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Pleistocene Stratigraphy and Vertebrate Faunas from the Neuwied Basin region of Western Germany.

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SUMMARY
Pleistocene vertebrate faunas mainly from archaeological sites have been discovered in the Neuwied Basin area of western Germany since the end of the C 19th. The results of recent research into the stratigraphy and biostratigraphy of these sites are briefly reviewed in this paper.

SAMENVATTING
Sinds het eind van de 19de eeuw zijn in het Neuwieder Bekken (Duitsland) pleistocene vertebrate fauna's, meestal bij archeologische opgravingen, ontdekt. De resultaten van recent onderzoek naar de stratigrafie en de biostratigrafie van deze vindplaatsen worden in dit artikel samengevat.

Introduction

The Neuwied Basin is situated in the Central Rhineland of Germany - a part of the Rhine valley where the river flows through the slate massif of the Rhenish Shield (fig.1a). The basin was formed by tectonic sinking of part of the Rhenish slate massif during the Middle Oligocene (SCHIRMER, 1990).

During the Pleistocene period river-gravels, loess and volcanic ash were gradually deposited in the basin. The importance of these deposits for the Quaternary in general had already been noted in the early 1900's (POHLIG, 1913), while the first fossils from the region had been published even earlier (SCHAAFFHAUSEN, 1879).

Over the past few years, archaeologists have discovered and excavated numerous Palaeolithic open sites in Middle and Late Pleistocene loess deposits of the region. Of especial interest here is the large amount of faunal material from several species of mammals associated with the lithic assemblages at these sites. Dating of the fossiliferous horizons is possible by means of correlation with age-equivalent stratigraphic markers, by absolute dating of loess (thermoluminescence) and volcanic deposits (potassium/argon and argon/argon) and by mammalian biostratigraphy.

In 1987 an interdisciplinary research group, supported by the Deutsche Forschungsgemeinschaft, was established to investigate Middle and Late Pleistocene localities and Palaeolithic sites in the Neuwied Basin.

Several institues are participating in this project covering aspects such as archaeology (Forschungsstelle Altsteinzeit, Neuwied), palaeontology and malacology (Institut für Paläontologie, Bonn), palaeobotany (Institut für Palynologie und Quartärwissenschaft, Göttingen), geology (Geologisches Institut, Cologne) and tephrachronology (Geomar, Kiel). The material excavated from the archaeological sites is being worked upon in the research facilities of the Forschungsbereich Altsteinzeit of the Römisch-Germanisches Zentral-museum, Neuwied, where some of the finds are already on view to the public in the associated Museum für die Archäologie des Eiszeitalters.

Pleistocene Stratigraphic divisions

In accordance with current practise, the Pleistocene will be divided in this paper into three main phases, designated as Early, Middle and Late Pleistocene. The magnetic reversal at the Matuyama-Brunhes boundary is taken as marking the boundary between the Early and the

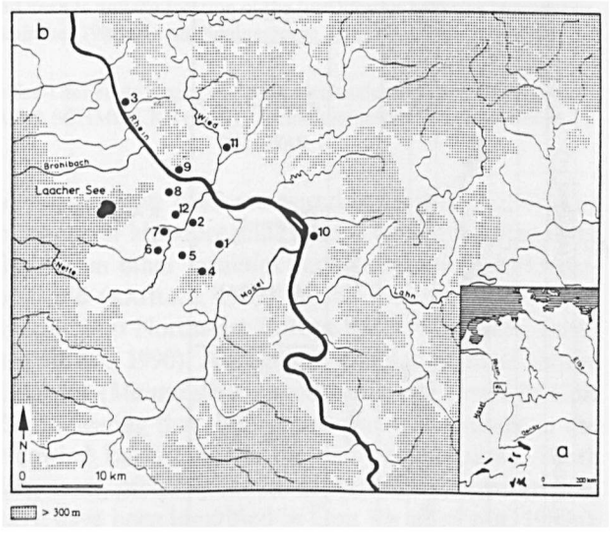

Fig. 1: a) Location of the Neuwied Basin.

b) Location of Early, Middle and Late Pleistocene sites described in the text. 1: Kärlich; 2: Miesenheim I; 3: Ariendorf; 4: Schweinskopf-Karmelenberg; 5: Wannen; 6: Tönchesberg; 7: Plaidter-Hummerich; 8: Andernach-Martinsberg; 9: Gönnersdorf; 10: Urbar; 11: Niederbieber; 12: Miesenheim II.

Fig. 1: a) Ligging van het Neuwieder Bekken.

b) Ligging van de Vroeg-, Midden- en Laat Pleistocene vindplaatsen. (1 t/m 12 zie engels onderschrift)

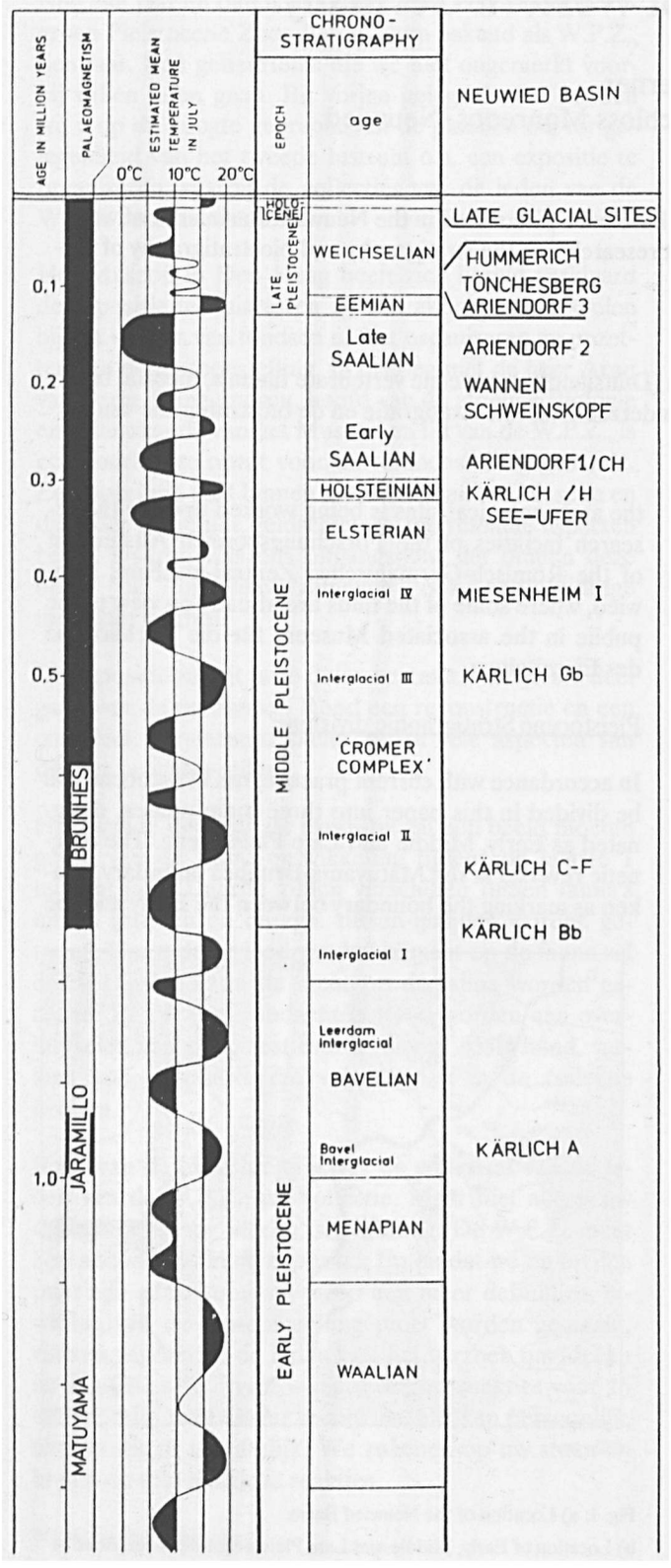

Fig. 2: Standard division of the Pleistocene in Europe and the proposed stratigraphical position of sites in the Neuwied Basin.

Fig. 2: Standaard indeling van het Pleistoceen in Europa en de veronderstelde stratigrafische posities van de vindplaatsen in het Neuwieder bekken.

Middle Pleistocene. The beginning of the Late Pleisstocene is correlated with the beginning of the Last or Eemian Interglacial at about 128,00 BP (Isotope Stage 5e).

The Middle and Late Pleistocene periods are divided in North-West Europe into a sequence of warm (interglacial) and cold (glacial stages. These begin with the early Middle Pleistocene Cromer complex of warm and cold stages, followed by the Elster glacioation and the Holsteinian interglacial. The following cold stage, the Saalian, is subdivided by a further warm phase into an older and a younger phase. The Saalian is followed by the Eemian, an interglacial, and finally by the Weichselian cold stage. Provisional correlations between the sites described in this paper and the Pleistocene divisions are given in fig. 2.

