environmental setting and associated lithic technology. Inconsistencies in the recording and interpretation of faunal data, small sample sizes, highly complex taphonomic histories, and the anticipated high degree of variability in hominid behaviour can make results of these analyses difficult to assess. While Middle Palaeolithic faunal assemblages remain difficult to interpret, discussions of subsistence during this period have started to focus less on the simplistic dichotomies between hunting and scavenging and the differences between modern and pre-modern humans. Rather, many researchers are now examining the dynamics of past subsistence and settlement systems, in which multiple variables in subsistence strategies are addressed to gain insight into the lifeways of Palaeolithic hominids. With these introductory remarks in mind, this paper will consider some of the key Middle Palaeolithic faunal assemblages from the Rhineland. After summarizing many of the noteworthy characteristics of these assemblages, the paper will consider the importance of the geographic settings of sites, prey selection, mortality profiles, and seasonality data. Finally, the paper will remark upon issues related to changes in Middle Palaeolithic technology and subsistence practices, the intensity of occupation and mobility of Middle Palaeolithic hominids.

Middle Palaeolithic faunal assemblages from the Rhineland

Following Bosinski (1963, 1982) and Conard & Fischer (2000), we divide the Middle Palaeolithic of Germany into two phases, the Early Middle Palaeolithic, which corresponds to the last two glacial cycles of the Middle Pleistocene, and the Late Middle Palaeolithic, which includes Eemian and Weichselian/Würmian assemblages. Relative to the Lower Palaeolithic,

the Middle Palaeolithic is seen as a period of technological diversity and variability. Prepared cores are known from the last three glacial cycles (Bosinski, 1967) and Mousterian assemblages are well known from the penultimate glaciation of Germany and neighbouring counties. Although their great diversity warns against generalizations, handaxes are present in both the Early and Late Middle Palaeolithic. The *'Jungacheuléen'* is seen as characteristic of the Early Middle Palaeolithic, while the bifacial *'Micoquien'* or *'Keilmessergruppe'* is more common in the Late Middle Palaeolithic. Eemian assemblages are often too small to allow a technological or typological classification, whereas the Würmian/Weichselian assemblages show a diversity that lies beyond those known from traditional areas of study, such as southwestern France. Laminar assemblages are known from the early phases of the last glaciation, while diverse scraper assemblages, as well as handaxe and *Keilmesser* sites, do not appear to correspond to narrow temporal zones within the Late Middle Palaeolithic (see Richter, 1997 for another interpretation). The complexity of the archaeological record makes the development of a universally applicable taxonomic system for the lithic assemblages of the German Middle Palaeolithic appear unlikely in the immediate future. A more detailed discussion of the chronostratigraphic and taxonomic problems associated with the classification of the region's Middle Palaeolithic industries can be found in a recent paper by Conard & Fischer (2000). Although the distinction between the Early and Late Middle Palaeolithic is well established, and generally accepted in Germany, differences in the subsistence patterns during these periods remain to be demonstrated.

Turning specifically to the Rhineland, this paper will examine many new Middle Palaeolithic find horizons that have been excavated during the 1980s and 1990s. The localities that form the basis of this paper include Ariendorf, Plaidter Hummerich, Schweinskopf-Karmelenberg, Tönchesberg, Wallertheim and Wannen. With the exception of Ariendorf and Wallertheim, the other find horizons are located on the elevated, loess filled craters of the volcanic mountains of the East Eifel (Bosinski *et al.*, 1986). The classic loess profile at Ariendorf is located on an upper terrace on the right bank of Rhine between Koblenz and Bonn (Turner, 1997). Wallertheim lies in an old brickyard in the Wiesbach drainage in Rheinhessen. Since Schmidtgen's excavation in the 1920s, the site has been the best known Middle Palaeolithic site in the region (Schmidtgen & Wagner, 1929). All six of these localities have been studied intensely using interdisciplinary methods. Many papers and several monographs are available on these localities, and abundant geological and ecological information, as well as a nearly exhaustive array of luminescence and 39Ar/40Ar dates have been published (e.g. van den Van den Bogaard *et al.*, 1989; Turner, 1990, 1997; Van den Bogaard & Schminke, 1990; Frechen, 1991, 1994; Zöller *et al.*, 1991; Conard, 1992; Gaudzinski, 1995a; Conard *et al.*, 1995b; Boenigk & Frechen, 1997; Zöller, 1997; Frechen & Justus, 1998).

With the exception of the original research at Wallertheim, all of the find horizons discussed here were systematically investigated using modern excavation methods, which were well suited for sites with faunal material. All identifiable faunal remains and fragments greater than 5 cm in size were piece-plotted. Smaller finds were collected by layer and quarter metre, and, in most cases, systematic water screening was conducted to recover samples of small bone fragments and microfauna. Even in the case of Schmidtgen's original excavation at Wallertheim, particular attention was paid to the recovery and analysis of all classes of mammalian faunal material (Schmidtgen & Wagner, 1929; Gaudzinski, 1995b). While taphonomic and interpretive problems commonly associated with Palaeolithic assemblages remain, a systematic selection bias during excavation can be ruled out for all of the find horizons discussed below. Thorough analysis of these faunal assemblages included the identification of shaft fragments, refitting of bones and bone fragments, and attributing bones to specific individuals. This paper draws heavily on the work of many colleagues who have excavated and prepared publications on faunal assemblages in the Rhineland in recent years (Schäfer, 1990; Turner, 1990, 1998; Conard, 1992; Justus, 1992;

Gaudzinski, 1995a,b; Kröger, 1995; Street, 1995; Conard, 1997; Conard *et al.*, 1998). These data provide the basis for a reconstruction of Middle Palaeolithic subsistence in the region. Turner (1990) has published a palaeontological overview of the Middle and Upper Pleistocene fauna of the region, but with the exception of Conard's (1997) report at the 1995 International Conference of Archaezoologists (ICAZ) meeting in Konstanz, no attempt has been made to synthesize the archaeological significance of the faunal data from the Middle Palaeolithic of the Rhineland. In the following section, several of the most important faunal assemblages of the region will be considered.

Assemblages from the Early Middle Palaeolithic

Ariendorf, archaeological horizon 2

The loess deposits of this Saalian-aged find horizon, located upon a terrace about 100 m above the Rhine River (Figure 1), have preserved the remains of horse (*Equus* sp. 47/3), woolly rhinoceros (*Coelodonta antiquitatis*, 50/2) and mammoth (*Mammuthus primigenius*, 152/1), with fewer remains of red deer (*Cervus elaphus*, 77/2), large bovid (cf. *Bison priscus*, 10/2) and wolf (*Canis lupus*), 37 lithic artifacts including unmodified flakes, cores and core fragments (Turner, 1998). Here, as elsewhere in this paper, the numbers in parentheses correspond to values for NISP/MNI. While the horizon had previously been correlated with the penultimate glaciation, Turner (1998) now argues on the basis of a wide variety of biostratigraphic data and absolute dates that a correlation with the third-to-last glaciation is more likely. This early Saalian correlation makes the horizon the oldest under consideration in this review.

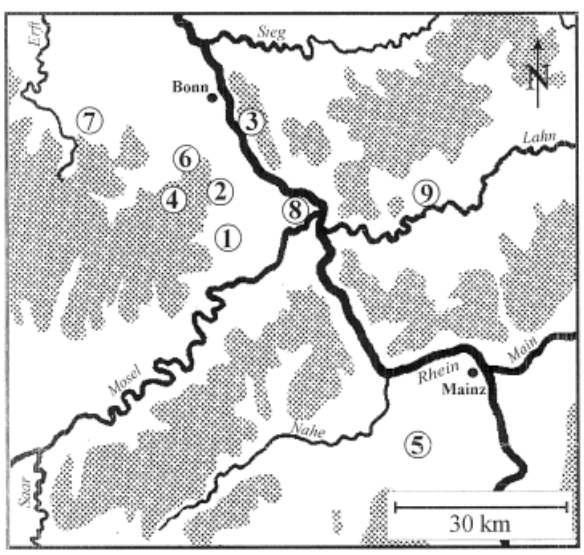

Figure 1. Map of the Rhineland with sites mentioned in the text. 1 = Schweinskopf-Karmelenberg, 2 = In den Wannen, 3 = Ariendorf, 4 = Tönchesberg, 5 = Wallertheim, 6 = Plaidter Hummerich, 7 = Kartstein, 8 = Metternich, 9 = cave sites in the Lahntal.

