M¹
□ *A.maastrichtiensis* n.sp. Belvédère 3
• *A.maastrichtiensis* n.sp. Belvédère 4
○ *A.sylvaticus* Belvédère 3
● *A.sylvaticus* Belvédère 4
■ *A.sylvaticus* or *A.maastrichtiensis* n.sp. Belvédère 3
+ *A.sylvaticus* or *A.maastrichtiensis* n.sp. Belvédère 4

Fig. 13. Length-width scatter diagrams of molars of *Apodemus sylvaticus* and *Apodemus maastrichtiensis* n. sp. from the faunas Belvédère 3 and 4.

those of *A. sylvaticus,* for instance by having better developed t7 and t9 at the upper molars M1 and M2.

Micromys minutus, the Harvest mouse, differs from *A. maastrichtiensis* n. sp. by having a m1 with 3 roots (a diagnostic character according to Böhme in Niethammer & Krapp, 1978). The t7 of M1 and M2 of *M. minutus* is well developed, t9 is smaller than the t6 in the living species. The fossil ones show a better developed t9 (Van de Weerd, 1979). Labial accessory cusps are absent in the lower molars of *M. minutus* (Böhme, in Niethammer & Krapp, 1978). *M. minutus* is also smaller than *A. maastrichtiensis* (length M1 1.3-1.5 mm (N = 205) (Storch et al., 1973).

Fauna; Belvédère 3
Material: 1 M1 dext., 1 M1 sin., 2 m2 dext.

Measurements:

		N	Min.	Max.	x̄
M1	length	2	1.69	1.78	1.74
	width	2	1.06	1.15	1.10
m2	length	2	1.05	1.06	1.06
	width	2	0.90	0.92	0.91

Fauna; Belvédère 4
Material: 3 M1 dext., 4 M1 sin., 7 M2 dext., 3 M2 sin., 10 m1 dext., 1 m1 sin., 6 m2 dext., 2 m2 sin.,

Measurements:

		N	Min.	Max.	x̄
M1	length	7	1.51	1.82	1.67
	width	7	1.02	1.09	1.06
M2	length	10	0.94	1.19	1.10
	width	10	0.99	1.08	1.02
m1	length	11	1.37	1.60	1.50
	width	11	0.84	0.95	0.91
m2	length	8	0.94	1.16	1.03
	width	8	0.88	0.98	0.94

Description and remarks
The M1; The position of the tubercles with regard to each other is variable to a certain extent. Also the connection between the tubercles and the presence of edges at the posterior side of for example t1 and t3 is variable. The t7 and t9 of M1 as well as M2 are small. The t3 of the M2 is absent in one specimen, in the others it is very small.

The m1 and m2 are characterized by the high steepness of the cusps.

The antero-central cusp of m1 is small. In most specimens the labial accessory cusps are small and little differentiated from the cingulum. The anterior cusps are separated from protoconid and metaconid in most of the specimens. Only very worn elements and a single unworn one show a low connection between these cusps.

The m2 has a small developed antero-labial cusp and a small terminal heel.

The M3 and m3 of *Apodemus* from Belvédère 3 and 4 show some variation in size but they do not show any diagnostic charachter to distinguish those of *A. maastrichtiensis* n. sp. from M3 and m3 of *A. sylvaticus.* Most probably the smaller ones can be assigned to *A. maastrichtiensis* n. sp. but it is hard to decide which specimens belong to *A. maastrichtiensis* n. sp. and which to *A. sylvaticus.* Therefore, M3 and m3 are not determined at specific level.

4.4.4. Carnivora

4.4.4.1. Mustelidae

Mustela cf. *nivalis* Linnaeus, 1766
(Weasel)

Fauna; Belvédère 4
Material: I2 sin., m2 dext.
Measurements: I2; antero-posterior diameter 0.88 mm
width 0.57 mm
m2; length 0.90 mm., width 0.85 mm

Description and remarks
The lower molar, m2, has only one cusp and an antero-posterior ridge on the labial part of the crown. Compared with the measurements by Hugueney (1975) of recent stoats and weasels and of fossil material from for example La Fage it is most likely that the m2 belongs to a weasel (*M. nivalis*). The upper incisor is rather large and, therefore, it cannot be excluded that this element belongs to the larger *M. erminea.*

4.4.5. Proboscidea

4.4.5.1. Elephantidae

The terminology and the measurements are according to Maglio, 1973.

Elephas antiquus Falconer and Cautley, 1845
(= *E. namadicus*)
(Straight-tusked elephant)

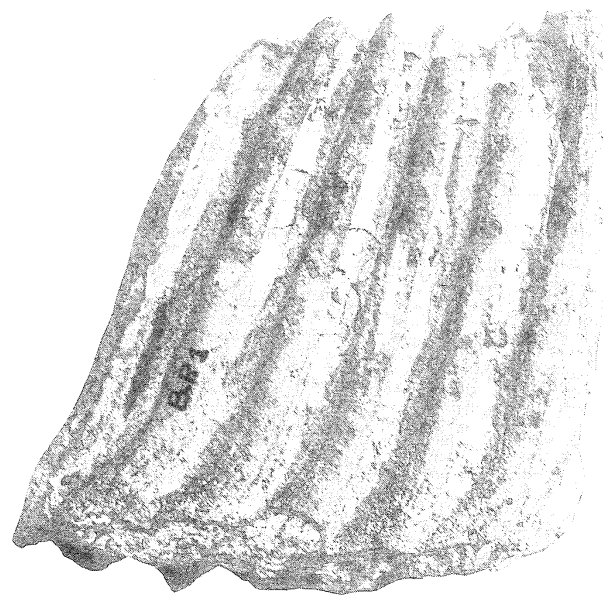Fauna; Belvédère 1
Material: molar fragment

Description and remarks
Cremers (1926) mentioned a molar of *E. antiquus* collected at the base of the gravel in the Maastricht-Belvédère pit. Two molar fragments of this elephant are stored in the Natural History Museum in Maastricht. Which of these two specimens is the one mentioned by Cremers is unknown. Both have about the same characters (width ± 80 mm, height more than 140 mm, lamellar frequency 4.5-5, enamel thickness ± 3 mm.) The plates are strongly bent antero-posteriorly, the enamel strongly folded and the enamel figures are lozenge-shaped. In these characters they correspond to the molar fragments of *E. antiquus* from Rhenen (Van Kolfschoten, 1981). They differ from Late Pleistocene molars of *E. antiquus* because of their lower lamellar frequency and their thicker enamel.

Mammuthus primigenius (Blumenbach, 1799)
(Woolly mammoth)
(Fig. 14)

Fauna: Belvédère 2
Material: incomplete lower molars m2 dext. and m2 sin. (Fig. 14), isolated plate fragments

Measurements:

	m2 dext.	m2 sin.
number of plates	6	6
length	—	79 mm
width	65 mm	73 mm
height	77 mm	110 mm
lamellar frequency	7.5	9.1
enamel thickness	2.0	1.5

Fig. 14. *Mammuthus primigenius:* buccal view of m2 sin. (Br 1).