EARLY AND EARLY MIDDLE PLEISTOCENE

Early and early Middle Pleistocene deposits are exposed in the Kärlich clay-pit and at Miesenheim I.

The Kärlich clay-pit

The Kärlich clay-pit is situated on the south-western edge of the Neuwied Basin (fig.1b). Commercial exploitation of high quality Tertiary clays for the ceramic industry began in the late 1890's and continues today. The clays lie some 20-30 metres below the present-day surface and their exploitation necessitates the removal of overlying Pleistocene gravel and loess deposits. The majority of the large mammal remains have been collected over several decades by Konrad Würges (BOSINSKI, 1983a; BOSINSKI *et al.*, 1980) and are exhibited in the Rheinlandhalle, Mülheim-Kärlich.

The Kärlich section is divided into a Tertiary basal series and a Quaternary (= Pleistocene) cover series. The Pleistocene deposits consist of a fluvial series overlain by loess beds with intercalated tephra horizons and palaeosols (fig. 3).

The basal fluvial deposits consist mainly of gravels laid down by the Rhine and Moselle (Units Ba and Bb). Tilted sands abd gravels are occasionally preserved at the base of this sequence (Unit A). A magnetic reversal in Unit Bb has been correlated with the Matuyama-Brunhes boundary, dated to about 730,000 BP. An older polarity reversal in unit A may be the equivalent of the Jaramillo Event (BOENIGK *et al.*, 1974). Units A and Ba therefore date to the latter part of the Early Pleistocene.

The units C - H were deposited during the early Middle Pleistocene period. Results of the most recent absolute dating of tephra by argon/ argon (40Ar/ 39Ar) laser dating and of loess by thermoluminescence dating are given in fig. 3. Discrepancies in the results between these two methods are apparent at this locality and others (see below, Ariendorf).

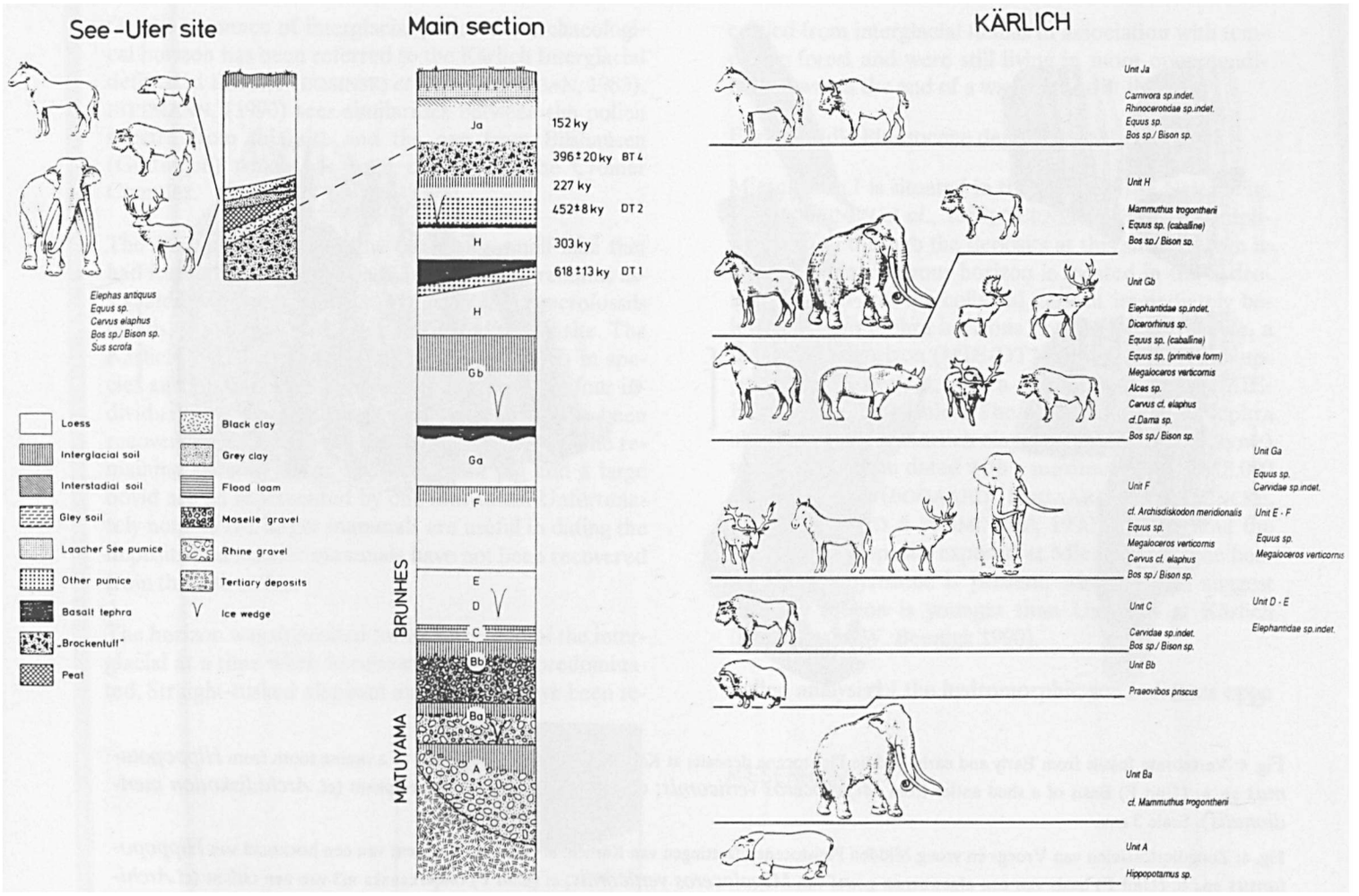

Fig. 3: Simplified section through the deposits at the Kärlich main section and See-Ufer site and the location of the fossiliferous horizons. Argon/Argon dates of tephra horizons DT 1, DT 2 and BT 4 after Bogaard, Bogaard & Schmincke (1989); thermoluminescence dates after Zöller, Stremme & Wagner (1988).

Fig. 3: Schematische doorsnede van de afzettingen van de vindplaatsen Kärlich en See-Ufer en de ligging van de fossielhoudende lagen. Argon/Argon waarden van de tuflagen DT1 en DT 2 en BT 4 naar BOGAARD, BOGAARD & SCHMINCKE (1989); thermoluminescentie waarden naar ZÖLLER, STREMME & WAGNER (1988).

The beginning of volcanic activity in the East Eifel is also shown by the heavy mineral spectrum of the deposits (RAZI-RAD, 1976). In unit Gb the first appearance of heavy minerals of volcanic origin is marked by a dominance of brown hornblende. This is replaced as the dominant mineral by pyroxene towards the base of unit H (pers. comm. W. Boenigk).

Molluscan remains from these units have been previously described by REMY (1959) and by LOZEK (in BRUNNACKER, 1971). Recent investigations have confirmed the earlier results (KOLFSCHOTEN, ROTH & TURNER, 1990); the molluscan faunas from the loess deposits indicate mainly cold, occasionlly damp climatic conditions. The molluscs from unit H indicate warmer conditions.

Early Pleistocene vertebrate faunas from Kärlich

Fragments of canine teeth of hippopotamus (*Hippopotamus* sp.) have been recovered in Unit A (fig. 4). The presence of hippopotamus here is evidence, along with finds from other localities such as Meiningfeld-Untermassfeld (KAHLKE, 1987), of the first migration ofthis species into Northwest Eorope (KOLFSCHOTEN, ROTH & TURNER, 1990). A fragment a molar tooth of steppe elephant (*Mammuthus trogontherii*) was found in Unit Ba, indicating that this species was also present in the Neuwied Basin towards the end of this phase. Teeth fragments, probably of extinct musk-ox (*Praeovibos priscus*), have been identified in Unit Bb (TURNER, 1989a). which may belong to either the Early or early Middle Pleistocene.