An open, cold steppe environment has been reconstructed for the time of occupation. Whereas only eight fragments belonging to one refitted rhinoceros humerus carry impact scars, 17 of the 482 recorded bones have been modified by carnivores. No cut-marked bones could be identified. Several remains from two rhinoceros individuals and lithics were found spatially associated with an irregularly shaped pit-like feature, whose origin is unclear. Turner rejects Bosinski's (Bosinski *et al.*, 1983a) suggestion that this feature represents the remains of a hut (Turner, 1998, pp. 136–137).

Mammoth remains in this layer are most numerous, but most of the specimens are molars and molar fragments with smaller quantities of tusk, ribs, vertebrae and several long bone fragments. The majority of the postcranial elements derive from a single young individual. The horse remains from this layer represent a minimum of three individuals of different ages. Head and limb elements predominate, and some foot bones were found in articulation. Although few in number, remains of bison are represented only by limb elements. Of the 77 finds attributable to red deer, 69 are fragments of antler. The remaining bone fragments represent the heads and limbs of a minimum of at least two individuals. A total of 12 shed antler bases were recovered from this layer. These finds may not indicate the presence of deer at the site, but could have been collected by hominids. The bases of two, non-shed red deer antler suggest a winter season of occupation (Turner, 1998).

Nearly all species from this horizon carry some traces of carnivore chewing. The presence of carnivore-induced damage could indicate that hominids played a subordinate role in the formation of the find horizon. Turner, however, remarks that the general lack of cut-marked bone may well be a product of the poor preservation of the bone surfaces. The remains of elephant suggest that the entire animal was present at the site. Based on comparisons with recent elephant mortality patterns and their relationship to landscape position and individual age, Turner (1998, pp. 172–173) discusses the possibility that the remains of the young adult male elephant in horizon 2 represent a kill site. The pattern of skeletal abundance from other species in this archaeological occurrence appear to have been chosen, and suggest that these remains were selectively transported to the site. If anthropogenic origin of the pit-like feature is rejected, and the high number of species is considered, the finds recovered from Ariendorf 2 speak in favour of a locality that was used on multiple occasions by both carnivores and hominids.

Schweinskopf-Karmelenberg, layers IV and V

These Middle Palaeolithic find horizons are located within the Saalian loess deposits, atop the Schweinskopf scoria cone (Bosinski *et al.*, 1986; Schäfer, 1987, 1990). The locality is adjacent to the prominent Karmelenberg mountain that stands approximately 300 m above the floor of the Rhine Valley. Systematic excavations have recovered the remains of animals in association with stone artifacts (Schäfer, 1987, 1990). While other find horizons have been examined, the main find horizon IV, and the lower lying find horizon V, are noteworthy when considering subsistence practices during the penultimate glaciation.

In layer IV, local quartz cobbles that were brought to and reduced at the site make up 95% of the 657 artifacts. Other raw materials with better chipping properties were often imported into the site as complete tools (Schäfer, 1990, p. 137). Three bifacially worked scrapers from this horizon are of typological significance. The diverse faunal remains from this site indicate an open, cold steppe environment. Of the 644 identified bones from layer IV, horse (*Equus* sp.) remains dominate the assemblage (330/11), followed by relatively high amounts of woolly rhino (*C. antiquitatis*, 133/4), reindeer (*Rangifer tarandus*, 60/6), and red deer (*C. elaphus*, 93/4). Mammoth (*M. primigenius*, 4/1) is represented by four fragments of tooth and bone. Only a small number of carnivore remains (wolf, *C. lupus*, 1/1; arctic fox, *Alopex lagopus*, 5/3) were recovered from layer IV. Horses of all ages are present in the assemblage, and the abundance of skeletal elements from horse and rhinoceros suggest that entire animals were present at the site and may have been hunted there (Schäfer, 1990, p. 99). The other species are represented predominantly by adult individuals. Anthropogenic and non-anthropogenic modifications to bone at Schweinskopf are not always quantified by Schäfer. He describes carnivore modification of this assemblage as rare (Schäfer, 1990, p. 109) and documents 11 bones with traces of carnivore chewing. In contrast, Schäfer describes several concentrations of broken long bone fragments bearing impact scars that appear to represent the remains of bone cracking for marrow extraction by hominids. A spring occupation at Schweinskopf IV is suggested by one cranial fragment of red deer from which the antler had been recently shed.

Only two stones recovered from layer V can be securely categorized as artifacts, and neither of these can be directly associated with the faunal remains (Schäfer, 1990, pp. 55–56). For layer V, this paper focuses on the fauna from the 89/50-95/54 area of excavation, which Schäfer (1990, p. 72) considers to be a representative sample of the deposit. The faunal sample from layer V ($n = 568$) is smaller than that of layer IV, and contains less identifiable material, making interpretation of this occurrence more difficult. Once again, remains of horse predominate (*Equus* sp., 60/3) among the remains of red deer (*C. elaphus*, 25/1), reindeer (*R. tarandus*, 13/1), large bovids (*cf. Bison priscus*, 25/2) and woolly rhinoceros (3/2). Limb bones of red deer, reindeer and bison are more abundant than other skeletal elements. Schäfer (1990, pp. 67–70) emphasizes the highly fragmented

nature of the appendicular elements of these species. In contrast, the remains of a minimum of three sub-adult horses are represented by a predominance of limb bones, several of which are complete. No remains of carnivores were recovered from this layer and traces of carnivore modification are generally rare on all taxa (Schäfer, 1990, pp. 68–69). Impact scars and bones broken in a fresh state are numerous (Schäfer, 1990, p. 69), indicating on-site extraction of marrow by hominids. Schäfer adds that the remains of red deer reflect anthropogenic transport of selected body parts to the site from off-site kills, although this may have been the case with other species.

In den Wannen, layers IV and V

Located in a volcanic crater above the surrounding landscape (Figure 1), five of the ten distinct geological deposits at this site preserve a large number of faunal remains found in association with stone tools (Justus & Urmersbach, 1987). All but the uppermost of these layers date to the penultimate glaciation (Frechen & Justus, 1998). A cool, steppe-like environment has been reconstructed for the time in which layers IV and V were deposited during the late Saalian. In layer IV, numerous remains of woolly rhinoceros (*C. antiquitatis*, 157/5), horse (*Equus* sp., 83/5) and red deer (*C. elaphus*, 31/3) have been recovered, in association with 25 flakes and flake fragments and three retouched tools, all made of local quartz (Justus, 1992). Less numerous remains of reindeer (*R. tarandus*, 3/1), badger (*Meles meles*, 3/1), wolf (*C. lupis*, 2/1), large bovid (*Bos/Bison*, 1/1) and mammoth (*Mammuthus* sp., 1/1) were also recovered. The rhinoceros remains include faunal elements from at least one juvenile and one adult individual; however, the age of the other individuals could not be determined. The skeletal abundance of a relatively complete adult individual indicates that the entire animal was present at the site. Justus (1992, p. 103) interprets this feature as a possible kill site, and argues that this animal died on site. The remains of the juvenile rhinoceros, horse and red deer show a bias towards limb and head parts, suggesting the selective transport of these elements to the site from a kill site outside the area of excavation (Justus, 1992, pp. 102–104). Bone weathering and other taphonomic processes may help to explain the scarcity of modified faunal remains and less dense faunal elements. Traces of carnivore chewing are present on five horse, four rhinoceros and at least three red deer bones, while one rhinoceros and six horse bones were broken in a fresh state.