4 cm

Fauna; Belvédère 5
Material: fragment of a lower molar
Measurements: lamellar frequency 9.1, enamel thickness 1.5 mm

Description and remarks

The incomplete molars and small molar fragments are poorly preserved. They have been found during the last few years since the archaeological investigations started in 1980. A large number of more complete molars were found in the Belvédère pit or surrounding pits in the Caberg terrace many years ago (Rutten, 1909, Cremers, 1925 and 1926). It is not known from which unit most of these molars were recovered.

It is hard to determine whether the lamellar frequency and the enamel thickness of the molars of Belvédère 2 differ from the molars of Belvédère 5, because of their incomplete and badly fossilized state. The differences seem to be small.

The other more complete molars, which were found many years ago, have a lamellar frequency of 7.5-10.2 and an enamel thickness of 1.35-2.2 mm. Because of these data and because of their height and width, the molars are assigned to *M. primigenius.* The low lamellar frequency and the high enamel thickness of some of the molars suggest that we are dealing with molars of the more primitive *M. armeniacus* (= *M. trogontherii*). However, less primitive molars are known from Unit 3, the lowermost deposit from which the molars might be derived. Therefore, all molars have been determined as *M. primigenius.*

Elephantidae indet.

Fauna; Belvédère 4
Material: ulna fragment

Remarks

The fragment measures: length ± 35 cm., maximal width 8 cm. Because of the few preserved morphological characters it is impossible to determine the specimen, even at generic level.

4.4.6. Perissodactyla

4.4.6.1. Equidae

The terminology is according to Eisenmann, 1979b

Equus sp
(Fig. 15)

Fauna; Belvédère 2
Material: I1 dext., I1 sin., I2 sin.

Remarks

The incisors show the normal *Equus* characters. Their size corresponds with those of the living *E. caballus.*

Fauna; Belvédère 5
Material: DP2 sin., fragm. of an upper (pre)molar, fragm. of a lower (pre)molar, humerus sin. (distal part), unciform dext., metacarpus III dext., metacarpus III dext. (incomplete), metacarpus III sin., metacarpus IV sin., anterior third phalange.

Measurements: taken according to the method proposed by Eisenmann, 1979a.

DP2 length	42.9 mm - 43.2 mm
width	23.4 mm - 24.0 mm

HUMERUS
width of the distal articulation facet	87.5 mm
anterior-posterior diameter of the internal distal end	101.2 mm
minimal height of the trochlea	43.0 mm

METACARPUS (dext. (complete one)-sin.) (Fig. 15)
maximal length 233-238 mm, external length 219-231 mm, diaphysal width 40.1-39.7 mm anteroposterior diameter (DAP) of the diaphysis — -30.5 mm, articular proximal width 56.0-54.7 mm, articular proximal DAP — -35.5 mm, width of the articular facet (AW) for the magnum 47.2-44.9 mm, AW for the unciform (anterior) — -14.9 mm, AW for the unciform (posterior) — -7.8 mm, supra-artical distal width 51.9-54.5 mm, articular distal width 53.8-54.2 mm, articular keel DAP — -37.8 mm, internal condyle minimal DAP — -32.1 mm, internal condyle DAP 31.4-33.7 mm.

THIRD PHALANGE
height	35 mm
width of the articular surface	54 mm

Description and remarks

All the material except for the incomplete metacarpus, was collected at site E, during the archaeological excavation of nov-dec. 1982.

One of the milkmolars is very worn and probably has been shed. The other is less worn. The sizes of the milkmolars and of the two complete metacarpal bones indicate that they belonged to a large-medium sized heavily-built horse (withers height 145-150 cm). Comparison of the ratio-diagrams made according to the method of V. Eisenmann (1979a) show that the morphology of the metacarpals corresponds best with those from Chatillon St Jean (Saalian?) assigned to *Equus* aff. *steinheimensis* (V. Eisenmann, pers. comm., 1985). The horse from Solutré (Weichselian) is less slender.

It is hard to determine the fossil horse material from Belvédère 2 and 5 at specific level because of the taxonomic problems concerning the Middle and Late Pleistocene Equidae and because of the small number
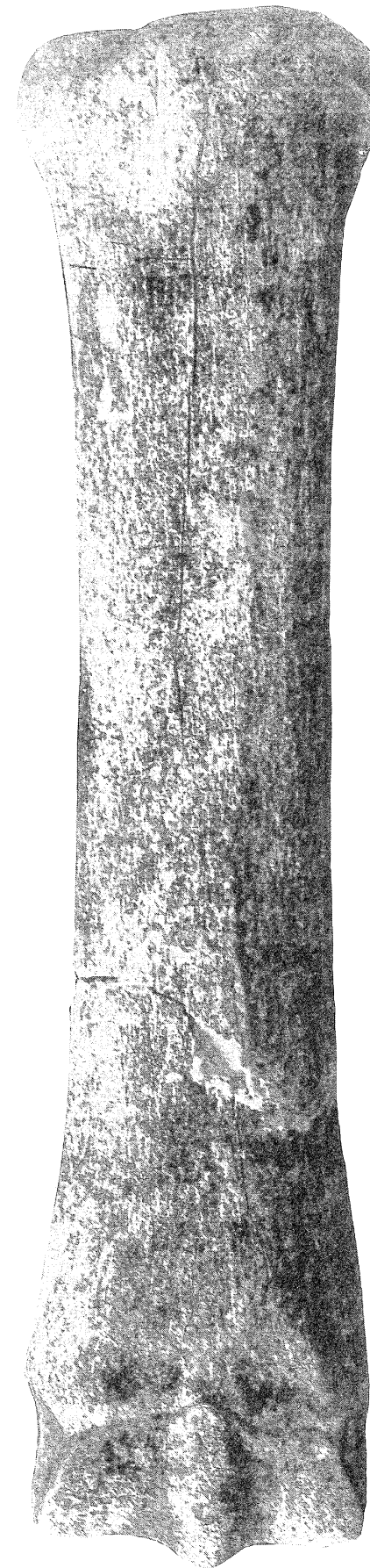

5 cm

Fig. 15. *Equus* sp.: metacarpus sin. (BWG 838), anterior view.

of specimens. Therefore, the material is described as *Equus* sp.

A very remarkable specimen is an incomplete metacarpus, broken at both ends. Because of the diameter of the diaphysis (36.5 mm) it is thought that it represents a metacarpus of a young individual. There is an oval shaped hole (min. diameter 6.5 mm, max. diameter 8.0 mm) on the posterior side of the diaphysis at about 80 mm from the proximal end of the bone. The hole is situated where the foramen nutricium should be present. It has an orientation that points to the proximal end of the bone.

A large number of fossil remains of horse is collected from the deposits of the Caberg terrace many years ago. The lithostratigraphic position of some specimens has been recorded, showing that many of these fossils most probably derived from the base of Unit 6. Most of the material belongs to a large caballine type of horse. In 1923, a nearly complete tooth row (p3-m3 dext.) and five upper incisors were found in the pit called 'the Waal'. These fossils belonged to a much smaller horse. The (pre)molars have a stenonine type of morphology. The long vestibular groove of the molars penetrates the so-called doubleknot very deeply, nearly touching the V-shaped margin of the double-knot. These characters and the size indicate that most probably this represents remains of *E. hydruntinus* (V. Eisenmann, pers. comm., 1985). The same type is also known from Rhenen (described as *Equus* spec. b, Van Kolfschoten, 1981) and from the North Sea (Hooijer, 1984 and 1985). The material will be described in another article (Van Kolfschoten, in prep.).