Early Middle Pleistocene vertebrate faunas from Kärlich (fig. 4)

Typical elements of the faunas from Units C-H are extinct species such as *Mammuthus trogontherii* and the early Middle Pleistocene form of giant deer *Megaloce-*

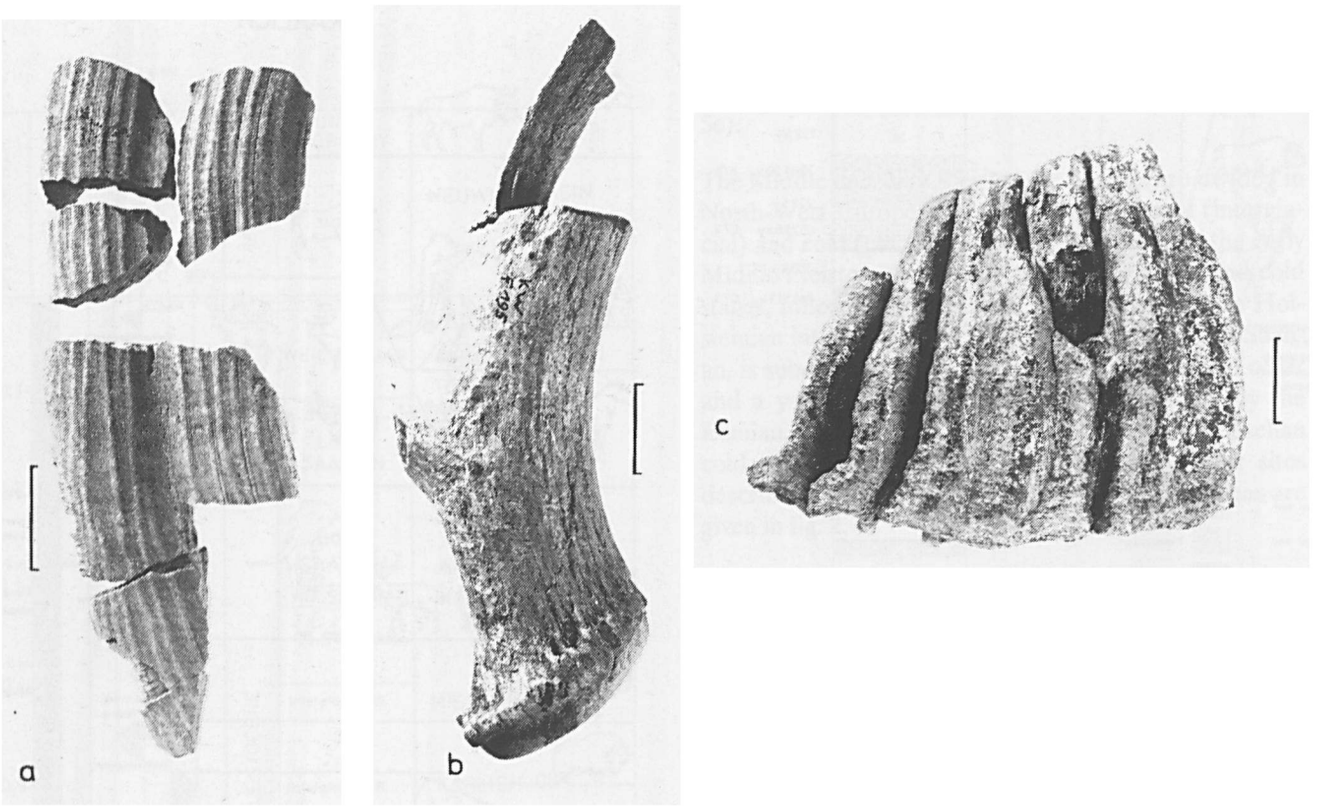

Fig. 4: Vertebrate fossils from Early and early Middle Pleistocene deposits at Kärlich. a: (Unit A) Fragments of a canine tooth from *Hippopotamus* sp. b: (Unit F) Basis of a shed antler from *Megaloceros verticornis*; c: (Unit F) Lower m3 from elephant (cf. *Archidiskodon meridionalis*). Scale 3 cms.

Fig. 4: Zoogdierfossielen van Vroeg- en vroeg Midden Pleistocene afzettingen van Kärlich. a: (Unit A) fragment van een hoektand van *Hippopotamus* sp.; b: (Unit F) basis van een afgeworpen gewei van *Megaloceros verticornis*; c: (Unit F) onderkaanks m3 van een olifant (cf *Archidiskodon meridionalis*). Schaal 3 cm.

ros verticornis. Occuring for the first time in these deposits are species such as caballine horses (*Equus* sp.) and red deer (*Cervus elaphus*) which have long stratigraphic ranges in the Neuwied Basin.

Interesting in unit F are several complete and fragmentary elephant molars which show some morphological similarities with those of *Archidiskodon meridionalis* (KOLFSCHOTEN & TURNER in press). A shed antler of extinct giant deer (*Megaloceros verticornis*) has been recovered from Unit F and teeth from the same species are present in Unit Gb (TURNER, 1989a). ROTHAUSEN, (1970) also described antler fragments from Unit E or F as belonging to this species.

Horse remains have been found in most of the loess units. Caballine horses occur in Unit G along with horses possessing a more primitive dental morphology. NOBIS (1970) has compared equid remains from Unit E or F with those of *Equus süssenbornensis*.

In Unit E several species of the extinct genus *Mimomys* occur, which dates this deposit to the early Middle Pleistocene. In Unit Gb the genus *Arvicola* (water voles) appears for the first time. Thus, the biostratigraphically important change from *Mimomys* to *Arvicola* must have taken place sometime between the deposition of the Units E and G.

Broadly speaking, the fauna from G belongs to the same group as that from Miesenheim I (see below) and the main fauna from Mosbach and Mauer.

The Kärlich "Seeufer" site

Excavations have been undertaken in the south-eastern part of the pit since 1980, when Konrad Würges discovered a hand-axe eroding out of newly quarried deposits here (BOSINSKI *et al.*, 1980; KRöGER, 1990b). Unfortunately the lack of any direct connection between the main section deposits and the sequence revealed here (fig. 3) means that the exact stratigraphic position of the archaeological horizon is still not clear. Slumped deposits of tephra ("Brockentuff") located below the archaeological horizon suggest that thereis a close chronological correlation between the site and an interglacial sequence in the main section (Unit H), which is overlain by in situ deposits of "Brockentuff".

This tephra has been dated to about 396.000 +/- 20.000 BP in the main section deposits at Kärlich (BOGAARD, BOGAARD & SCHMINCKE, 1989; BOGAARD & SCHMINCKE, 1990).

On the presence of interglacial pollen the archaeological horizon has been referred to the Kärlich Interglacial defined at this site (BOSINSKI *et al.*, 1980; URBAN, 1983). BITTMANN, (1990) sees similarities between the pollen spectra from this site and the one from Bilshausen (Göttingen) which has been referred to the Cromer Complex.

The site was located on the bank of a small lake that had formed in a depression. Large mammal remains associated with many stone artifacts and macrofossils (seeds, wood etc.) have been excavated at this site. The Kärlich "Seeufer" fauna is not particularly rich in species and is dominated by the remains of at least four individuals of straight-tusked elephant which have been recovered so far from the site (TURNER, 1989a). The remaining species, horse, red deer, wild pig and a large bóvid are all represented by one individual. Unfortunately none of the larger mammals are useful in dating the deposits and smaller mammals have not been recovered from this site so far.

The horizon was deposited towards the end of the interglacial at a time when hornbeam woodland predominated. Straight-tusked elephant and wild pig have been recorded from interglacial faunas in association with temperate forest and were still living in more open conditions towards the end of a warm phase at this site.

Early Middle Pleistocene deposits at Miesenheim I

Miesenheim I is situated in the valley of the Nette (Fig. 1b) (BOSEINEN *et al.*, 1984; TURNER, 1989b). A simplified section through the deposits at this site is shown in fig. 5. The fossiliferous horizon is located in the hydromorphic soil and the colluvial deposit immediately below this. Two tephra horizons are present at the site, a thin pumice horizon (MIE-DT1) directly above the upper colluvial deposit, and a thicker basalt ash (MIE-BT1) above the pumice. The same sequence of tephra also occurs in the Kärlich clay-pit in Unit H (see above) where it has been dated with a maximum age of 618.000 ± 13.000 BP (BOGAARD, BOGAARD & SCHMINCKE, 1989; BOGAARD & SCHMINCKE, 1990). Throughout the sequence of deposits exposed at Miesenheim I the heavy mineral pyroxene is present, which would suggest that the section is younger than Unit Gb at Kärlich (pers. comm. W. Boenigk 1990).