Only three quartz artifacts were recovered in association with the 1116 bones and bone fragments in layer V, (Justus, 1992, pp. 105–107). As was the case in layer IV, the most numerous species in layer V are horse (*Equus* sp., 133/7), rhinoceros (94/6) and red deer (61/3), with less numerous remains of mammoth (*Mammuthus* sp., 2/1), large bovid (*Bos/Bison*, 2/1), chamois (*Rupicapra* sp., 3/1) and lion (*Panthera leo speleaus*, 4/1). Justus (1992, p. 122) argues for two overlapping patterns among horse remains: one in which the extremities and cranial remains predominate, and one in which whole carcasses are present. As a result of the relatively good preservation in this layer, the observed pattern of skeletal elements cannot be attributable to differential bone preservation. According to Justus (1992), a portion of the horse remains were transported by hominids to the site, while others represent the remains of animals killed at or near the site by carnivores. Only six horse bones preserve unambiguous characteristics of having been broken in a fresh state by hominids, while four bones preserve damage attributable to carnivores (Justus, 1992, p. 207). The axial and cranial elements of red deer are under-represented leading Justus to suggest that limb bones may have been selectively transported to the site. Conversely, the remains of rhinoceros suggest that entire animals were present at the site and presumably died there (Justus, 1992, pp. 122–123). Only two rhinoceros bones with traces of carnivore chewing could be identified; no information on anthropogenic modification is given. It seems that the faunal remains are attributable to the activities of both carnivores and hominids. A winter occupation at Wannen V is suggested by one fragment of unshed antler of red deer (Justus, 1992, p. 140).

Tönchesberg, find horizon 1A, upper lava loess

The Saalian deposits from Tönchesberg 1A were recovered from the fill of a scoria cone ca. 100 m above the Nette River, a tertiary tributary of the Rhine (Figure 1). Although the loess and scoria deposits are likely to have been the product of solufluction, the finds contained therein offer environmental and cultural information about the use of the site. The general depositional environment is similar to that of Saalian horizons at Schweinskopf and Wannen (Conard, 1992). An open vegetation characterized by cool temperatures has been reconstructed for the site at the time of deposition. Three lithic artifacts were recovered from the main excavation in association with a fauna, which included the remains of horse (*E. ferus*, 49/2), red deer (*C. elaphus*, 101/4), large bovid (*Bos/Bison*, 38/2), and less abundant remains of reindeer (*R. tarandus*, 8/1), woolly rhinoceros (*C. antiquitatis*, 3/1), wild ass (*E. hydruntinus*, 1/1), and lion (*Felis leo*, 2/1) (Table 2). A smaller excavation of the same stratum produced remains of horse, red deer, woolly rhinoceros and reindeer, along with a quartz core, while surface collections of this find horizon produced additional faunal remains, as well as four cores, two scrapers and one flake.

Horse, red deer and large bovid represent 89% of bone finds from the main excavation. Ninety percent of 736 bone fragments of these species derive from the limbs. The participation of non-anthropogenic agents in the formational history of the deposit is documented by six bones with definite traces of carnivore chewing. Although no cut-marked bones could be identified, 512 of the bone fragments had been broken in a fresh state, of which four show clear signs of anthropogenic fractures from dynamic loading (Binford, 1981; Shipman, 1981; Johnson, 1985). Analysis of cementum annuli of two red deer teeth by Pike-Tay indicates occupations in late fall or early winter and fall, whereas the results from a horse tooth sectioned by Burke indicate spring. Based on these data and comparisons with a palaeontological collection from a similar Saalian-aged setting of the Tönchesberg 1A lower lava loess, Conard (1992) has suggested that hominids were active in the formation of this find horizon, and that they hunted or had early access to the carcasses of cervids, equids and bovids from Tönchesberg 1A.

Assemblages from the Late Middle Palaeolithic

Wallertheim, find horizon A

The open-air site Wallertheim lies in the fluvial deposits of the Wiesbach, a tertiary drainage of the Rhine (Figure 1). Sedimentological (Becze-Deák & Langohr, 1997) and biostratigraphical (Damblon, 1997; Mania, 1997; Turner, 1997; Uerpmann & Dechert, 1997; Van Kolfschoten & Thomassen, 1997) evidence, as well as thermoluminscence determinations (Zöller, 1997) and earlier comparisions with the Milankovitch curve (Schmidtgen & Wagner, 1929) and local terrace stratigraphy indicate interglacial conditions and suggest a correlation with the Eemian.

Carbonized botanical remains were preserved in the fine-grained sediments of this layer. Preliminary results from analyses of these remains document the presence of wild cherry or blackthorn (*Primus* sp.) and poplar (*Poplus*). The presence of these thermophilic species reflects not only interglacial conditions, but also the vegetation cover in the area adjacent to the site. Analysis of the molluscan fauna from layer A indicates a generally open, dry and warm meadow to steppe-like landscape, with significant bush and tree cover in the lower lying areas near the Wiesbach (Mania, 1997). The occurrence of fallow deer (*Dama dama*) indicates the presence of wooded areas adjacent to the site, as this species is known to forage in small groups and prefer niches with lush bush and tree cover (Van den Brink, 1968). Data from a detailed analysis of the sediment in layer A allow for the reconstruction of a rather stable, vegetated surface on the floodplain of the Wiesbach. This low-lying position in the landscape received a contribution of non-calcareous alluvial sediments and calcareous sediments from the surrounding slopes, which led to poor bone preservation (Becze-Deák & Langohr, 1997).

The analysis of the more than 6700 lithic artifacts recovered from this horizon document the opportunistic, primary reduction of the red rhyolite and tuffaceous rhyolite that dominate the assemblage. These two raw materials were most likely procured from sources approximately 3 km from the site, and brought on site in one or more blocks and reduced within the area of excavation. Fifteen tools of diverse lithic raw materials were recovered from the assemblage. Superimposed among these artifacts, 382 bones and bone fragments could be documented. The remains of fallow deer (23/5), large bovid (*Bos/Bison*, 46/4) and horse (*E. ferus*, 13/1) are the most numerous (Table 2); no specimens of these taxa indicate sub-adult individuals in the assemblage. In addition, three bones could be attributed to wolf (*C. lupis*) and one to beaver (*Castor fiber*). The remains of fallow deer and large bovid show traces of human activity. Thirty-three small fragments of burned bone (3–19 mm in size), most likely attributable to fallow deer, were found in a 60 cm diameter, semi-circular concentration, which has been interpreted as the remains of a hearth. The dark brown to white colour of the burned remains can be correlated with Shipman *et al.* (1984), stages II–IV, suggesting a fire which burned at temperatures between 285–940°C. Not only the high temperature of the fire, but also the small size of the fragments are indicative of a long burning fire (Shipman *et al.*, 1984).

The skeletal abundance of large bovid remains indicates that appendicular elements and teeth occur more often in the assemblage than ribs, cranial elements or vertebrae. Although this may be the result of selective transport, it may also be a product of preferential preservation of animal remains with high bone densities (cf. Brain, 1981; Lyman, 1984). The relative low abundance of high density bovid teeth suggests that differential weathering of whole skeletons cannot explain the pattern of skeletal elements at the site. A similar pattern can be seen among the remains of fallow deer from this horizon, although, in this case, upper limb bones are particularly well represented. Only one cut-marked bone, determinable only to size-class 3 (see Table 2), could be identified in this find horizon. This is probably a product of the generally poor bone preservation in the layer. Four bovid hind limb bones exhibit impact fractures and 18 appear to have been broken in a fresh state. One tibia from *D. dama* exhibits impact scars, and nine other bones of this species were broken in a fresh state. Only six bones from this assemblage show traces of carnivore chewing and of these, two could be attributed to *E. ferus*. These data indicate that the remains of bovids and cervids are of anthropogenic origin, while those of horse cannot unambiguously be attributed to hominids. Analysis of cementum annuli from two specimens (*D. dama* and *Bos/Bison*) suggests occupation during the summer (Pike-Tay, 1997).

Wallertheim, the Schmidtgen excavations, 'Fundschicht'

From 1925 to 1928, Schmidtgen & Wagner (1929) conducted archaeological and geological investigations at Wallertheim. Several find-bearing strata were identified at the site. The richest of these is usually referred to as the *'Fundschicht'*, and from it, 542 stone artifacts and more than 12500 bones and bone fragments were recovered (Gaudzinski, 1995a). Stratigraphically, this early Weichselian layer correlates most closely with find horizon C from the recent excavation (Conard *et al.*, 1995b). The lithic assemblage consists mostly of unmodified flakes of local raw materials, which appear to have been chipped at the site. Some unifacially and bifacially retouched scrapers and points were also recovered.