4.4.6.2. Rhinocerotidae

The terminology and the measurements are according to Guérin, 1980.

Dicerorhinus hemitoechus (Falconer, 1868)
(Steppe rhinoceros)
(Fig. 16a-b)

Fauna; Belvédère 4
Unit: 4
Material: DP2 and DP3 sin., 8 upper (pre)molar fragments

Measurements:
DP2; length at the base of the crown 31.5 mm
width at the base of the crown 37.3 mm
DP3; length at the base of the crown 41.5 mm
width at the base of the crown 40.5 mm

Unit: 5.2.
Material: humerus

Description and remarks

The two milk-molars (Fig. 16a and b), found at site C (square m.Hz-7), fit together very well and have the same state of wear. The enamel is very thin. The profiles of the ectolophs of the milk-molars are undulated like those of *D. hemitoechus* from Lunel-Viel (Guérin, 1980). The size of the molars corresponds to the milk-molars of *D. hemitoechus.*

Some of the fragments have thicker enamel. In view of this, and because of their size it is thought that we are dealing with fragments of upper (pre)molars. The profiles of the ectoloph fragments show a
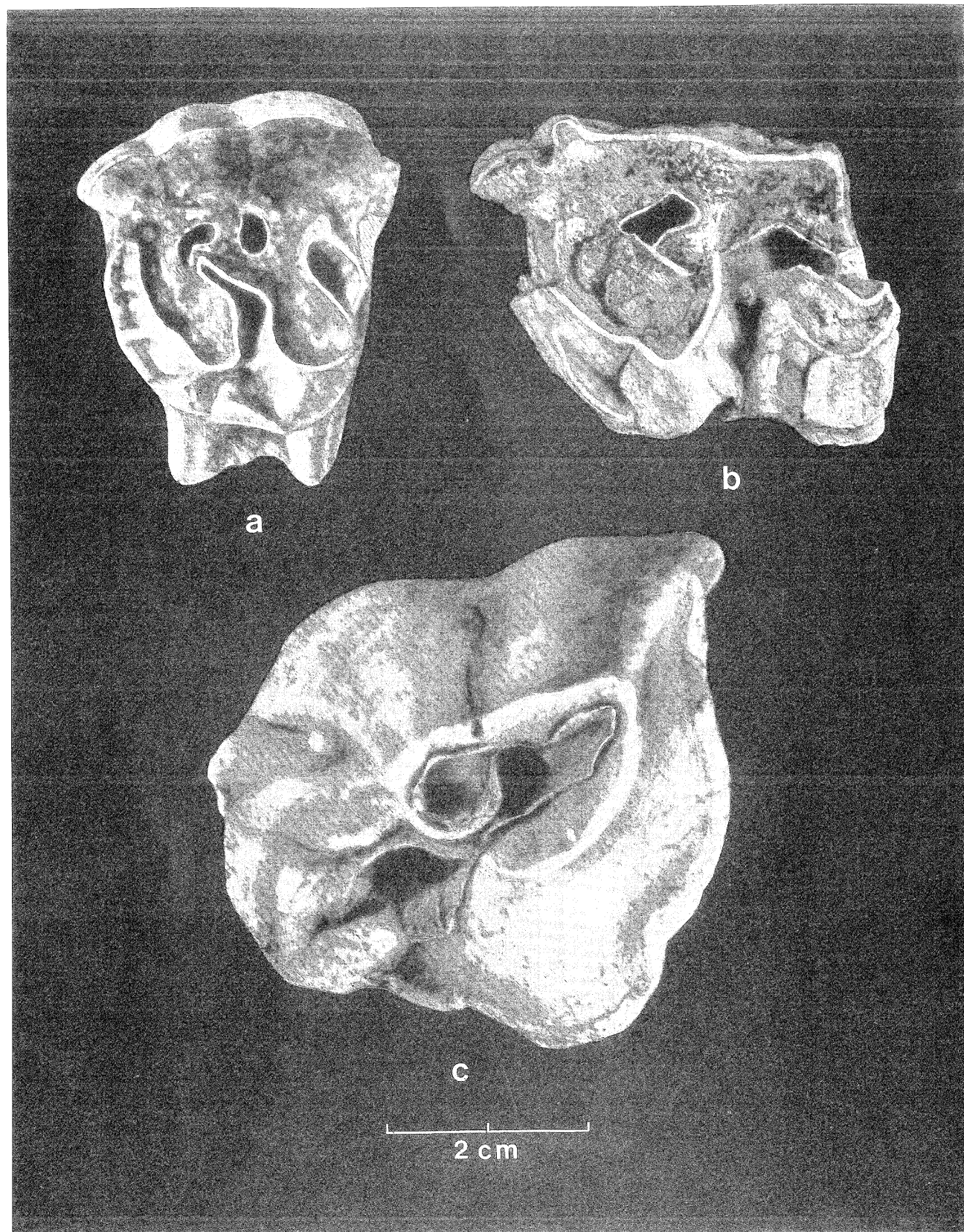
Fig. 16. a-b: *Dicerorhinus hemitoechus:* a: occlusal view of DP2 sin.; b: occlusal view of DP3 sin.; c: *Coelodonta antiquitatis:* occlusal view of M3 dext. (BWG 861).

strong undulation which is characteristic for the up-per (pre)molars of *D. hemitoechus* (Guérin, 1980).

The humerus found at site B (Unit 5.2) is poorly preserved. The compressed remains have the size and the shape of a humerus of a rhinoceros.

Coelodonta antiquitatis (Blumenbach, 1799)
(Woolly rhinoceros)
(Fig. 16c)

Fauna; Belvédère 2
Material: incomplete skull

Description and remarks
In the summer of 1984 an amateur collector (R. Schönlau) found bone fragments of a skull of a rhino-ceros at the top of Unit 3. The fragments partly fit to-gether. The skull is incomplete and the dental ele-ments are missing. The bony septum nasale indicates that this is a skull of the woolly rhinoceros (*Coelodon-ta antiquitatis*).

A number of (pre)molars of *C. antiquitatis* were found in the Caberg terrace many years ago. These are stored in the Natural History Museum at Maastricht and R.G.M. at Leiden. Among the fossils there is a piece of an upper jaw with M1-M3 dext. The molars are cemented with very coarse gravel most probably from Unit 3. The M3 has a triangular outline indicating a post Saalian age (Guérin, 1980). More pri-mitive M3, of Saalian age, should have a more rectan-gular outline, according to Guérin (1970 and 1980). Among the M3 molars found at Rhenen there are spe-cimens with a rectangular outline but there is also one molar with a triangular outline. These molars are found in deposits which have been displaced by the Saalian ice-sheet. This indicates that the triangular shape of the M3 of *Coelodonta antiquitatis* does not provide conclusive evidence for a post Saalian age.

The outline of the M3 resembles that of the M3 mo-lars of *C. antiquitatis* from Belvédère 5.

Fauna; Belvédère 5
Material: skull fragments, M3 dext. (Fig. 16c), M3 sin., ectoloph of an upper (pre)molar.