Pollen analysis of the hydromorphic soil indicates open

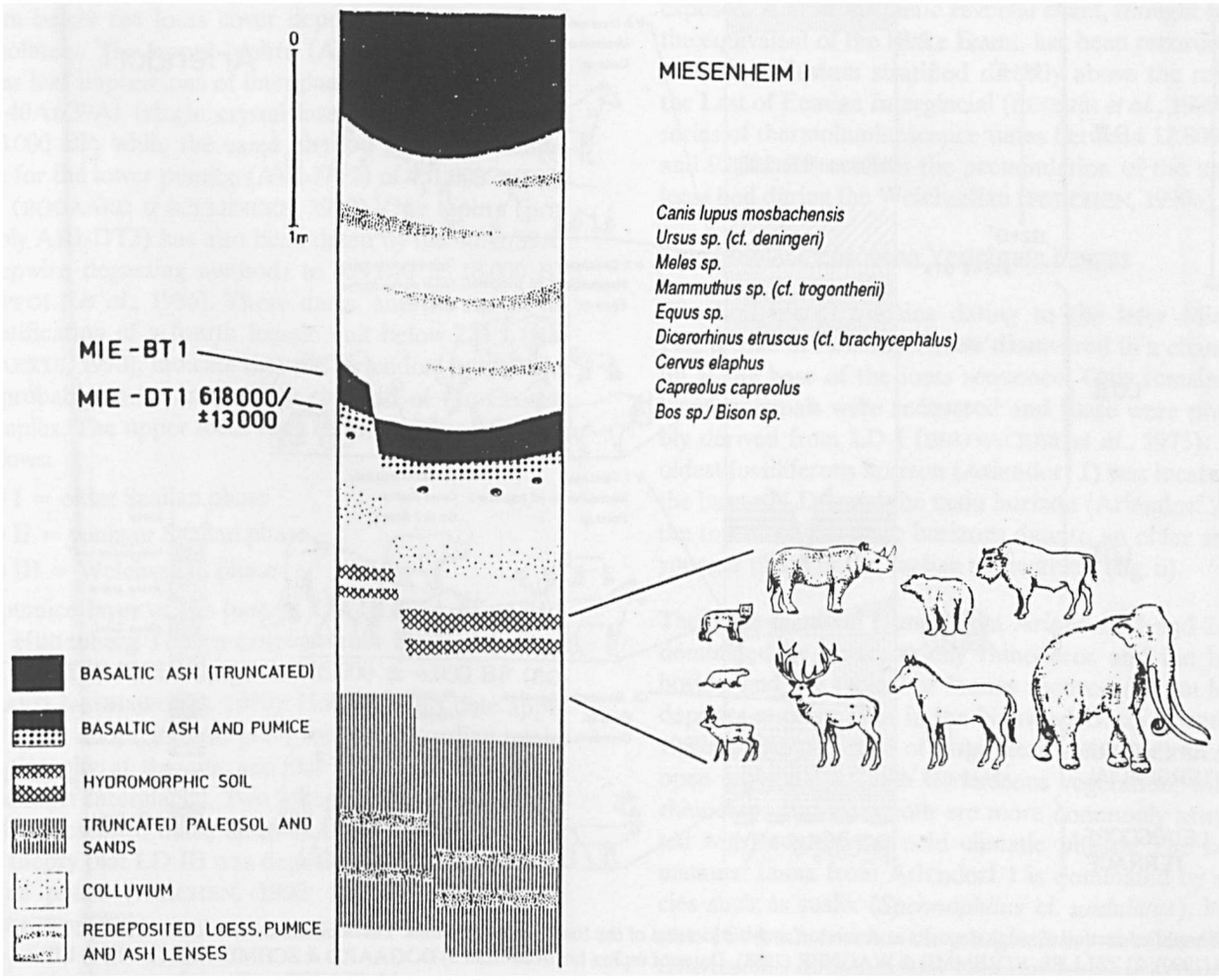

Fig. 5: Simplified section through deposits at Miesenheim I and the location of the fossiliferous horizon. Maximum age of the tephra horizon MIE-DT1 taken from BOGAARD & SCHMINCKE (1990).

Fig. 5: Schematische doorsnede door de afzettingen van Miesenheim I en de plaats van de fossielhoudende laag. Maximum ouderdom van de tuflaag

pine and birch woodland which has been interpreted as indicating the end of an interglacial phase (URBAN in BOSCHEINEN *et al.*, 1984).

The rich fauna supports this interpretation. Amongst the fragmentary molluscan remains occur species indicative of warm conditions; the presence in the fauna of the wood mouse (*Apodemus*), dormice (*Eliomys* and *Muscardinus*) and roe deer (*Capreolus capreolus*) also indicate forested conditions. Species usually associated with a more open environment such as the hamsters (Cricetus and *Allocricetus*) and horse (*Equus* sp.) are, however, also present. Several species of molluscs, a single, fragmentary fish vertebra, the remains of waterfowl and beavers (*Castor* and *Trogontherium*) indicate that at the time of deposition of the layer a body of water, possibly a small lake with rich vegetation growing along its banks, was present at the site.

Biostratigraphically important for the dating of the Miesenheim I find horizon are certain extinct faunal elements such as the extinct Mosbach wolf (*Canis lupus mosbachensis*), a bear, tentatively indentified as Deningers bear (*Ursus* cf. *deningeri*) and Etruscan rhinoceros (*Dicerorhinus etruscus* cf. *brachycephalus*), which are all known to have become extinct before the Holstein Interglacial (TURNER, 1989a).

Important in the microfauna is the primitive form of the ground vole (*Arvicola terrestris cantiana*). KOLFSCHOTEN (1990a, 1990b) places this fauna in the Cromer IV Interglacial. This interglacial is generally dated to between 400 000 - 450 000 BP which shows that the maximum age given for the tephra stratified above the find-horizon is about 100.000 years too old.

Later Middle and Late Pleistocene

So far, the only fossiliferous horizons in the Neuwied Basin dating to the later Middle Pleistocene are from cold stage deposits. Assemblages dating to an older phase of the Saalian Cold stage have been recorded at Ariendorf (Ariendorf 1 and Channel-infill) and assemblages dating to a younger Saalian phase have been recovered at the same locality (Ariendorf 2) and in the craters of the extinct Wannen and Schweinskopf volcanoes.

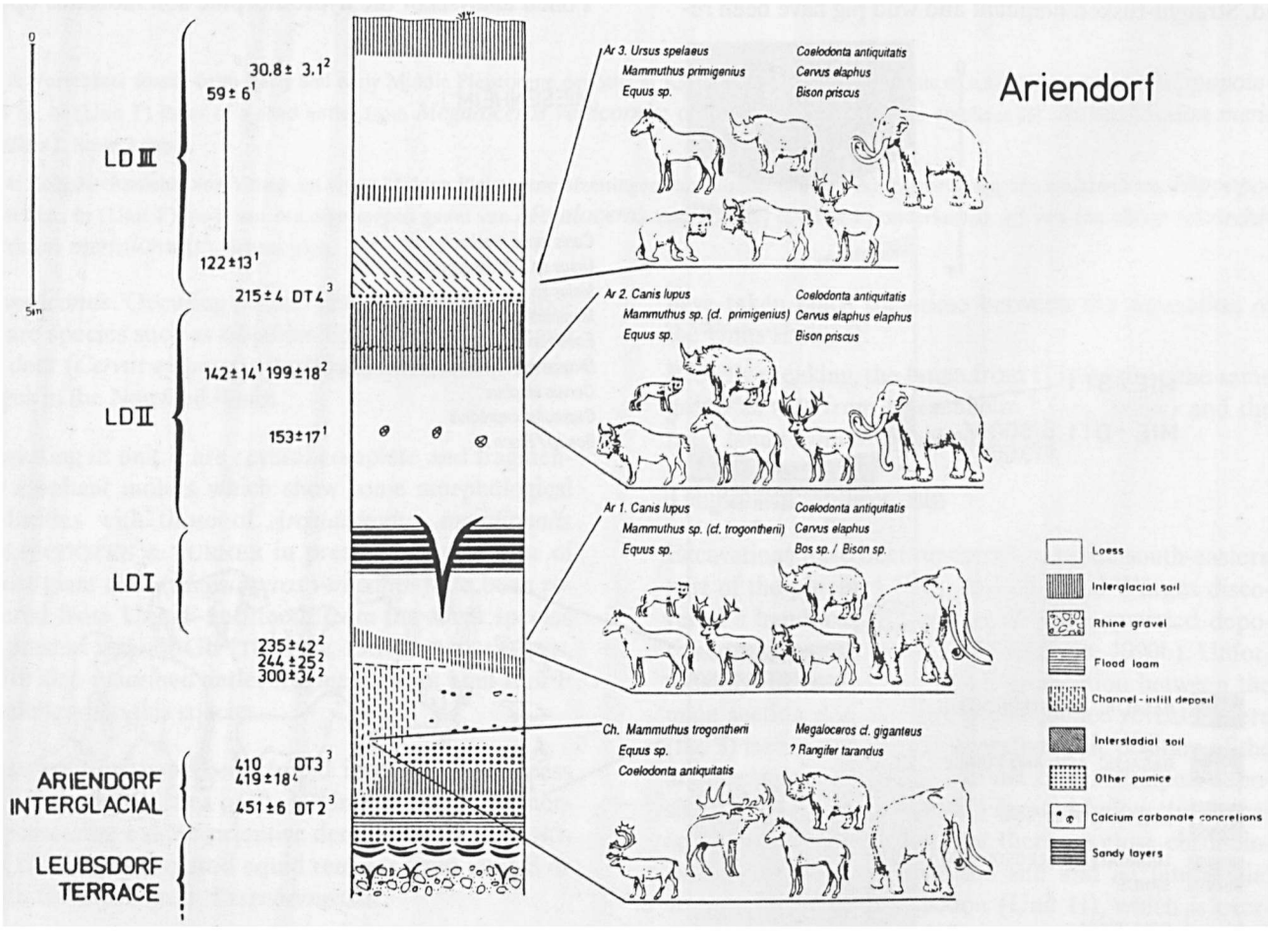

Fig. 6: Simplified section through deposits at Ariendorf and the location of the fossiliferous horizons. Thermoluminescence dates after 1) FRECHEN (1990); 2) ZöLLER, STREMME & WAGNER (1988). Dates of tephra horizons from 3) BOGAARD & SCHMINCKE (1990); 4) LIPPOLT, FUHRMANN & HRADETZKY (1986). All dates given in ky.