Although discrepancies in the exact provenance of some finds do exist, the large mammalian fauna, in which the remains of large bovid (66% of the assemblage) outnumber those of horse, indicate an open, steppe-like environment, though indicators of more wooded areas are present in both molluscan and macrofaunal (*Sus scrofa*) samples (Gaudzinski, 1995a, pp. 280–283).

A re-analysis of the faunal material conducted by Gaudzinski confirms Schmidtgen's interpretation of the numerous bison remains (861/52), which she identified as *Bison priscus*, as resulting from hunting by Middle Palaeolithic hominids

(Gaudzinski, 1995a,b). In contrast to Schmidtgen, however, Gaudzinski does not attribute horse remains (*Equus germanicus* and *Equus przewalskii*, 228/13) to hominid activities. Other species, including rhinoceros (*Dicerorhinus* cf. *hemitoechus*, 1/1), wolf (*C. lupis*, 1/1), hyena (*Crocuta* sp., 1/1) and lion (*Panthera leo spelaea*, 1/1), play a subordinate role in the interpretation of the assemblage. Among the bovid remains, lower limbs and head parts are over-represented, and the mortality profile is prime-dominated. The bison remains preserve 65 impact scars, a feature not observed among other species in this layer. Cut-marked bones are rare (Gaudzinski, 1995a, p. 372), although this may be a product of poor surface preservation of bone. So far, it has not been possible to obtain results from the analysis of cementum annuli for the large bovid teeth, although Gaudzinski suggests that the presence of several young animals could indicate a summer occupation (Gaudzinski, 1995a, p. 298). This find horizon provides the strongest evidence for multiple episodes of monospecific hunting during the Middle Palaeolithic of the Rhineland, and Gaudzinski (1996) has addressed this issue in a pan-European context.

Wallertheim, find horizon D

Information on palaeoenvironments at the time of deposition of find horizon D indicates intermediate conditions after the Eemian Interglacial that probably correlate with oxygen isotope stage 5c (Conard *et al.*, 1995b). Evidence from molluscs found in this stratum suggest rather warm, dry summers and cool, but not extremely cold winters (Mania, 1997). The wooded areas associated with find horizon A gave way to increased amounts of open grassland, with only occasional bushes and trees adjacent to the low-lying site on the floodplain. No molluscan forms typical for true forest settings were found, although the presence of some hydrophilic forms indicate the presence of standing water near the site. Analysis of the sediments of this layer do not indicate a stable, vegetated surface, but rather one on which primarily clayey, non-calcareous fluvial sediments aggraded on the Wiesbach floodplain. As a result of the relatively rapid burial, bone preservation in this deposit is better than that of find horizon A.

Data from the more than 2300 stone artifacts found in this layer indicate that both the primary production of flakes and blades, as well as the rejuvenation and recycling of previously made tools, took place here (Conard & Adler, 1997). Thirty-three retouched tools and a variety of points were recovered from the find horizon. The debitage from this horizon has a strong laminar component, and numerous backed and double backed forms are present. Although the remains of large bovid (*Bos/Bison*, 21/3) occur in this layer, the remains of equids (*E. ferus*, 100/3), which belong to at least one adult and two sub-adult individuals, predominate (Table 2) and exhibit the most modifications. In addition, remains attributable to wild ass (*E. hydruntinus*, 7/2), wolf (*C. lupis*, 1/1), beaver (*C. fiber*, 1/1) and lion (25/1) were identified. Cut-marked horse bones ($n = 14$) include the ventral surfaces of the pelvis and several lumbar vertebrae, as well as the medial surface of the scapula. This concentration of cut-marks is atypical for filleting or disarticulating (Binford, 1981, p. 106), and warrants further investigation. Two distal humerus fragments from *E. hydruntinus* are also cut-marked. Six impact scars were identified on shaft fragments of *E. ferus*, and one on a humerus fragment of *E. hydruntinus*. The cementum analysis of one horse (*E. ferus*) tooth indicates a summer death (Burke, 1997).

Skeletal abundance data of horse indicate that both axial and appendicular elements are present, with an unusually low frequency of metapodia and phalanges. This cannot be explained by differential preservation as these elements are relatively durable, but may instead suggest selective removal of these parts from the area of excavation by carnivores or hominids. Alternatively, the horses may have been killed elsewhere by hominids, who then carried selected parts to the site, as Conard (1992) has suggested for early Weichselian finds from Tönchesberg 2B. It is clear that hominids were processing portions of horses at the site, and the apparent selection of equine over other species in this archaeological occurrence may be a

result in part of the increased amount of grassland that is attractive to horses.

Wallertheim, find horizon E

This find horizon is dominated by the remains from at least two well-preserved large bovids (*Bos primigenius*, 361/2), which were deposited on the marshy banks of the Wiesbach under relatively warm conditions that probably correspond to OIS 5c. Additional, less numerous species identified in this layer include: horse (44/5), wild ass (2/1), wolf (32/1), red deer (3/1), fallow deer (1/1) and lion (1/1) (Table 2). The presence of charcoal from oak (*Quercus* sp.) and black poplar (*Poplus nigra*), as well as unburned leaves, tentatively identified by Damblon (1997) as black poplar suggest warm moist conditions, which are consistent with the geographic setting of the site, and the results from other ecological analyses (Mania, 1997; Van Kolfschoten & Thomassen, 1997). The faunal remains from this horizon were found in association with 17 stone artifacts, including four tools, made on diverse raw materials. No lithic refits could be found, and the horizon provides little evidence for on-site knapping. These observations, along with the faunal studies, suggest that the artifacts probably represent a background lithic assemblage, which accumulated independently of the bovine fauna (Conard, 1998). Many of the bovid remains were found in articulation, and the skeletal representation of these adult individuals does not indicate that particular elements were selected, but rather that the animals had died at the location where they were excavated. No clear traces of carnivore or anthropogenic modification could be found. Analysis of the cementum annuli from four bovid teeth indicates deaths in late summer and late winter to early spring (Pike-Tay, 1997). The presence of complete bovid carcasses and the apparent lack of modifications suggest that the large bovid remains in this layer were deposited in the absence of hominid activity (Conard, 1999). In the light of the assemblage excavated earlier by Schmidtgen, the seemingly natural bovid-dominated faunal assemblage in layer E points to the presence of diverse archaeological and palaeontological signatures in the Upper Pleistocene sediments of the Wiesbach floodplain.

Wallertheim, find horizon F

This deposit preserves the remains of at least 15 *E. ferus* (643/15) individuals, and at least one *E. hydruntinus* (27/1, Table 2). Horse remains represent more than 90% of the identified faunal remains by count and weight (Prindiville, 1998). Other, less numerous species include large bovid (*Bos/Bison*, 21/2), red deer (*C. elaphus*, 1/1), fallow deer (*D. Dama*, 2/1), roe deer (*C. capreolus*, 3/1), rhinoceros (*Rhinocerotidae*, ind., 1/1), lion (1/1), bear (*Ursus* sp., 30/1) and wolf (1/1). In addition to other environmental indicators, the presence of charcoal from species including spruce (*Picea*), pine (*Pinus*) and birch (*Betula*) suggests that this deposit formed under cooler conditions, with more open grassland than those of find horizon E (Damblon, 1997). Ninety-nine stone artifacts of numerous raw materials and diverse forms were recovered from this layer. Despite the fact that one horse bone was used for retouching lithic artifacts, the lithic assemblage itself provides relatively little evidence for primary on-site stone knapping. Thus, like Wallertheim E, this lithic assemblage appears, at least in part, to represent a background accumulation, which formed independently of the majority of the faunal remains (Conard, 1998). The mortality profile indicates a predominance of sub-adult and senile individuals, which Levine (1983) describes as attritional. While at least one adult individual is represented by all skeletal elements, other individuals are only represented by limb bones. Ten impact scars and nine cut-marked horse bones indicate that hominids butchered and extracted marrow from several of the horses, but traces of carnivore chewing ($n = 26$) are the most abundant type of modification. Seasonality data for this layer derive from the incremental analysis of two horse teeth (*E. ferus*), which indicate both summer and winter deaths (Burke, 1997). The presence of several very young individuals demonstrates mortality during the warmer months, while studies of tooth eruption indicate

deaths during multiple seasons (Prindiville, 1998). As was the case at Wannen V, a combination of anthropogenic and non-anthropogenic agents was responsible for the accumulation of equids in F.