Measurements: M3

length	53.7-54.7 mm
width	55.5-56.2 mm
height	70.0-71.5 mm

All the material was collected at site E. Most of the skull fragments are eroded and do not fit together. The unworn molars were found very close to each other and to the skull fragments. Both molars and the skull fragments probably belonged to one young indi-vidual.

The molars have an undulated ectoloph, a triangu-lar outline without a posterior valley and a closed me-difossette (Fig. 16). One molar has a large basal pillar at the entrance of the lingual valley.

4.4.7. Artiodactyla

4.4.7.1. Cervidae

The terminology and the measurements are accor-ding to Heintz, 1970.

Cervus elaphus Linnaeus, 1758
(Red deer)
(Fig. 17a-b)

Fauna; Belvédère 2
Material: antler fragment
Measurements: minimal diameter of the burr; 52 mm.

Description:
The shed antler has within a short distance of the burr a brow tine and a bez tine. Both tines and the beam are incomplete.

Fauna; Belvédère 4
Site; B
Material: dp4 sin., m1 sin., m3 sin. (incomplete), astragalus, distal epiphysis of a metapodial.

Measurements:
dp4: length 28.3 mm., width at the base of the crown 12.0 mm.
m1 : length 25.9 mm., width at the base of the crown 14.3 mm.
m3 : length 25-30 mm., width —
Astragalus: lateral length   56.8 mm.
            medial length   53.6 mm.
            proximal width   36.4 mm.
            distal width   34.3 mm.
            ant.-post. diam. at the medial side 30.2 mm.
            ant.-post. diam. at the lateral side 31.2 mm.

Description and remarks
The dp4 is slightly worn, the m1 unworn (see Fig. 17a-b). The m1 has a small extostylid and a well deve-loped cingulum at the anterior-labial side. The size of the material indicates that it belonged to a rather large red deer.

The state of wear of the dp4 and the m1 show that we are dealing with a red deer which was about half year old (Eygenraam en Pieters, 1964). The not fully grown distal epiphysis of a metapodial might have be-longed to the same young individue. As artifacts were found at the same site, there might be a relation be-tween human activity and the presence of the re-mains of a young red deer. If this is inferred, it is most likely that man visited the site during the end of au-tumn or the beginning of winter, half a year after the birth-time of red deer.

Fauna; Belvédère 5
Site; E
Material: antler fragment, radius dext. (prox. part)

Measurements:
radius; proximal width   65 mm.
        prox. width of the articulation surface   62 mm.
        ant.-post. diameter of the articulation surface   33 mm.

Description and remarks
The antler fragment has a rugged surface and does not show any further particular characters. The size and other morphological characters of the radius frag-ment corresponds with radii of the living *C. elaphus*. It is too large for assignment to *Rangifer tarandus* and too small for *C. (Megaceros) giganteus*.

Cervus (Megaceros) giganteus (Blumenbach, 1803)
(Giant deer)
(Fig. 17c-d)

Fauna; Belvédère 4
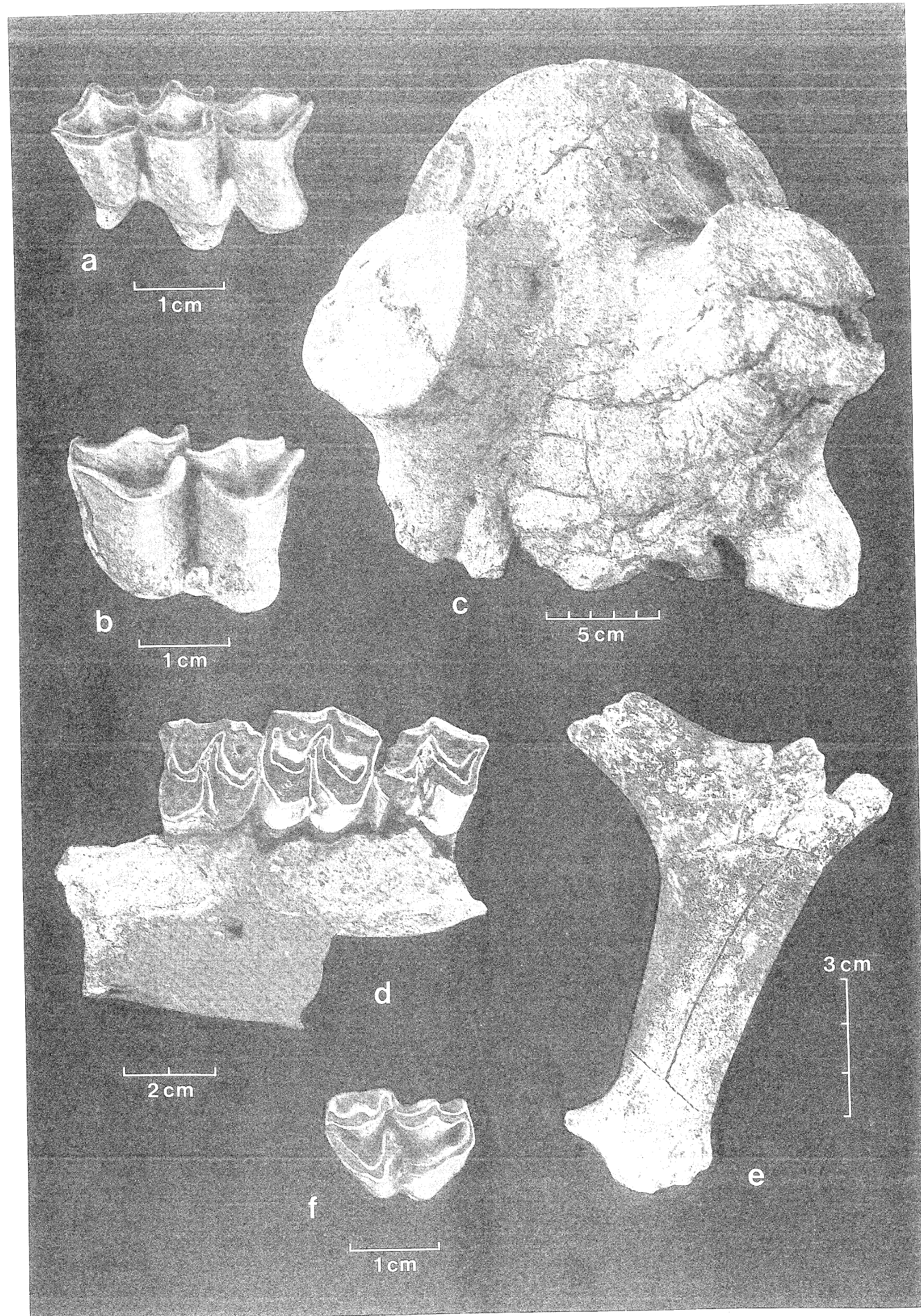Material: incomplete skull with P3-M3 sin., tibia

Remarks

The skull was found near site B in a very fragmentary state. The state of wear of the dentition shows that we are dealing with a skull of a rather old individual (Fig. 17c). The antler was shed. The maximal diameter of the burr suggests a huge antler (Fig. 17d). The estimated length of the skull indicates a very large giant deer.