Fig. 6: Scematische doorsnede door afzettingen van Ariendorf en de plaats van de fossielhoudende lagen. Thermoluminescentie naar 1) FRECHEN (1990); 2) ZöLLER, STREMME & WAGNER (1988). Ouderdom van de tuflagen naar 3) BOGGAARD & SCHMINCKE (1990); 4) LIPPOLT, FUHRMANN & HRADTEZKY (1986). Alle waarden in ky.

The Ariendorf gravel quarry.

The Karl Schneider gravel quarry at Ariendorf is situated about thirty kilometres to the north of the Neuwied Basin (fig. 1b) and is the type site of the Ariendorf Interglacial. Removal of overlying loess deposits prior to gravel extraction has revealed several archaeological and fossiliferous horizons (BOSINSKI, BRUNNACKER & TURNER, 1983; BRUNNACKER *et al.*, 1975; TURNER, 1985, 1989a, 1990a). Although strictly outside the Neuwied Basin the site is included in this paper because of its importance for the understanding of the stratigraphical and chronological framework of the region.

The deposits in the Ariendorf quarry (fig. 6) were originally described by Brunnacker (BRUNNACKER *et al.*, 1975). At that time, three loessic units (LD I, LD II, and LD III) and intercalated palaeosols were observed stratified above gravels of the Middle Terrace of the Rhine (Leubsdorf Terrace).

Evidance for a fourth interglacial episode, the "Ariendorf Interglacial" was recorded at the interface of the Leubsdorf Terrace and the loess deposits.

Two layers of pumice tephra (ARI-DT2 and ARI-DT3) from below the loess cover deposits have been dated absolutely. The upper tephra (ARI-DT3), which contains leaf impressions of interglacial species, was dated by 40Ar/39Ar (single crystal laser method) to around 410.000 BP, while the same method gave a maximum age for the lower pumice (ARI-DT2) of 451.000 ± 6000 BP (BOGAARD & SCHMINCKE, 1990). One tephra (probably ARI-DT3) has also been dated by the 40Ar/39Ar (stepwise degassing method) to 419.000 ± 18.000 BP (LIPPOLT *et al.*, 1986). These dates, and the recent indentification of a fourth loessic unit below LD I (HAESAERTS, 1990), indicate that the Ariendorf Interglacial is probably to be assigned to the end of the Cromer complex. The upper loess beds have been correlated as follows:

LD I = older Saalian phase

LD II = younger Saalian phase

LD III = Weichselian phase

A pumice layer at the base of LD III is identical with the Hüttenberg Tephra erupted from the Wehr volcano, which has been dated to 215.000 ± 4.000 BP (BOGAARD & SCHMINCKE, 1990). However, this date appears to be about 100.000 years too old according to the stratigraphy at the site and the absolute dates of the Ariendorf Interglacial, Two independant series of thermoluminescence dates taken in LD II and III, support the theory that LD III was deposited during the Weichselian phase (FRECHEN, 1990; ZÖLLER, STREMME & WAGNER, 1988).

Extinct volcanoes of the East Eifel Field.

The craters of the East Eifel volcanoes appear to have been repeatedly occupied by early man (fig.1b), as is shown by the rich archaeological horizons associated with faunal remains recovered from craters on the Plaidter-Hummerich, Tönchesberg, Schweinskopf-Karmelenberg and Wannen volcanoes (BOSINSKI *et al.*, 1986; CONARD, 1990; JUSTUS, 1988; KRöGER, 1990a; SCHAEFFER, 1990b).

During scoria extraction the crater-fill is removed and fossiliferous horizons contained within it are revealed. Generally two loess beds with a single intercalated palaeosol are stratified within the craters (fig. 7a).

The oldest loess deposits at these sites therefore appear to date to the Penultimate or Saalian Cold Stage; the upper loess beds date to the Last or Weichselian Cold Stage, and often reveal at their summit the typical Late Glacial sequence of Alleröd soil and Laacher See pumice. The Hüttenberg Tephra has been identified at the Wannen and Schweinkopf-Karmelenberg volcanoes in deposits predating the eruption. This tephra has been dated to 215.000 ± 4.000 BP (BOGAARD & SCHMINCKE, 1990), and is more in accordance with the proposed stratigraphy at these sites than at Ariendorf.

At the Tönchesberg (fig. 7b), a detailed series of humic horizons at the base of the upper loess bed have been exposed. A brief magnetic reversal event, thought to be the equivalent of the Blake Event, has been recorded in a humic colluvium stratified directly above the soil of the Last of Eemian Interglacial (BECKER *et al.*, 1989). A series of thermoluminescence dates between 12.800 BP and 92.300 BP confirm the accumulation of the upper loess bed during the Weichselian (FRECHEN, 1990a).

Late Middle Pleistocene Vertebrate Faunas

The first faunal remains dating to the later Middle Pleistocene at Ariendorf were discovered in a channel-fill at the base of the loess sequence. Only remains of large mammals were recovered and these were probably derived from LD I (BRUNACKER *et al.*, 1975). The oldest fossiliferous horizon (Ariendorf 1) was located at the base of LD 1 and the main horizon (Ariendorf 2) at the top of LD II; these horizons date to an older and a younger phase of the Saalian respectively (fig. 6).

The large mammal faunas from Ariendorf 1 and 2 are dominated by horse, woolly rhinoceros and the large bovids, and are typical of faunas recovered from loess deposits at other sites in the Neuwied Basin (TURNER, 1989a). The presence of large herbivores indicates an open environment with herbaceous vegetation; woolly rhinoceros and mammoth are more commonly associated with faunas from cold climatic phases. The small mammal fauna from Ariendorf 1 is dominated by species such as suslik (*Spermophilus* cf. *undulatus*), hamster (*Cricetus cricetus* cf. *praeglacialis*) the lemmings (*Dicrostonyx torquatus* and *Lemmus lemmus*), common vole (*Microtus arvalis*) and short-tailed vole (*Microtus agrestis*), which live today in either open tundra or steppe biotopes (KOLFSCHOTEN, 1990a, 1990c).