Tönchesberg, find horizon 2B

A wide variety of environmental indicators recovered from this find horizon allows the reconstruction of an open habitat at the time of occupation, which has been dated to one of the first cooling episodes after the Eemian interglacial (Bittmann, 1990; Van Kolfschoten, 1990; Conard, 1992). Several dozen burnt faunal remains and seven burnt lithic finds were recovered in a 4 m^2 concentration, and have been interpreted as the remains of a hearth. The lithic assemblage includes 557 chipped artifacts, and is dominated by locally available quartz, with lesser amounts of quartzites and siliceous slates from the region, and flints from 100 km or more distance. Noteworthy, is the abundance of laminar debitage and diverse backed blades and several backed points, including several with damaged tips. If the 574 fragments of antler are counted, the most abundant species in this archaeological occurrence is red deer. However, for the purpose of examining subsistence and hunting, the shed antlers can be excluded, leaving 32 faunal remains from three individuals. Remains of horse (*Equus* sp., 27/2) and large bovid (*Bos/Bison*, 56/4) are also relatively numerous, with smaller amounts of rhinoceros (*D. hemitoechus*, 9/1), fallow deer (*D. Dama*, 4/2), wild ass (*E. hydruntinus*, 1/1), lynx (*Lynx lynx*, (5/1), fox (*Vulpes vulpes*, 21/1) and hyena (*Hyaenidae* sp., 1/1) (Table 1). The relative frequency of skeletal elements of large bovid represented in the assemblage deviates slightly from those of horse and red deer. Horse and red deer share a similar body part distribution, in which upper limb bones predominate, and both axial and cranial elements are rare or completely absent. While 15 bones exhibiting traces of carnivore chewing could be observed, none of the bones preserve clear cut-marks. The majority of long bone fragments from equids and cervids carry impact fractures, and several of these bones were found in concentrations that could be refitted. Although several limb bones from bovids were not broken, all of the major limb bones of equids and cervids have been cracked by hominids for extracting marrow. Pike-Tay's examination of a single red deer tooth suggests that the occupation occurred in the late fall or early winter (Conard, 1992). Tönchesberg 2B offers evidence for off-site hunting of cervids, equids and, possibly, bovids, followed by the transport of high utility meat and marrow-bearing body parts to the site for further processing and consumption (Conard, 1992).

Plaidter Hummerich, 'Hauptfundschicht', D1

Finds from Plaidter Hummerich, whose main find horizon dates to the early part of the last glaciation (Bosinski *et al.*, 1983b; Kröger, 1987, 1995; Street, 1995) were recovered from a volcanic crater high above the surrounding landscape. Of all the Palaeolithic sites in the East Eifel, Plaidter Hummerich has been described as the most exposed, offering the least protection from the elements (Bosinski *et al.*, 1986). Open, steppe-like conditions have been reconstructed for the time of occupation (Street, 1995). The lithic assemblage from layer D1 contains more than 500 pieces, and is dominated by artifacts made of local quartz. Local materials appear to have been knapped at the site, whereas several artifacts on exotic raw materials were brought into the site as completed tools. As is the case at other sites in the East Eifel, flints from the Meuse Valley over 100 km away are present in the assemblage. Occasional bifacially worked tools are present among several retouched flakes (Kröger, 1987, 1995). The broad spectrum of taxa identified in the assemblage (Turner, 1990; Street, 1995) is dominated by red deer (*C. elaphus*, NISP = 310), horse (*Equus sp.*, NISP = 164) and large bovid (*Bos/Bison*, NISP = 180). This pattern is similar to that of other Early Weichselian sites in the Rhineland. Although the skeletal distributions of the main species are limb-biased, and the assemblage could be viewed as the product of selective transport by hominids, interpretations of this layer must be treated with caution. Information on seasonality

Table 1. Tönchesberg, faunal remains from find horizons 1A, 1B, 2B, 2C and 2D

	1A (lower lava loess)		1A (upper lava loess)		1B		2B		2C		2D		Total	
	n	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight
Bos/*Bison*	4	180	38	1638			56	10 000			1	13	99	11 831
Small Caprid			5	46									5	46
Cervus elaphus	9	254	101	1914	17	482	606	59 673	67	4976	12	1887	812	69 186
Dama dama							4	98					4	98
Equus hydruntinus			1	19	2	94	1	22	1	205			5	340
Equus ferrus	40	3633	49	2394	83	8659	27	3022	9	749	3	572	211	19 029
Coelodonta antiquitatis	2	408	3	n.a.	3	905							8	1313
Diceerorhinus hemitoechus							9	509					9	509
Rangifer tarandus	3	109	8	72	9	422							20	603
Canis lupus			1	3									1	3
Vulpes vulpes	1	2					21	160	2	8			24	170
Felis leo	1	50	2	257									3	307
Lynx lynx							5	10					5	10
Aves indet.			1	n.a.									1	n.a.
Hyaenidae indet.							1	4					1	4
Total, identifed	**60**	**4636**	**209**	**6343**	**114**	**10 562**	**730**	**73 498**	**79**	**5938**	**16**	**2472**	**1208**	**103 449**
Indeterminate					4	53	45	43	19	n.a.	4	n.a.	72	96
Indeterminate, size class 1	1	11	27	186			1	3					29	200
Indeterminate, size class 2	34	447	191	2122	13	48	108	2218	35	479	13	83	394	5397
Indeterminate, size class 3	58	1653	320	7162	57	976	36	2066	2	141	4	277	477	12 275
Indeterminate, size class 4	1	525	2	42			1	110					4	677
Total, indeterminate	**94**	**2636**	**540**	**9512**	**74**	**1077**	**191**	**4440**	**56**	**620**	**21**	**360**	**976**	**18 645**
Total	**154**	**7272**	**749**	**15 855**	**188**	**11 639**	**921**	**77 938**	**135**	**6558**	**37**	**2832**	**2184**	**122 094**

Counts of identified and unidentified remains with approximate weight in grams.
Examples of indeterminate size classes: 1 = beaver, fox, roe deer; 2 = boar, fallow deer, red deer, reindeer, wild ass; 3 = horse, aurochs, bison; 4 = rhinoceros, elephant, mammoth.

and modifications to bone is not yet available. Despite the occasional presence of articulated bones, the preservation in horizon D1 is generally poor and portions of the deposit appear to have been post-depositionally reworked in multiple episodes (Street, 1995). The under-representation of vertebrae, ribs, cranial elements and cancellous tissue as well as cut-marked bone may be the result of bone weathering (Street, 1995). While Middle Palaeolithic hominids are responsible for a portion of the large mammalian fauna, the difficult taphonomic setting has hindered several analyst's attempts to isolate this component of the assemblage.

Tönchesberg 1B

The youngest Middle Palaeolithic faunal assemblage in the region is that of Tönchesberg 1B. This find horizon lies at the base of the Middle Weichselian loess, and has been dated both chronostratigraphically and with TL to ca. 65 ka (Conard, 1992). The sedimentological setting and the faunal assemblage are indicative of an open grassland environment. The lithic assemblage includes 120 chipped artifacts of diverse raw materials, of which quartz is the most numerous. The faunal remains are dominated by horse (83/5), with lesser amounts of red deer (*C. elaphus*, 17/1), reindeer (*R. tarandus*, 9/1), woolly rhinoceros (*C. antiquitatis*, 3/1) and wild ass (*E. hydruntinus*, 2/1). The sediments are probably not in an *in situ* context, but could not have been moved far from their original positions. The assemblage contains the remains of five young horses, all of which would still have been members of family herds at the times of their deaths. Mandibles and limb elements are abundant, while most of the axial skeletal remains are poorly represented, possibly a result in part of taphonomic attrition of elements with low bone density. The remains of other species are too few in number to allow meaningful conclusions to be drawn. In comparison with the faunal assemblages from Tönchesberg 2B, the bones in horizon 1B had not been broken as frequently for marrow. Poor surface preservation prevents the identification of cut-marks. As it is improbable that five young horses would have died in the same location on an isolated hilltop, and been buried with numerous lithic artifacts without active predation, hominid hunting of these animals appears likely. The season of death of the animals, based on tooth eruption, indicates that several distinct episodes are preserved here.