The tibia, found at site C, is badly fossilized. Its length is about 41 cm., the minimal diameter of the diaphysis about 3 cm.

Rangifer tarandus (Linnaeus, 1758)
(Reindeer)
(Fig. 17e-f)

Fauna; Belvédère 5
Material: (found at site E) dext. antler fragment, DP3 dext., fragm. metacarpus, fragment metatarsus

Measurements:
antler: max. diameter of the burr   32.2 mm
        min. diameter of the burr   26.2 mm
        distance between burr and first tine 68.0 mm
DP3 length 16.0 mm, width 12.0 mm

Description and remarks

The antler consists of a proximal shed fragment (Fig. 19a). It has an oval shaped cross-section, a smooth surface, and a small developed brow tine. Because of its size it most probably represents an antler of a young individual. The DP3 (Fig. 19b) is slightly worn. Its morphology of the DP3 corresponds with a DP3 of the living *R. tarandus* in many characters, but differs by having a less developed metacone, an U shaped trench between paracone and parastyle (instead of a V shaped trench) and a less deep trench between metacone and metastyle. The hypocone of the milkmolar from the Belvédère is too small to assign the specimen to *C. elaphus*.

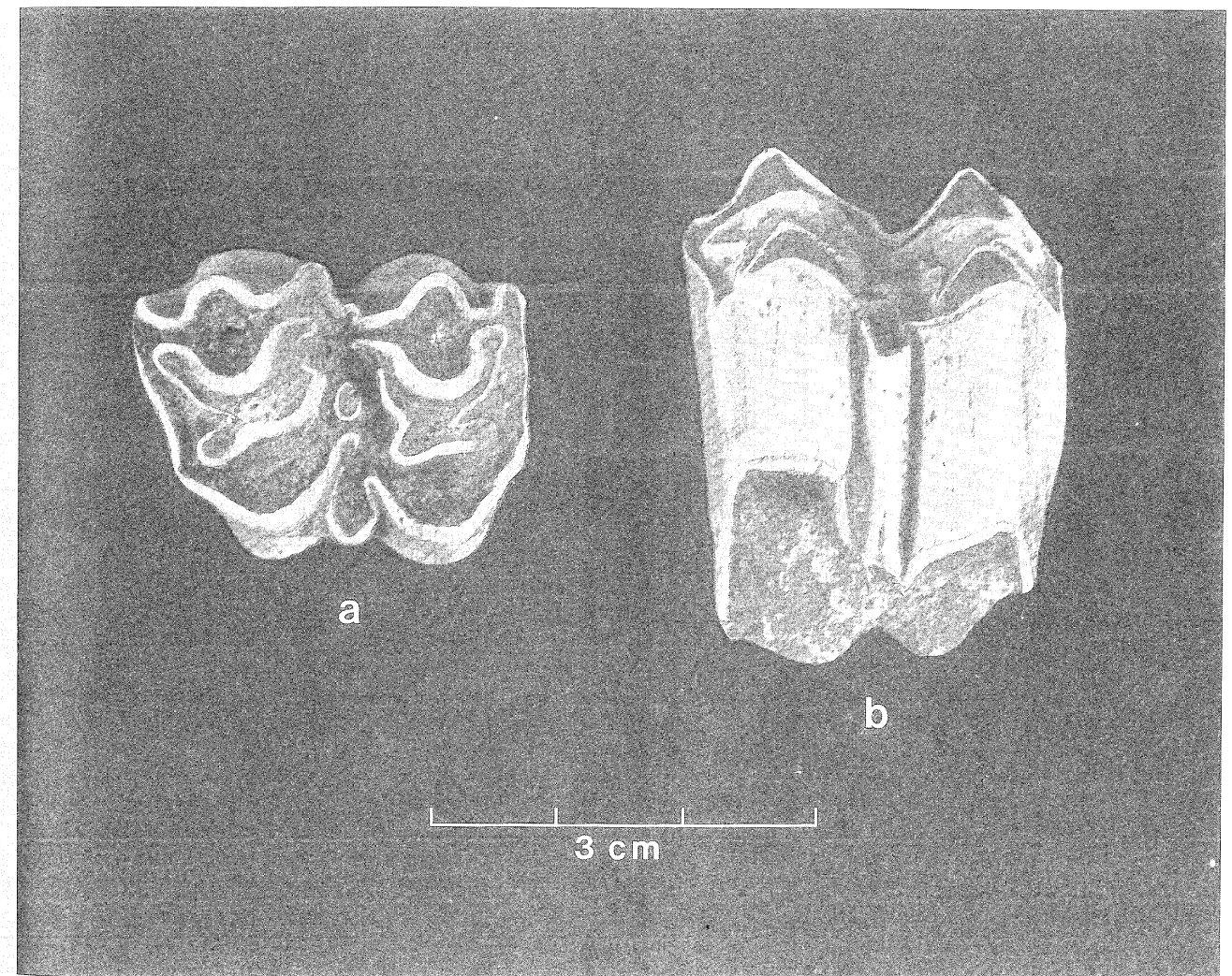The two bones are very fragmentary. Their morphology corresponds to the living reindeer.

Fig. 18. *Bos primigenius / Bison priscus:* M1/2 dext. (BWG 951); a: occlusal view; b: buccal view.

Fig. 17. a-b: *Cervus elaphus:* a: dp4 sin.; b: m1 sin.; c-d: *Cervus (M) giganteus.* c: posterior part of the skull (dorsal view); d: the anterior part of the skull with M1-M3 (ventral view); e-f: *Rangifer tarandus:* e: antler fragment. dext. (BWG 921) f: DP3 dext. (BWG 922).

Rutten (1909) placed the late-glacial reindeer from The Netherlands and Northern Europe in a new subspecies *R. tarandus diluvii*, characterized by a very small or absent brow tine.

Cremers (1927) described a skull fragment with part of an antler from the Belvédère pit. The specimen has a small brow tine, similar to the specimen from Belvédère 5 (Fig. 17e). However, according to Degerbøl and Krog (1959) a small brow tine is not characteristic of the Danish population as stated by Rutten (1909). They say that the brow tine is small in some Danish antlers, but often is very large and palmated. Since 1909 these types have also been found in The Netherlands.

Capreolus capreolus Linnaeus, 1758
(Roe deer)

Fauna; Belvédère 4
Material: dp2 dext., m1/m2 sin. (prox. part of the molar), fragment of a lower molar

Measurements: dp2   length 7.0 mm width 4.5 mm
m1/m2 length — width 8.6 mm

Description and remarks
The dp2 has a well developed parastylid and it differs in this respect from the dp2 of a recent roe deer in the collection of the I.V.A.U. Its morphology resembles that of the dp2 of a Holocene roedeer from the peat of Burwell Fen (England) figured by Reynolds, 1931. Because of this and because of its size all the material listed above has been determined as *Capreolus capreolus*.

The dp2 molar is very slightly worn, indicating that the young animal died or lost its milk molar shortly after June, the period in which roe deer usually are born. The worn m1/m2 fragment found at site B, belonged to an older individual.