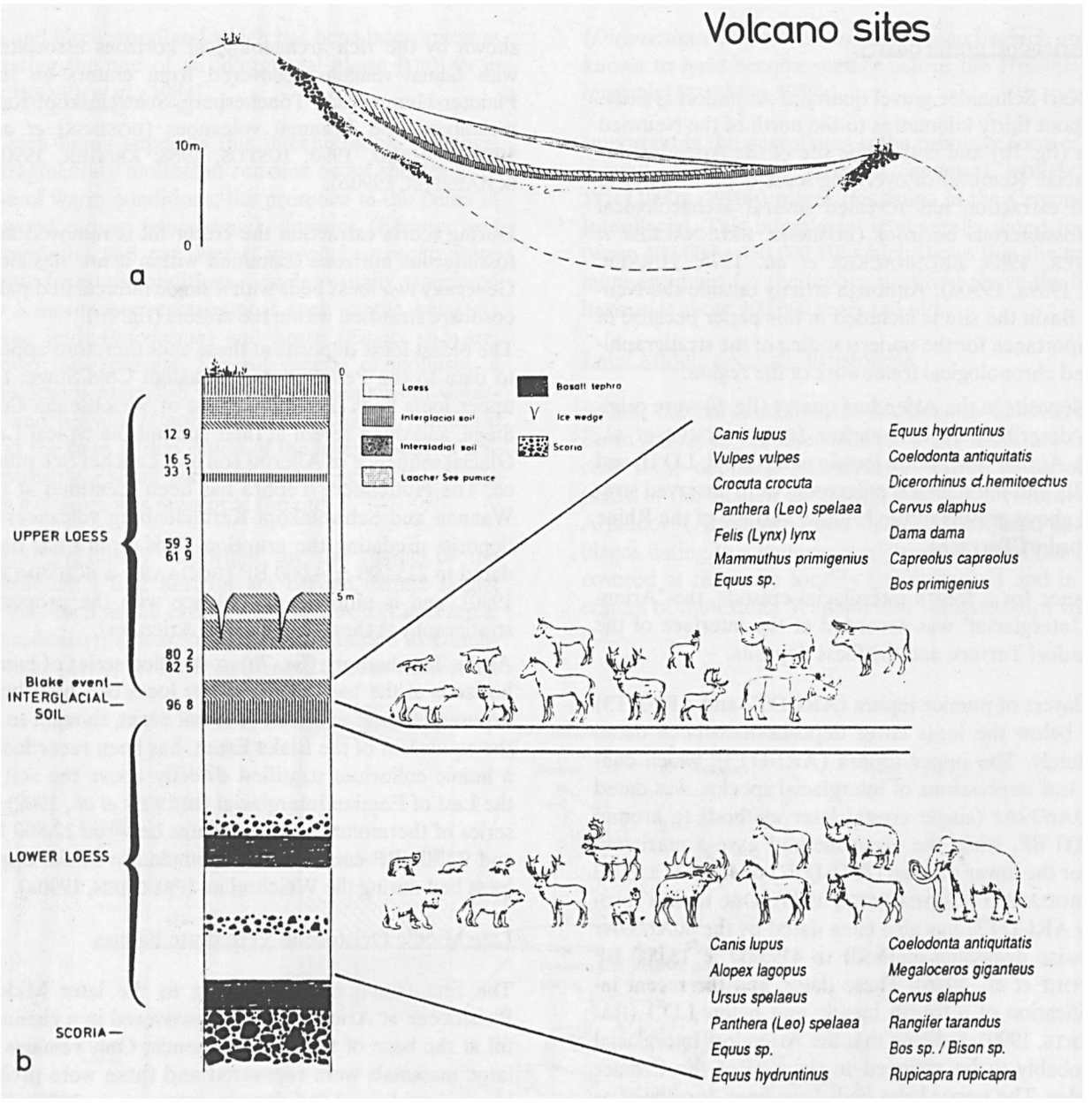

Fig. 7: a) Simplified section through the crater-fill of an extinct volcano, using the Plaidter-Hummerich as an example. b) Simplified section through crater-fill deposits based on the Tönchesberg and the location of the fossiliferous horizons. Faunas are compiled from Wannen and Schweinskopf-Karmelenberg (lower loess); Plaidter-Hummerich and Tönchesberg (humic horizon at base of upper loess). Thermoluminescence dates (ky) taken from FRECHEN (1990); location of Blake Event after BECKER et al. (1990).

Fig. 7: a) Schematische doorsnede van een krater opvulling, met Plaidter-Hummerich als voorbeeld. b) Schematische doorsnede door afzettingen van een krater opvulling gebaseerd op Tönchesberg en de plaats van de fossielhoudende lagen. De fauna's zijn samengesteld uit Wannen en Schweinskopf-Karmelenberg (onderste löss); Plaidter-Hummerich en Tönchesberg (hunus laag en basis van bovenste löss). Thermoluminescentie (ky) naar FRECHEN (1990); plaats van Blake Event naar BECKER et al. (1990).

The faunas are also characterized by the first appearance of a wolf similar in size to the recent animal. Steppe elephant (*Mammuthus trogontherii*) occurs in the channel-infill deposit and is replaced by a more evolved elephant, resembling *Mammuthus primigenius* in the younger Ariendorf 2 assemblage.

Biostratigraphically important for these horizons is the presence of the woolly rhinoceros (*Coelodonta antiquitatis*) in the fauna from the archaeological horizon at the base of LD I. This species is generally considered to have occurred for the first time in northwestern Europe during the Saalian Cold Stage and therefore indicates that the loess deposit LD I should not be older than this stage as has already been suggested by the stratigraphy at the site (TURNER, 1989a).

Amongst the small mammals from Ariendorf 1 and 2 the remains of more evolved forms of the water voles (*Arvicola*) have been recovered. The evolutionary stage of the teeth indicates that the Ariendorf 1 fauna (*Arvicola terrestris* ssp. A) is similar in age to faunas from lo-

calities such as Maastricht-Belvédère (Holland) and Weimar-Ehringsdorf (Germany), which have been dated to an older Saalian phase. In Ariendorf 2 *Arvicola terrestris* ssp. B has been identified; this subspecies also occurs in the fauna from Rhenen in the Netherlands, dated to the Saalian (KOLFSCHOTEN, 1990a, 1990c).

The main fossiliferous horizons at the Wannen and Schweinskopf-Karmelenberg sites date to the Saalian Cold Stage (fig. 8). The large mammal faunas at these sites are very similar to those from Ariendorf 1 and 2 (TURNER, 1989a). They are dominated by large herbivores such as woolly rhinoceros (Coelodonta antiquitatis) and horse. Reindeer (Rangifer tarandus) and arctic fox (Alopex lagopus) indicate cold climatic conditions. The extinct wild ass (Equus hydruntinus) occurs for the first time at these sites in the Neuwied Basin faunas (fig.7).

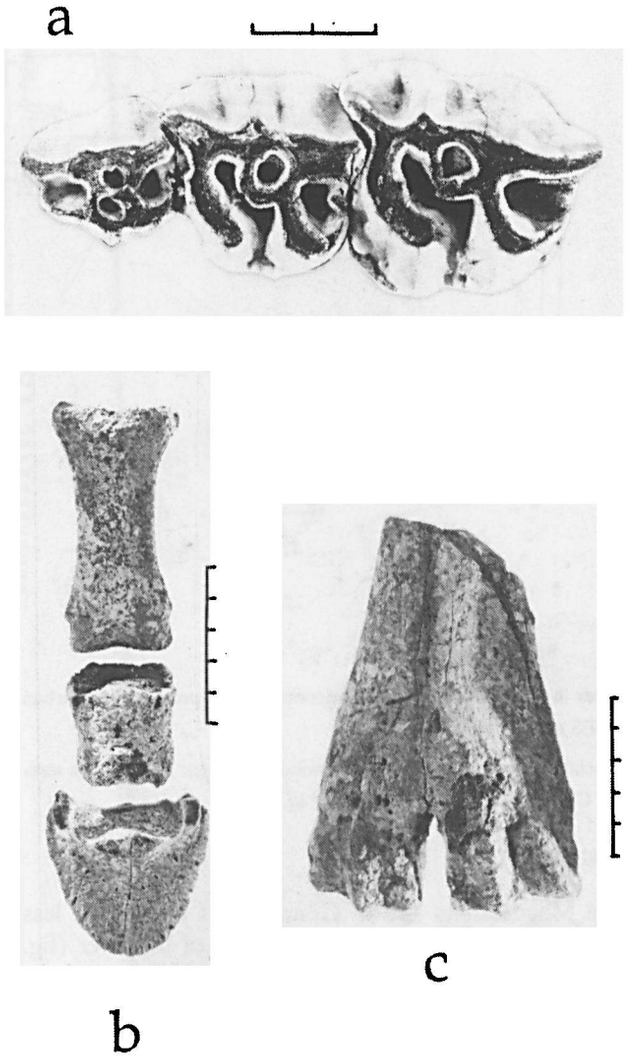

Fig. 8: Vertebrate fossils from extinct volcano sites. a: Upper deciduous cheek tooth row of woolly rhinoceros *Coelodonta antiquitatis* from Wannen. b: Footbones of wild ass *Equus hydruntinus* from Plaidter-Hummerich. c: Distal fragment of a metacarpus of aurochs *Bos primigenius* from Plaidter-Hummerich.

Fig. 8: Zoogdierfossielen van gedoofde vulkaankrater vindplaatsen. a: Uitgevallen bovenkaakskiezen van een wolharige neushoorn *Coelodonta antiquitatis* van Wannen. b: Botten van de wilde ezel *Equus hydruntinus* van Plaidter-Hummerich. c: Distaal fragment van een metacarpus van een oeros *Bos primigenius* van Plaidter-Hummerich.

Late Pleistocene Vertebrate faunas

The main fossiliferous horizons at the Tönchesberg (Tö2) and Plaidter-Hummerich and the youngest horizon at Ariendorf (Ariendorf 3) are all located in humic horizons stratified directly above the soil of the Eem Interglacial and date to the earlist part of the Late Pleistocene (fig.6 & 8).

The faunas from Tönchesberg and Hummerich indicate a temperate climate and an open environment (TURNER, 1989a, 1990b). They are dominated at both localities by the aurochs (*Bos primigenius*), a species often occuring in temperate Pleistocene faunas. Similarly the fallow deer (*Dama dama*) appears to have been restricted to interglacial phases in association with temperate forest. On the other hand, horse and extinct wild ass are both indicative of open grassland or at least locally open herbaceous vegetation; the latter being a habitat also favoured by the extinct rhinoceros (*Dicerorhinus hemitoechus*). The presence of woolly rhinoceros (*Coelodonta antiquitatis*) at the Hummerich in a fauna indicating warm conditions is rather unusual, but not unknown.