Discussion

Geographic setting and site preservation

The comparison of faunal assemblages in the Rhineland is impeded by variable bone preservation. This problem is seen most acutely in find horizons such as Tönchesberg 2A, the main Middle Palaeolithic horizon at Metternich (Conard *et al.*, 1995a), and the horizons at the locality of Rheindahlen (Thieme, 1983; Thissen, 1986), where abundant lithic artifacts have been recovered, but faunal material is absent. While useful in addressing a number of other questions, these sites provide little information toward addressing the issues of Middle Palaeolithic hunting and subsistence. In some cases, such as Tönchesberg 1A, 1B and Hummerich D1, faunal assemblages have been recovered from reworked contexts that hinder their interpretation. Furthermore, the conspicuous absence or low frequency of cut-marks and other surface modifications in the assemblages from nearly all find horizons suggests that imperfect preservation has led to the loss of information on butchery practices. While the last two decades of fieldwork have provided the information necessary to open a dialogue on Middle Palaeolithic subsistence systems, faunal analysts must still view the current data as a fragmentary, fossil remnant of a much more complicated whole. The several dozen known find horizons located in sedimentary basins represent a fraction of the total number of sites from this period, spanning three glacial cycles and ca. 250000 years. Thus, we are looking at only the smallest pieces of the original picture, which has largely been destroyed by a variety of taphonomic processes. The placement of the known sites is entirely shaped by the positioning of brickyards and lava, pumice and gravel quarries,

which expose the deeply buried Middle and Upper Pleistocene sediments containing sites.

Despite the selection of sites from mining areas, the preceding survey of Middle Palaeolithic occurrences from the Rhineland reveals the exploitation of a wide variety of geographic and topographic settings ranging from elevated volcanic craters in the East Eifel (Schweinskopf, Wannen, Tönchesberg, Hummerich and others), to sites on small tributaries of the Rhine (Wallertheim), as well as sites within the Mosel Valley (Metternich) and the Rhine Valley (Ariendorf). Cave sites in this region, such as Kartstein (Rademacher, 1911) and sites in the neighbouring Lahntal (Terberger, 1993), are rare, and offer limited information on subsistence because of their early discovery, excavation and selective recovery methods. Some trends are visible in the stratigraphic and sedimentary contexts of Middle Palaeolithic sites in the region of study. Sites from the Early Middle Palaeolithic are almost exclusively limited to loess deposits, while Late Middle Palaeolithic sites, and, especially, those from the early glacial, are often found in humic deposits. The only securely dated Eemian find horizon is Wallerthiem A, and the lack of other sites of similar age is almost certainly related to the frequent erosion of interglacial sediments in the region. The humic deposits of the later Early Weichselian, which probably correlate to cold dry phases of OIS 5a, do not contain finds (e.g. Conard *et al.*, 1995b). Finally, aside from the equid assemblage at the base of the Middle Weichselian loess at Tönchesberg 1B, no sites mentioned above date to either OIS 4 or the Middle Weichselian. This is particularly surprising, as in other regions of central and western Europe, this period represents a phase of intensive occupation.

A temporal shift in the positioning of sites during the Early and Late Middle Palaeolithic is not readily detectable. Finds from the scoria cones of the East Eifel are equally numerous before and after the last interglacial. The new interpretation of the Ariendorf stratigraphy (Turner, 1998) does not allow for a Weichselian find horizon, but the broad temporal spacing of horizons 1–3 indicates that this locality was used over multiple glacial cycles. The significance of the absence of Weichselian-aged find horizons at Ariendorf should not be over-interpreted. The absence of Early Middle Palaeolithic find horizons at Wallertheim is not surprising, as pre-Eemian deposits are generally lacking at the site. The general lack of low-lying sites dating to the Early Middle Palaeolithic probably reflects the rarity of low-lying Saalian exposures that could contain such find horizons. Both Metternich (unpublished fieldwork, Conard) and Rheindahlen (Thieme, 1983), however, preserve pre- and post-Eemian finds, albeit lacking fauna, suggesting a level of continuity in the placement of sites.

Concerning the location of sites within the scoria cones of the East Eifel, Schäfer (1990, pp. 108–111, 117–118) has suggested that these positions may have been sought out as unique biotopes offering standing water, different vegetation and shelter, relative to the surrounding landscape. If this had been the case, these previously attractive settings would have ceased to be a focus of human activity, as the basins were filled with sediment during the Late Pleistocene (Conard, 1992). This shift is clearly documented by the near absence of Upper Palaeolithic finds from the scoria cones of the East Eifel. After more than 100000 years of relatively intense Middle Palaeolithic occupation of these mountain top localities, this change reflects a dramatic shift in land-use.

Prey selection and transport

The predominance of a small number of species within a faunal assemblage can reflect prey selection by hominids, a feature that has been used as a criterion to differentiate Middle and Upper Palaeolithic hunting economies (Mellars, 1989). For example, reindeer-dominated Magdalenian assemblages have been interpreted as a reflection of a highly organized hunting economy (Enloe, 1991). However, as Mellars (1989) points out, these specialized faunal assemblages are dependent upon a variety of other extrinsic and intrinsic variables (location, season, group-size), and their interpretation must be treated with caution. Chase (1989) notes that specialized hunted assemblages in the Late Upper

Palaeolithic, although impressive, are relatively infrequent, may represent only one part of a larger subsistence strategy, and can be found in the Middle Palaeolithic as well. The osteometric analysis of faunal remains from over 20 European Middle and Upper Palaeolithic sites led Weinstock-Arenovitz (1997, pp. 187–188) to the conclusion that a predator–prey relationship between hominids and reindeer has existed since oxygen isotope stage 6, and one may assume that this relationship also existed with other species. This hypothesis is supported by the increasing number of open-air Middle Palaeolithic sites dated to the last glacial cycle, in which the remains of large bovids predominate (Gaudzinski, 1996). It seems likely that the economic strategies behind the monospecific assemblages at sites like Wallertheim (Schmidtgen & Wagner, 1929; Gaudzinski, 1995a), Le Borde (Jaubert *et al.*, 1990) and Mauran (Farizy *et al.*, 1994) may have been different from those of the Late Upper Palaeolithic. These differences may not only reflect changes in hominid cognitive abilities, but also changes in the environment, hunting practices and social behaviour.

During the Middle Palaeolithic of the Rhineland, several differences in prey selection exist between sites. Find horizons containing elephants and rhinoceros are more common before the Eemian Interglacial than after. While mammoth is virtually absent from Late Middle Palaeolithic faunal assemblages, both woolly rhinoceros (*Coelodonta antiquitatis*) and narrow-nosed rhinoceros (*Dicerorhinus hemitoecus*) are occasionally found in Late Middle Palaeolithic assemblages (Turner, 1990). Bovids, cervids, and equids are usually the key game species throughout the Middle Palaeolithic and are present in varying frequency, at times to the near exclusion of other species. Reindeer, while present in Weichselian horizons including Tönchesberg 1B, is more frequent in the sites with Saalian loess deposits (Turner, 1990). The fluctuating abundances of bovids, cervids and equids is illustrated in the comparisons of find horizons from Tönchesberg and Wallertheim, presented in Tables 1 and 2. Here, one sees that the abundance of both bovids and equids, based on NISP and weight, occasionally represent well over 75% of assemblages. Cervids are nearly always present, but never truly dominate an assemblage. So far, the rich assemblage of bovid remains from Schmidtgen's excavations at Wallertheim presents the best example of specialized hunting in the Middle Palaeolithic of the Rhineland (Gaudzinski, 1995a,b). However, the diversity of site types and prey species documented at Wallertheim over a period of several tens of thousands of years should not be underestimated (Conard, 1998; Conard *et al.*, 1998).