Cervidae indet
(large cervid)

Fauna; Belvédère 5
Material: lingual part of an upper molar

Measurements: length 19 mm, height of the crown 25 mm

Remarks
The lingual part of a low-crowned upper molar indicates the presence of a large deer with the size of a giant deer (*Cervus (Megaceros) giganteus*) in the fauna Belvédère 5.

4.4.7.2. Bovidae

Bos primigenius/Bison priscus
(Aurochs/Bison)
(Fig. 18)

Fauna; Belvédère 5
Material: M1/2 dext.
Measurements: length 31.8 mm, width 26.0 mm, height 40 mm.

Remarks
The size of the high crowned molar corresponds with the upper molars of *Bos primigenius* and *Bison pris-*

cus. It is most probable that it represents a molar of *Bison priscus* because the habitat of *Bison priscus* corresponds better with the environmental indications of the other species of the fauna from Belvédère 5.

5. PALAEOECOLOGY AND AGE OF THE BELVÉDÈRE FAUNAS

In this chapter the composition, palaeoecology and age of the faunas Belvédère 1-4 will first be discussed together. Belvédère 5 is treated at the end of the chapter. The habitat preferences referred to are according to Van den Brink (1978), Niethammer and Krapp (1978) and Corbet (1978).

5.1. COMPOSITION OF BELVÉDÈRE 1-4

The total number of specimens and the minimum number of individuals are given behind the species name. Relative frequencies of the species are given for the smaller mammal associations only. This frequency is based on the number of dental elements.

Fauna; Belvédère 1

	number of specimen	min. N. of indiv.
Elephas antiquus (*Hippopotamus* sp)	1	1

The molar of the straight-tusk elephant, *Elephas antiquus*, was found in 1926 in the Belvédère pit at the base of Unit 3 (Cremers, 1926). Probably from the same stratigraphical level are the remains of *Hippopotamus* sp. found in 1816 in the Caberg terrace at the place where Fort Willem I was built. These remains are mentioned by Habets (1887) and have been lost for many years (Rutten, 1909).

Fauna; Belvédère 2

	number of specimen	min. N. of indiv.
Mammuthus primigenius	2	2
Equus sp.	3	1
Coelodonta antiquitatis	1	1
Cervus elaphus	1	1

Fauna; Belvédère 3

Leuciscus cephalus				
Chondrostoma nasus				
Talpa europaea	5	2.86%	1	3.45%
Sorex araneus	4	3.81%	1	3.45%
Neomys fodiens	3	2.86%	2	6.90%
Ochotona pusilla	1	0.95%	1	3.45%
Spermophilus cf. *undulatus*	2	1.90%	1	3.45%
Cricetus cricetus praeglacialis	1	0.95%	1	3.45%
Clethrionomys glareolus	11	10.48%	3	10.34%
Arvicola cantiana/terrestris	12	11.43%	3	10.34%
Microtus gregalis	1	0.95%	1	3.45%
Microtus arvalis and/or *Microtus agrestis*	6	5.71%	5	17.24%
Microtus sp.	47	44.76%	6	20.69%
Apodemus sylvaticus	10	9.52%	2	6.90%
Apodemus maastrichtiensis n. sp.	4	3.81%	2	6.90%
	105	99,99%	29	100.01%

The faunal list of Belvédère 3 consists of smaller

mammal species only. Undeterminable larger mammal fossils, consisting largely of bone fragments, have been collected from the base of Unit 4. There is a nearly complete vertebra similar in size to that of a red deer.

Fauna; Belvédère 4

Leuciscus cephalus
Chondrostoma nasus
Esox lucius
Emys orbicularis

	number of specimen		min. N. of indiv.	
Anatidae indet.	1		1	
Erinaceus cf. *davidi*	1	0.16%	1	0.84%
Talpa europaea	56	7.99%	5	4.20%
Sorex araneus	72	11.29%	9	7.56%
Sorex minutus	23	3.61%	4	3.36%
Neomys fodiens	18	2.82%	4	3.36%
Crocidura cf. *leucodon*	1	0.16%	1	0.84%
Eliomys quercinus	1	0.16%	1	0.84%
Clethrionomys glareolus	122	19.12%	16	13.45%
Arvicola cantiana/terrestris	28	4.39%	5	4.20%
Pitymys cf. *subterraneus*	1	0.16%	1	0.84%
Microtus oeconomus	3	0.47%	2	1.68%
Microtus agrestis	18	2.82%	8	6.72%
Microtus arvalis and/or *Microtus agrestis*	38	5.96%	21	17.65%
Pitymys/Microtus sp.	132	20.96%	22	18.49%
Apodemus sylvaticus	93	14.58%	9	7.56%
Apodemus maastrichtiensis n. sp.	36	5.64%	10	8.40%
	638	100.02%	118	99.99%

Mustela cf. *nivalis*	2	1
Elephantidae indet.	1	1
Dicerorhinus hemitoechus	10	1
Cervus elaphus	5	1
Cervus (Megaceros) giganteus	2	1
Capreolus capreolus	3	1

5.2. THE PALAEOENVIRONMENTAL AND PALAEOCLIMATOLOGICAL INTERPRETATION OF BELVÉDÈRE 1-4

Fauna 1
The records of *Elephas antiquus* from other sites in Northwestern Europe show that this species was associated with temperate forests. *Hippopotamus* probably preferred a subtropical-temperate climate and an area with rivers and lakes bordered by grassland.

Fauna 2
Mammuthus primigenius and *Coelodonta antiquitatis* are known to prefer a cold climate and open areas (tundra and steppe). *Equus* also prefers open areas but a warmer climate. Nowadays *Cervus elaphus* lives in woods of the temperate zone although there are populations in Scotland which are adapted to live in open areas on the highlands (Van den Brink, 1978). In the light of its present distribution the co-occurrence in Belvédère 2 of *Cervus elaphus* and *Mammuthus primigenius*, *Coelodonta antiquitatis* and *Equus* is remarkable. *C. elaphus* is, however, often found in association with these species for example in the fauna Belvédère 5 and the fauna from Ariendorf (Turner in Bosinski et al., 1983). The cold stage occurrences of *C. elaphus* in treeless steppe tundra vegetational con-

ditions may be indicative of the absence of heavy snowfalls (Stuart, 1982).

Fauna 3
The species of fauna 3 indicate various habitats. The fish and the water shrew *Neomys fodiens* are tied to water. If *Arvicola cantiana/terrestris* preferred the same habitat as the living water vole *A. terrestris*, which is most likely, it is also associated with water. A steppe-environment is indicated by the steppe pika *Ochotona pusilla*, the ground squirrel *Spermophilus* cf. *undulatus*, the hamster *Cricetus cricetus praeglacialis* and the narrow skulled vole *Microtus gregalis*. *M. gregalis* occurs both in wooded steppe and in a tundra environment. *Microtus arvalis* and *M. agrestis* are widely distributed in Europe. The habitat of *M. arvalis* is open country such as pastureland. *M. agrestis* prefers moist areas such as high rough pastures and peat-moors, and lives also in the temperate forests and taiga of Europe. The bank vole *Clethrionomys glareolus* is indicative of the presence of woods for it mainly inhabits deciduous woods. The wood mouse *Apodemus sylvaticus* is not restricted only to deciduous woodland. It mainly inhabits open country and fringes of woods. The mole *Talpa europaea* and the common shrew *Sorex araneus* have a wide range of habitats.