This species is recorded mainly from cold stages, but is also known to have occurred during interglacials in association with the more open conditions prevailing at the end of such phases (STUART, 1982). Remains of small mammal from the Tönchesberg, such as the field vole (*Microtus agrestis*) and the common vole (*Microtus arvalis*) (KOLFSCHOTEN, 1990d) and some species of molluscs also indicate open conditions. Northern lynx (*Felis (Lynx) lynx*), red fox (*Vulpes vulpes*) and spotted hyaena (*Crocuta crocuta*) are also present.

The larger mammals and molluscan fauna from the humic horizon at Ariendorf 3 appear to represent a cooler climatic phase at the beginning of the Weichselian.

Late glacial

During the Last Glacial Maximum (ca. 20.000 BP) northern and central Europe, including the Rhineland, appears to have been deserted by man; probably environmental conditions were too extreme to allow settlement. A reoccupation first follows in response to climatic amelioration in the Late Glacial.

The archaeological and palaeontological sites known from the Neuwied Basin within this period fall between the Bölling interstadial and the late Alleröd (BOLUS *et al.*, 1988). In terms of absolute dates the assemblages fall between 13.000 BP and 11.000 BP; in terms of cultural development they are assigned to the Magdalenian and Federmesser groups (fig. 9).

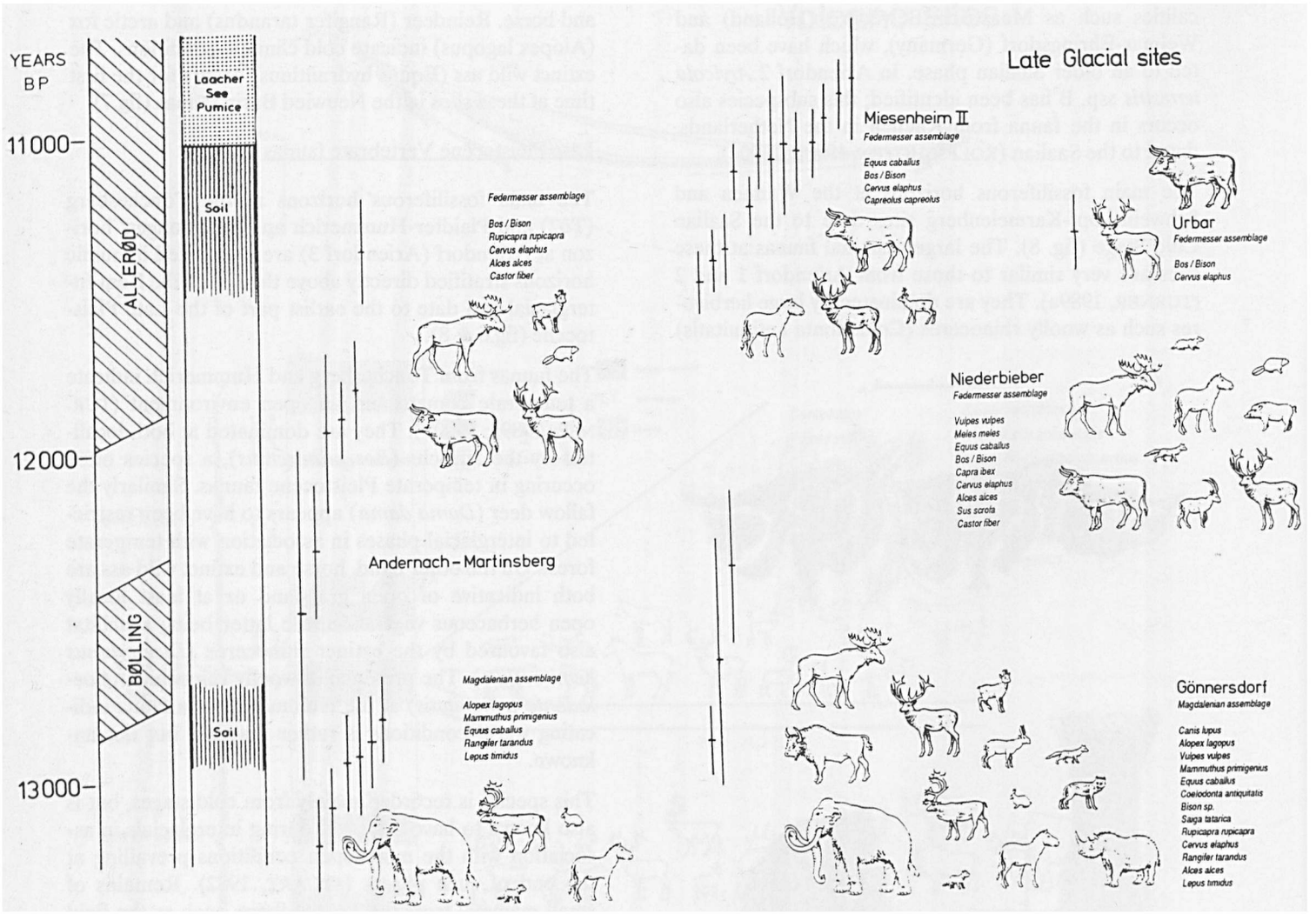

Fig. 9: Summary of faunal assemblages and radiocarbon dating of Late Glacial sites in the Neuwied Basin. Horizontal bars represent radiocarbon date; vertical bars show standard deviation. Radiocarbon dates taken from HEDGES *et al.*, 1987.

Fig. 9: SAmenvatting van de fauna assemblages en C14 datering van de Laat Glaciale vindplaatsen van het Neuwieder Bekken. Horizontale strepen geven de C14 waarden weer; de verticale strepen tonen de standaard debiatie. C14 waarden naar HEDGES *et al.*, 1987.

During the first part of this period the Neuwied Basin reveals an open cold steppe biotope dominated by herds of large game animals such as horse, reindeer and bison, and inhabited by the last surviving mammoth and woolly rhinoceros. This environment formed the ecological setting for the two important Magdalenian sites of Gönnersdorf and Andernach.

Andernach-Martinsberg

Andernach-Martinsberg lies on the west bank of the Rhine at the point where the river flows through the narrow channel of the "Andernacher Pforte" (fig.1b), leaving the flat, open landscape of the Neuwied Basin for the narrow Rhine Gorge to the north.

The Martinsberg is a sloping promontory of land formed by a lava flow of Middle Pleistocene age which, at this point, reached the Rhine over a width of some five hundred metres (BOSINSKI & HAHN, 1972; VEIL, 1979).

Gönnersdorf

The Magdalenian site of Gönnersdorf is situated less than 2 km away on the opposite side of the river (fig. 1b), and would have been visible from the Martinsberg site.

It too lies in a sheltered position, in this case on a gentle, south-facing slope of the Middle Terrace of the Rhine (BOSINSKI, 1979).

Both sites were covered by Laacher See pumice, immediately below which was a clearly recognizable soil development of Alleröd age (fig. 9). The Magdalenian cultural layer was found in loess-loam below this soil, although at both sites vertical displacement (frost heaving?) of material could be observed.

Pollen analysis places both Gönnersdorf (LEROI GOURHAN in BRUNNACKER, 1978) and Andernach at the end