Recognizable patterns in the transport of animal resources can also be seen among the sites discussed above. These patterns in skeletal abundance of species at times correlate with the position of sites in the landscape. For example, the body part distributions of taxa from the tops of scoria cones, like Tönchesberg 2B and 1A, Wannen IV and V and Schweinskopf V, suggest that horse, red deer, large bovids and, perhaps, juvenile rhinoceros were acquired off-site, and that their limbs were selectively transported to the sites. Some of the faunal constituents of lower-lying sites, like Wallertheim E, F and the Schmidtgen excavations, suggest that these animals died at or near where their skeletons were excavated. These sites represent positions in the landscape where hominids hunted animals, or, at times, scavenged from fresh carcasses. In contrast, Wallertheim A and D represent Late Middle Palaeolithic sites to which skeletal portions from multiple kills were repeatedly transported. At the Early Middle Palaeolithic sites, including Schweinskopf IV, skeletal part data indicate that horses and even rhinoceros were hunted at or very near the site. The size of quarry also appears to have influenced skeletal frequencies. The elephant remains from Ariendorf 2, and the rhinoceros remains from Wannen IV, document the presence of entire animals, suggesting that these animals died or were killed on site.

In summary, two distinct patterns of body part representation can be identified:

1. Sites in which most skeletal elements of animals are present. In the Rhineland, this pattern is particularly common with larger mammalian species, and is unknown among game species smaller than large equids.

Table 2. Wallertheim, faunal remains from six find horizons (A–F)

	A		B		C		D		E		F		Total	
	n	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight	*n*	Weight
Bos/Bison	46	257	139	6267	54	2746	21	1202	361	53 637	21	1857	642	65 966
Bos primigenius											1	60	1	60
Capreolus capreolus											3	15	3	15
Cervus elaphus	5	96	9	58	1	21	8	55	3	54	1	4	27	288
Dama dama	23	192	25	123	8	64	1	2	1	4	2	6	60	391
Cervidae, ind.	1	62	3	4	2	3	2	2			2	12	10	83
Sus scrofa			3	40									3	40
Equus ferus	13	512	31	1862	61	3620	100	3340	44	1507	643	38409	892	49 250
Equus hydruntinus					2	296	7	399	2	87	27	811	38	1593
Equus sp.	3	144	6	158	15	358	4	52	8	127	31	281	67	1120
Rhinocerotidae, ind.			1	657	2	80					1	95	4	832
Castor fiber	1	2	7	45	2	5	1	2					11	54
Ursus sp.											30	1953	30	1953
Canis lupus	3	9			10	94	1	3	1	9	1	3	16	118
Vulpes vulpes					1	2	1	1	32	159			34	162
Panthera leo			1	6	3	94	25	1524	1	3	1	9	31	1636
Aves indet.							6	25			2	2	8	27
Crocuta crocuta					2	8							2	8
Total, identifed	**95**	**1274**	**225**	**9220**	**163**	**7391**	**177**	**6607**	**453**	**55 588**	**766**	**43 517**	**1879**	**123 597**
Indeterminate	157	180	86	350	45	222	122	625	77	733	55	1043	542	1242
Indeterminate, size-class 1							3	8	3	8	3	16	9	32
Indeterminate, size-class 2	31	152	49	330	41	304	40	201	9	59	74	511	244	1557
Indeterminate, size-class 3	99	1618	186	2223	206	3084	157	2370	179	3790	308	3628	1135	16 713
Indeterminate, size-class 4					3	197	4	100					7	297
Total, indeterminate	**287**	**1950**	**321**	**2903**	**295**	**3807**	**326**	**3304**	**268**	**4590**	**440**	**5198**	**1937**	**19 841**
Total	**382**	**3224**	**546**	**12 123**	**458**	**11 198**	**503**	**9911**	**721**	**60 178**	**1206**	**48715**	**3816**	**143 438**

Counts of identified and unidentified remains with weight in grams.
Examples of indeterminate size-classes: 1 = beaver, fox; 2 = boar, fallow deer, reindeer, wild ass; 3 = red deer, horse, aurochs, bison; 4 = rhinoceros, elephant, mammoth.

2. Sites in which limb bones of higher utility predominate and have frequently been broken open to extract marrow. This type of distribution is particularly prevalent among cervids, bovids and equids, and is documented in both the Early and Late Middle Palaeolithic.

Find horizons with over-representation of heads and distal limb bones are uncommon. This may be explained by the thorough collection procedures used during excavation, and by the heavy emphasis on studying and refitting all classes of remains, including limb bone fragments (cf. Marean & Kim, 1998).

Mortality profiles

For many species at sites from the Rhineland, age profiles are of limited use because the samples are often too small to produce meaningful results. However, when a sufficient number of individuals are present, several recognizable patterns can be observed. Remains of horses from all age groups are present in the Saalian deposits at Schweinskopf IV (Schäfer, 1990), suggesting that no single age group was selected over another. Prindiville (1998) describes the horse mortality profile at Wallertheim F as 'attritional', as both very young and very old individuals predominate, whereas Justus (1992) suggests that two different patterns among horse remains are present at Wannen V. In contrast to this, the majority of bovids from Schmidtgen's excavations at Wallertheim are attributable to 'prime-aged' adults (Gaudzinski, 1995a).

These sites demonstrate variable, and in some cases, overlapping mortality patterns, rather than the dominance of a single idealized age profile, as has been presented in other Palaeolithic contexts (cf. Klein, 1982; Levine, 1983; Stiner, 1990). Specific animal behaviour and its relationship to an animal's age and sex must also be considered when interpreting mortality profiles. One cannot necessarily assume that the hunting of prime-aged animals was the goal of Palaeolithic peoples. As Turner (1998, p. 172) has pointed out, for some species, including elephant, it may have been easier to hunt young and old animals. Furthermore, no single mortality pattern should be expected or seen as a universal signature for hominid hunting. For example, the assemblage from Tönchesberg 2B can be characterized as containing prime age adults that were hunted in multiple episodes from the surrounding populations of bovids, cervids and equids. In contrast, the assemblage from Tönchesberg 1B is dominated by very young horses, apparently taken from family herds. The occurrence of old and young animals in an assemblage may at times be the result of deliberate hunting, and not necessarily the result of hominid scavenging or carnivore kills. Just as modern human and non-human hunters do not exclusively restrict their hunting to prime age animals, there is little reason to expect this to be the single signature of hunting for all prey species among Palaeolithic hunters.

Seasonality

The seasonality data from several sites in the Rhineland indicate occupation at different times of the year, which is to be expected in any region in which year-round occupation persisted. On the basis of cementum annuli studies of bovids, cervids and equids (Burke, 1997; Pike-Tay, 1997), the two well-preserved camps of Wallertheim find horizons A and D on the Wiesbach floodplain both represent summer occupations. Studies of equid tooth eruption (Prindiville, 1998) and cementum annuli (Burke, 1997) indicate multiple seasons of death at Wallertheim F. Provided these determinations can be seen as indicators of hominid presence, they suggest more complex seasonal use of the Weisbach floodplain (Conard *et al.*, 1998). At Wallertheim E, cementum annuli studies indicate bovid deaths in both the warm and cold parts of the year (Pike-Tay, 1997). Tönchesberg has also yielded a complex pattern of occupation. Pike-Tay (1997) has identified late autumn and early winter as the season of death of red deer at Tönchesberg 1A and 2B. Burke's (1997) cementum annuli determination on a single horse tooth indicated a spring death at the upper lava loess of Tönchesberg 1A.

A purely palaeontological accumulation at Tönchesberg 1A offers an example of one

assemblage that formed independently of hominids. In contrast to the archaeological horizons, this palaeontological accumulation yielded winter and late winter seasonality, based on cementum annuli for horse and red deer, respectively (Conard, 1992). This period of nutritional stress is when a high proportion of deaths independent of hominid influence could be expected.