The presence of *Microtus* and *Apodemus*, and the absence of lemmings lead us to the conclusion that the climate at the time was temperate. The presence of steppe-elements seems to indicate rather dry conditions away from the river in which the sediments were deposited. Along its banks the forest may have grown, the presence of which is indicated by the combination of *Clethrionomys glareolus* and *Apodemus sylvaticus*.

Fauna 4
The faunas Belvédère 3 and 4 are different in a number of aspects. The most conspicuous difference is the absence of the steppe-elements in Belvédère 4. Instead, there is a greater number of species which indicate a more humid environment.

The European pond tortoise *Emys orbicularis* inhabits ponds, lakes and rivers with still or slow flowing water. The presence of this species is indicative for a rather warm climate. A mean July temperature exceeding 17-18 C° combined with a considerable amount of sunshine with few damp, cloudy or rainy days seem to be necessary for the eggs to hatch (Stuart, 1982). The northern limit of its breeding range in Northwestern Europe is situated south of the Netherlands. More eastwards in Central Europe it reaches a higher latitude (Stuart, 1982). Occasionally the European pond tortoise occurs in The Netherlands and it is very unlikely that this only represents animals introduced by man.

The presence of the European pond tortoise gives evidence that the mean summer temperature during deposition of Unit 4b was about the same or, more likely, exceeded that of the present day.

Hedgehogs, like *Erinaceus europaeus* live in dry areas of the deciduous and mediterranean woodland zones and inhabit for instance fringes of woods just

as the bicoloured shrew *Crocidura leucodon*. The pygmy shrew *Sorex minutus* occurs in the same habitat but also in more humid areas. *Eliomys quercinus* inhabits deciduous and mixed forests. It is widely distributed in the southern part of Western Europe up to the southern part of The Netherlands. The European pine vole *Pitymys subterraneus* lives in rather humid open areas in the temperate forest zone and more eastwards in the steppe zone.

The larger mammals also indicate the presence of deciduous woods and open country areas. The weasel *Mustela nivalis* occurs in areas with forests and high ground covering vegetation. *Dicerorhinus hemitoechus*. and *Cervus (M) giganteus*, the giant deer, were living in an open environment. *Cervus elaphus* nowadays prefers a temperate climate and a wooded habitat but is very adaptive as noted above. The roe deer *Capreolus capreolus* is associated with forests.

The environment as indicated by Belvédère 4 seems to have consisted of grasslands and forests. The absence of steppe representatives indicates that the climatic conditions are like those of today, perhaps somewhat warmer because of the presence of *Emys orbicularis*.

5.3. THE ENVIRONMENTAL CHANGES AT THE STADIAL-INTERSTADIAL TRANSITION

The lower part of the fluviatile sediments consists of coarse gravel, in the upper part of which only larger mammal remains have been found. In the overlying Units 4a and 4b, one can recognize a fining upwards sequence in sediment grain size. The decrease in velocity of flow, indicated by the upward change in grain size, cannot explain the difference in composition of the Belvédère 3 and 4 smaller mammal faunas. Instead, the time needed to explain these faunal differences indicates that the deposition of these fluviatile sediments cannot be attributed to a single depositional event in a short period.

The lower gravels (Unit 3) were deposited during a cold stage. The overlying mostly sandy sediments (Unit 4a) contain fauna remains which indicate a temperate continental climate. The fauna-association from the uppermost part of the fluviatile sequence indicates a more humid warm-temperate climate. These data document the palaeoecological change during the transition from the cold stadial period to a warm-temperate stage. First of all the tundra changes into an environment with mainly steppe and some woods afterwards followed by a more humid environment with forests alternated with some open areas. The data of the malacological investigation of the same traject support the ideas about the palaeoecological transition (see T. Meijer, 1985). This transition is most probably the result of climatic changes caused by changes in the atmospheric circulation (J. Oerlemans, pers. comm, 1985).

A comparable environmental sequence is indicated by the smaller mammals from the Jankovich cave in Hungary described by Kretzoi, 1957. These document the transition of the Weichselian cold stage with a tundra environment, to the Holocene with a fauna

characterized by a high frequency of steppe-elements followed by a warm-temperate stage with a more humid climate and a wooded environment.

5.4. THE RELATION BETWEEN HUMAN ACTIVITY AND THE PRESENCE OF LARGER MAMMAL FOSSILS AT THE SITES B, C AND G

The faunal assemblages Belvédère 1 and 2 do not show any involvement of man. The scarce remains from these units are very fragmentary and do not show traces which are clearly caused by human beings.

Many of the artifacts and the bone fragments, collected from Unit 4a and 4b, were found isolated but there are a few clear concentrations of artifacts, molars and bone fragments (see Roebroeks, 1985). The bone material is badly preserved due to decalcification of the sediments and is in general hard to identify.

Besides bone fragments, site B yielded a humerus of a rhinoceros, a milkmolar, an astragalus and a distal epiphysis of a metapodial of a red deer and a molar fragment of a roe deer. A skull of a giant deer and remains of an European pond tortoise were found about 4 meters east of Site B. At Site C there was a concentration of artifacts, milkmolars, molar fragments and unindentifiable bone fragments of a steppe rhinoceros. Site C yielded also a tibia of a giant deer. Remains of an elephant, a rhinoceros, a red deer and a roe deer were collected at Site G, during the excavations in Nov.-Dec. 1984 and during the summer of 1985. Except for the elephant bone fragment, the material from Site G is not described in this paper.

The stage of wear of the molars of the red deer found at Site B, indicates that they belonged to an individual which died when it was about a half year old. At present red deer are usually born in June. This indicates that the one from Maastricht-Belvédère site B died at the end of autumn or during the first part of the winter. The inferred relationship between human activity and the presence of these fossils suggests that man visited the site during the end of autumn or during the beginning of the winter period. The milkmolar of the roe deer, *Capreolus capreolus,* shows that the animal died during an earlier annual period. But the relation between the presence of this molar and human activity is not clear.

5.5. THE STRATIGRAPHICAL POSITIONS OF THE FAUNA-ASSOCIATIONS

The stratigraphical position of Belvédère 1 is not clear. It is most likely that it dates from late Early Pleistocene or early Middle Pleistocene (Van Kolfschoten and Vervoort-Kerkhoff, in prep.).

The fauna of Belvédère 2 contains the woolly rhino *Coelodonta antiquitatis*. The migration of *C. antiquitatis* from Asia to Europe is supposed to have taken place during the beginning of the Saalian period (Guérin, 1980). Therefore, the maximal age of Unit 3 is considered to be Early Saalian. The biostratigraphical value of the triangular shape of the M3 of *C. antiquitatis* has been discussed above (see the

systematic description of *C. antiquitatis*).

The most primitive specimen of *Mammuthus primigenius*, probably from Unit 3, suggests a Saalian or an Early Weichselian age for this unit. A Weichselian age for Unit 3 does not fit the biostratigraphical data from the overlying Units 4a and 4b.