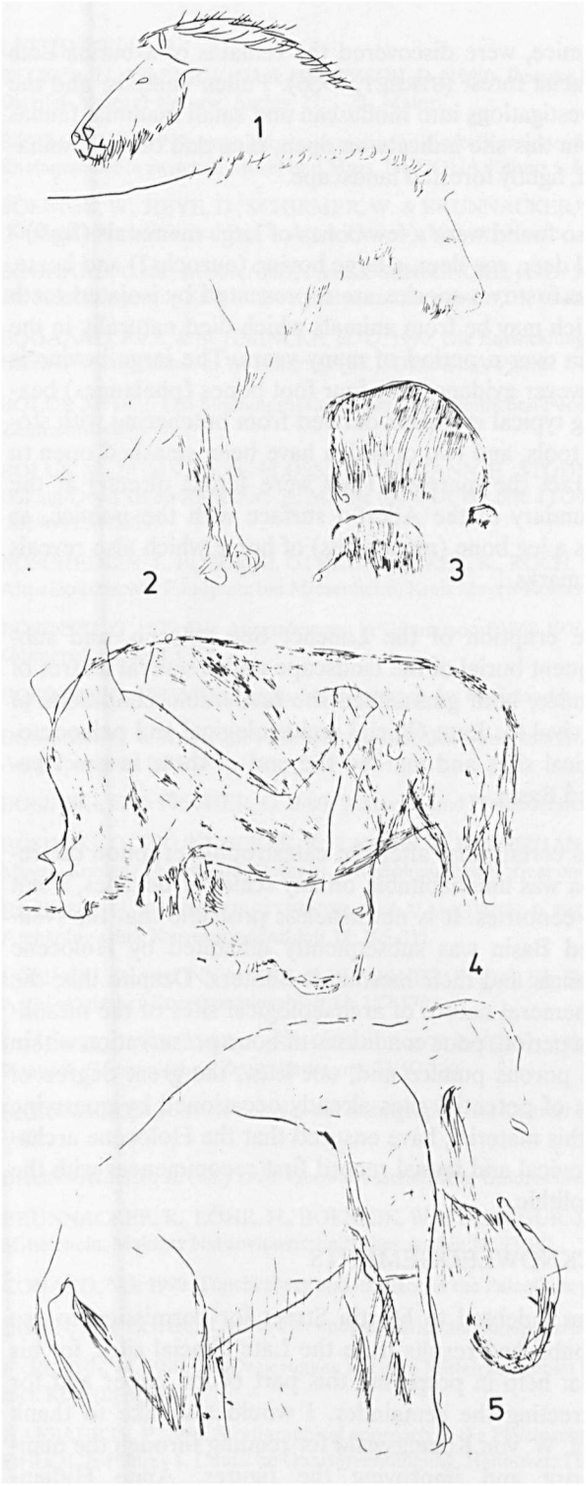

Fig. 10: Naturalistic depictions of Late Glacial fauna from Magdelenian horizon at Gönnersdorf. 1 and 2 horse, 3 immature mammoths, 4 superimposed rhinoceros and mammoth (feet to top), 5 adult mammoth. Scale 1,2 = 2:3; 3, 4, 5 = 1:3. After BOSINSKI & FISCHER (1980).

Fig. 10: Natuurgetrouwe afbeeldingen van de Laat Glaciale fauna van de Magdelenien horizon van Gönnersdorf. 1 en 2 paard, 3 onvolwassen mammoeten, 4 imponerende neushorn en mammoet (van top tot teen), 5 volwassen mammoet. Schaal 1,2 = 2:3; 3, 4, 5, = 1:3. Naar BOSINSKI & FISCHER (1980).

of a milder climatic oscillation, interpreted as the Bölling interstadial, in which more forested conditions predominated. In addition macroscopic remains of birch,willow and pine were found in the Magdalenian layers at Gönnersdorf. A pollen spectrum typical of the Alleröd interstadial is at both sites first recognizable in layers above the Magdalenian horizon.

The animal remains recovered from the two sites are numerous (several thousand individually recorded finds from each site) and reflect the diversified fauna typical of the Late Glacial cold-steppe (fig. 9).

In the case of the large mammal bones, and probably also the majority of bird and fish remains, it is clear that we are dealing with animals hunted and brought to the site by man. Small mammals by contrast reflect the biotope on the actual site or (in the case of material transported by avian predators) from the immediately surrounding region (MALEC in BRUNNACKER, 1978, RABENSTEIN 1988).

The dominant food species among the large mammals is at both sites the horse (*Equus* sp.). Reindeer (*Rangifer tarandus*) is also represented at both sites by several individuals. Arctic fox (*Alopex lagopus*) is common at both Andernach and Gönnersdorf and is indeed the most common species if calculated on number of individuals identified in the material from the published Concentration I at the latter site (POPLIN, 1976). The arctic hare (*Leptus timidus*) is also present at both sites. Other large mammal species are, at Gönnersdorf, for the most part evidenced by only small amounts of material and include wolf (*Canis lupus*), red fox (*Vulpes vulpes*), mammoth (*Mammuthus primigenius*), woolly rhinoceros (*Coelodonta antiquitatis*), bison (*Bison* sp.), chamois (*Rupicapra rupicapra*), saiga antelope (*Saiga tatarica*), elk (*Alces alces*) and red deer (*Cervus elaphus*). At Andernach the range of species so far identified from the Magdalenian horizon is smaller overall (fig. 9).

An important feature of the two sites are large numbers of slate plaques bearing engravings of human figures and animals. In contrast to the intensely stylied human figures, the animal engravings are carried out in a highly naturalistic style and with great skill. Large mammal species typical of the Late Glacial, such as horse, woolly rhinoceros and mammoth (BOSINSKI & FISCHER, 1980), are immediately recognizable (fig. 10).

This corpus of engravings provides the palaeontologist with a rare and vivid insight into an extinct faunal assemblage, which could only be parallelled by, for example, cave art or frozen and dessicated animal carcasses.

Late Glacial sites buried by tephra of the Laacher See Eruption

The most recent volcanic event in the Eifel region was the eruption of the Laacher See volcano during the second half of the Alleröd Interstadial almost exactly 11.000 years ago.

The tephra deposits erupted by the Laacher See volca-

no have led to the survival in the Neuwied Basin of many stratified and radiometrically dated archaeological sites with well preserved faunal assemblages (fig. 9) such as Andernach-Martinsberg, Urbar, Niederbieber and Miesenheim II. Outside this favoured region faunal material has little chance of survival on open sites.

By the time of the Laacher See eruption the region was again forested with trees such as willow, birch, pine and especially poplar. The differentiated topography and a rich undergrowth supported a varied fauna, some of which would eventually form the Holocene Rhineland fauna.

The presence at Andernach-Martinsberg of a younger archaeological horizon was only finally proven by recent excavations. The typical loess-steppe vertebrate fauna present in the Magdalenian horizon at this site has disappeared.

Some species, such as mammoth (*Mammuthus primigenius*) and woolly rhinoceros (*Coelodonta antiquitatis*) are already extinct. The Alleröd vertebrate fauna consists of elk (*Alces alces*), red deer (*Cervus elaphus*), beaver (*Castor fiber*), chamois (*Rupicapra rupicapra*) and aurochs (*Bos primigenius*) (STREET, in prep.).

The site of Urbar is located to the north of Koblenz some 500 m to the east of the Rhine (fig.1b). Situated on a promontory 80m above the Lower Rhine Terrace the site commands a view of the entire Neuwied Basin (EIDEN & LÖHR, 1974). The fauna (fig.9) is dominated by red deer, although a large bovine is also represented. A detailed taphonomic analysis has yet to be carried out but at least seven individuals of red deer are present at the site (TURNER, 1989a).

The most extensive Federmesser site in the region under consideration is Niederbieber (Neuwied). This site was discovered after quarrying of Laacher See pumice during the autumn of 1980 and excavations have taken place here regularly since then. The site is located on a southwest-facing spur of land (fig.1b) between the valleys of the Wied and the Herschbachgraben (BOSINSKI *et al.*, 1982; BOLUS, 1991).

A wide range of large mammals has been identified from this site (fig.9). The species most commonly present is the red deer. Elk, beaver and horse are also present within more than one of the excavated areas. Species represented in only one concentration are a bovine (*Bos/Bison*), badger (*Meles meles*), red fox (*Vulpes vulpes*), ibex (*Capra ibex*) and - the only record of this species in the Late Glacial of the Neuwied Basin - wild pig (*Sus scrofa*).

The site of Miesenheim II lies 155 m above sea level in the valley of the Nette, some 3 km to the south of the town of Andernach at the northern end of the Neuwied Basin (fig. 1b). At this location, below 4 m of Laacher pumice, were discovered the remains of a buries Late Glacial forest (STREET, 1986). Pollen analysis, and the investigations into molluscan and small mammal faunas from this site indicate an open, pine and birch dominated, lightly forested landscape.

Also found were a few bones of large mammals (fig.9) - red deer, roe deer, a large bovine (aurochs?) and horse. The first two species are represented by isolated teeth which may be from animals which died naturally in the area over a period of many years. The large bovine is however evidenced by four foot bones (phalanges) bearing typical cutmarks derived from butchering with stone tools, and two of which have been smashed open to extract the marrow. They were found directly at the boundary of the Alleröd surface with the pumice, as was a leg bone (metatarsus) of horse which also reveals cutmarks.

The eruption of the Laacher See volcano, and subsequent burial of the landscape under several metres of pumice, both guaranteed the favourable conditions of survival for Late Glacial archaeological and palaeontological sites and marked the end of these in the Neuwied Basin.

It is certain that after the catastrophic eruption the region was uninhabitable on any scale for decades, if not for centuries. It is nevertheless probable that the Neuwied Basin was subsequently inhabited by Holocene animals and their mesolithic hunters. Despite this, the ephemeral nature of archaeological sites of the mesolithic period, poor conditions of bone preservation within the porous pumice and, not least, the great degree of loss of potential sites already occasioned by quarrying of this material, have ensured that the Holocene archaeological and faunal record first recommences with the Neolithic.

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