Unfortunately, many find horizons in the region have yet to yield reliable seasonality data. However, annual cementum studies may provide the best prospects for gaining additional data, which would be useful in confirming or refuting the following patterns:

1. The Wiesbach floodplain in Wallertheim served as an attractive summer camp to which hominids transported high quality body parts of individual bovids, cervids and equids.
2. Red deer found in archaeological contexts at Tönchesberg represent late autumn or early winter kills.
3. Predominantly non-anthropogenic faunas include examples of deaths both during the cold season, as well as from multiple seasons.

More data on the seasonal use of sites in the region is critical for any attempts to reconstruct the Middle Palaeolithic settlement systems of the Rhineland.

Hunting versus scavenging

Two commonly cited criteria for scavenging included an over-representation of low utility skeletal parts, particularly heads and feet, and the predominance of attritional mortality profiles characterized by an abundance of very young and very old individuals (Binford, 1981, 1984, 1985; Stiner, 1991, 1994; Marean, 1998; Marean & Kim, 1998). Rarely, if ever, can both of these criteria be met with faunal assemblages of the Rhineland.

The generally low frequency of cut-marked bone at sites in the Rhineland could also be seen as a further argument for scavenging. However, as Conard (1992), Turner (1998) and others have discussed, the level of surface preservation at sites in the Rhineland often leaves little possibility for identifying cut-marks. The levels of carnivore-chewed bone, while marginally higher, are still far lower than those of assemblages published from other regions. The most common indications of anthropogenic modification to bones from the Middle Palaeolithic of the Rhineland are impact fractures, which result from dynamic loading of compact bone (Johnson, 1985). These modifications are more commonly preserved, but of only marginal consequence, as the act of bone cracking does not require that hominids have hunted the animal in question.

In the Rhineland, the main evidence for hunting consists of repeated cases in which high utility body parts of predominantly prime-aged prey have been transported to sites for processing and consumption. While neither of the these observations rigorously prove that hunting was, in every case, the mode of acquisition, they do indicate repeated access to high utility body parts. These observations suggest hunting or, at a minimum, early access scavenging as a mode of procurement. Given the well-documented existence of wooden hunting spears in the Lower and Middle Palaeolithic of Germany, and the presence of stone points among the Middle Palaeolithic artifact assemblages of the Rhineland, hunting is the most likely explanation for the composition of these faunal assemblages. In addition, evidence for both seasonal patterns of prey exploitation and the curation and maintenance of hunting tool kits (Conard, 1997; Conard & Adler, 1997) suggest a systematic and controlled use of the landscape in which hunting was carefully planned and executed to meet the needs of Middle Palaeolithic groups.

Nonetheless, the likelihood is high that scavenging augmented the more dominant mode of food procurement via hunting. As O'Connell *et al*. (1988) have demonstrated, scavenging plays a detectable role among the food procurement strategies of contemporary hunters and gatherers. There is no need to view scavenging as either fundamentally undesirable relative to hunting, or as indicative of lesser cognitive skill when comparing hominid populations. Barring

behavioural taboos, hominids from all time periods would have welcomed the windfall of scavenging a freshly dead animal when the circumstance arose.

Lithic technology and subsistence

In the Rhineland, most lithic assemblages associated with faunal remains contain high percentages of unmodified flakes, low percentages of formal tools and no clear correlation between lithic types and particular hunting or butchering activities. As a result of the abundance of non-flint raw materials, microwear studies have rarely been attempted, effectively eliminating this line of inquiry. The only lithic assemblage types which clearly stand out among the find horizons discussed above are the laminar assemblages from Tönchesberg 2B (Conard, 1990) and Wallertheim D (Conard & Adler, 1997). Both of these sites provide evidence for lithic retooling and the curation of tools at camps to which high-utility skeletal parts of equids, cervids and, to a lesser extent, bovids were transported. Conspicuous among the lithic artifacts of both sites are backed and double backed blades, bladelets and points (Conard & Adler, 1997). Several points from Tönchesberg 2B and Wallertheim D preserve damage to their tips, which can be seen as an indication that they were used as weapons. At Wallertheim D, burins are also well represented. The lithic assemblages from the other sites discussed above are either too small to be clearly characterized, or are dominated by tools and debitage of quartz or other materials with irregular knapping properties.

Mobility and intensity of occupation

The duration and intensity of Palaeolithic occupations can be approximated by examining the abundance of faunal and lithic materials and by archaeological features. Although the majority of species discussed above are represented by fewer than five individuals per sample, these remains still represent hundreds or even thousands of kilograms of edible and otherwise useful materials. The faunal evidence suggests that Middle Palaeolithic sites in the Rhineland represent either:

1. remains of large camps which supported larger groups of people for relatively long periods of time;
2. or sites which were visited by smaller groups on several occasions.

Problems of demonstrating contemporaneity of finds in a single geological horizon can hinder interpretation in these contexts (Conard & Adler, 1997; Conard *et al.*, 1998). The lithic assemblages associated with the faunal remains from these sites are often small, and there is little evidence for structures during the Middle Palaeolithic of the Rhineland. Such features, when present, usually represent the remains of hearths as at Tönchesberg 2B and Wallertheim A. The only other candidates for features are possible structures made of lava and antler at Tönchesberg 2B and the thus far unpublished concentrations of silicified limestone manuports in several of the find horizons at Wallertheim. Had these sites been intensely used, more features could be expected. On balance, these data are suggestive of relatively brief occupations that may reflect the presence of several family groups or smaller segments of these Middle Palaeolithic populations.

While not always the case, the density of faunal and lithic materials at these sites is generally low, and this may be a by-product of settlement in unconstrained space and small areas of excavation that rarely cover more than a few hundred square metres. These excavations are often too small to identify the spatial limits of occupations (cf. O'Connell, 1987). As discussed above, some horizons such as Wallertheim A and D appear to result from occupations at a single time of the year, but even these horizons could easily reflect multiple periods of occupation and be taken to suggest a subsistence strategy in which mobility was high and occupation intensity, relatively low. The Rhineland has yet to produce indications of true base camps reflecting several months of occupation in which dozens of prey animals and a wide array of archaeological features are found (Conard, 1998). At present, the duration of occupation of most find horizons could be best

measured in hours, days and, in some cases, weeks; nowhere in the Rhineland are sites indicative of long-term occupation known. Compelling arguments for long-term occupations first appear in the Upper Palaeolithic, with the appearance of semi-permanent occupations at the Magdalenian sites of Andernach and Gönnersdorf. The settlement intensity and population density in the Rhineland during the Middle Palaeolithic was probably sparse when compared with archaeologically richer regions, including northern and southwestern France or the parts of Levant during periods of favourable environmental conditions.

Conclusions

This review of the current data from Middle Palaeolithic excavations in the Rhineland represents an attempt to synthesize the most important data relevant to subsistence, settlement and hunting economies in the region. Better temporal resolution and environmental data are still needed to help identify more meaningful patterns of subsistence. Many of the observations and generalizations presented here can be viewed as working hypotheses that could help to enhance critical studies of Middle Palaeolithic subsistence and settlement. If the pace of field and laboratory research in the region remains high, the coming decades should allow for a refinement of the ideas and hypotheses presented here.

Acknowledgements

Our thanks go to G. Bosinski, S. Gaudzinski, A. Justus, K. Kröger, J. Schäfer and, especially, M. Street and E. Turner for countless discussions over the years. We are grateful to D. Adler, A. Kandel, L. Niven, M. Prindiville, H.-P. Uerpmann, and an anonymous reviewer for their useful comments on an earlier draft of this paper. We also thank A. Burke for inviting us to participate in the 1998 ICAZ symposium, and particularly for her patience as we prepared this paper during three field seasons far from our home institute. Excavation and analyses at Tönchesberg and Wallertheim were made possible through the financial support of the Deutscher Akademischer Austauschdienst (DAAD), Deutsche Forschungsgemeinschaft (SFB 275), the Landesamt für Bodendenkmalpflege in Mainz, the University of Connecticut and the Leakey Foundation. The staffs of the Römisch-Germanisches Zentralmuseum in Mainz and the Department of Early Prehistory and Quaternary Ecology of the Univeristy of Tübingen provided much technical support for the fieldwork and laboratory analyses reported here.

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