The presence of the advanced *Arvicola terrestris* at Rhenen in sediments pushed by the Saalian ice sheet shows that *A. terrestris* replaces *A. cantiana/terrestris* before the end of the Saalian (Van Kolfschoten, 1981) and not during the Eemian as supposed by Von Koeningswald (1973). Therefore, it is evident that the faunas Belvédère 3 and 4, from the Units 4a and 4b respectively, containing *A. cantiana/terrestris,* must be dated before the end of the Saalian period. As *Coelodonta antiquitatis*, found in the underlying Unit 3, indicates a post-Holsteinian age for the studied sediments deposition of Units 4a and 4b took place during a warm-temperate interval within the Saalian. This interval might be correlated with the Hoogeveen interstadial, the first temperate interval within the Saalian (see Zagwijn, 1973). The smaller mammal fauna-association from Rhenen must date from a later interval within the Saalian (= ? Bantega-interstadial).

5.6. BIOSTRATIGRAPHICAL CORRELATION OF THE FAUNAS BELVÉDÈRE 3 AND 4 WITH OTHER MIDDLE PLEISTOCENE MAMMAL FAUNAS

The fauna-associations Belvédère 3 and 4 are characterized by;
- the presence of *Arvicola cantiana/terrestris*
- the absence of *Talpa minor, Drepanosorex* and *Trogontherium*
- the relative high frequency of *Microtus agrestis* within the *Microtus agrestis/M. arvalis* assemblage of Belvédère 4.

This fauna-association is typical for the *Arvicola cantiana/terrestris* Zone, one of the three biozones to be defined for N.W. Europe for the late Middle Pleistocene (Van Kolfschoten, in prep.). The *A. cantiana/terrestris* Zone is tentatively correlated with the Hoogeveen interstadial of the Early Saalian (see previous paragraph).

A fauna with a corresponding association has been found at Wageningen (The Netherlands) in a pit called De Fransche Kamp (Van Kolfschoten, in prep.). The fauna from Ariendorf (Western Germany) (Bosinski et al., 1983, Steensma and Van Kolfschoten, in prep.) fits also into the *Arvicola cantiana/terrestris* Zone. The fauna from Ariendorf indicates a cold stage and is therefore not chronologically equivalent to the faunas Belvédère 3 and 4 and the fauna from Wageningen.

The fauna from the Lower Travertines of Ehringsdorf (Heinrich, 1980a, 1981 a and b) corresponds to the faunas Belvédère 3 and 4 in many aspects. The steppe-elements known from Belvédère 3 are dominant in the fauna from Ehringsdorf. However, the fauna-association from Ehringsdorf includes also species of more or less moist biotopes (Heinrich, 1981b). The corresponding fauna-association supports the idea of Heinrich (1982) that the fauna from the Lower

Travertines of Ehringsdorf must be correlated with an interstadial period within the Saalian.

There is also much resemblance between the fauna-association Belvédère 3 and 4 and the fauna from La Fage (Chaline, 1975, Guérin 1973, Beden & Guérin, 1975). Chaline (1975) describes the presence of *Arvicola terrestris* in the fauna from la Fage but Jánossy (1976) notes the presence of *Arvicola cantiana/terrestris* in the fauna from La Fage, Lazaret and the lower loess deposits from Achenheim. Jánossy correlates these faunas with his Castellum phase which might correspond to our *Arvicola cantiana/terrestris* Zone.

Correlation of the Units 3 and 4 from Maastricht-Belvédère with the Achenheim sequence (Heim, et al., 1982) is difficult. The first occurrence of *Coelodonta antiquitatis* and its co-occurrence with *Mammuthus primigenius* and the *Mammuthus trogontherii /primigenius* transitional type at the base of cycle II of the Achenheim sequence suggests a correlation between the deposition of this cycle and the lowermost Pleistocene deposits from Maastricht-Belvédère. Whether the remains of *Arvicola cantiana/terrestris* mentioned by Jánossy (1976) are also derived from this part of the sequence is unknown.

All the faunas which correspond to the fauna-associations Belvédère 3 and 4 should have an Early Saalian age.

There are also a number of Middle Pleistocene faunas which are considered to be older than the *A. cantiana/terrestris* faunas. These faunas are placed in the *Arvicola cantiana* Zone characterized by the evolutionary stage of *Arvicola* and the presence of *Talpa minor, Drepanosorex savini, Trogontherium cuvieri* and the absence or the occurrence in a low frequency of *Pliomys* and *Microtus agrestis*. Faunas which are correlated to the *Arvicola cantiana* zone are for instance the fauna from Neede with *Trogontherium cuvieri* (Hooijer, 1959), Bilzingsleben with *Arvicola cantiana* and *Trogontherium* (Heinrich, 1980b) and Miesenheim (Van Kolfschoten in Boscheinen et al., 1984). The fauna from Miesenheim shows all the characteristics of the *Arvicola cantiana* Zone. This Zone is tentatively correlated to the Holsteinian interglacial period.

Pre-Eemian fauna-associations with *Arvicola terrestris* postdating the fauna-association from Belvédère 3 and 4 are known from Rhenen (Van Kolfschoten, 1981) and Biache St. Vaast (Chaline, 1978). These faunas are tentatively correlated to the Bantega interstadial (see Zagwijn, 1973).

5.7. COMPOSITION OF BELVÉDÈRE 5

Fauna; Belvédère 5	number of specimen		min N. of indiv.	
Nyctea scandiaca	1		1	
Talpa europaea	1		1	
Spermophilus (Urocitellus) cf. *undulatus*	8	2.95%	1	1.79%
Cricetulus migratorius	1	0.37%	1	1.79%
Dicrostonyx torquatus	220	80.88%	39	69.64%
Arvicola terrestris	3	1.10%	2	3.57%
Microtus gregalis	1	0.37%	1	1.79%
Microtus oeconomus	39	14.34%	12	21.43%
	272	100.01%	56	100.01%

Mammuthus primigenius	1	1
Equus sp.	10	2
Coelodonta antiquitatis	4	1
Cervus elaphus	2	1
Rangifer tarandus	4	1
Cervidae indet. (large deer)	1	1
Bos primigenius/Bison		
priscus	1	1

The mammal fossils from Site E do not show any indication of being transported over a large distance. The remains of the arctic lemming are in some cases rather complete. Therefore, the fauna-association can be regarded and treated as representing a single fauna.

5.8. PALAEO-ENVIRONMENTAL AND PALAEO-CLIMATOLOGICAL INTERPRETATIONS OF THE BELVÉDÈRE 5 FAUNA-ASSOCIATION

The arctic lemming (Dicrostonyx torquatus), the most abundant species in this fauna is restricted to the Palaearctic tundra. It is predated by tundra birds of prey like the snowy owl (Nyctea scandiaca). Talpa europaea lives in a wide range of habitats. Open grassland or steppe environment is indicated by the ground squirrel Spermophilus cf. undulatus. The grey hamster (Cricetulus migratorius) is now an element of the steppe fauna. The water vole, Arvicola terrestris, is widely distributed in Europe and Asia. It is closely associated with water. Microtus gregalis, the narrow-skulled vole, occurs both in a tundra environment and in the wooded steppes. M. oeconomus has a wide distribution and occurs for instance in a tundra environment to the wooded parts of the steppe zone.

Mammuthus primigenius and Coelodonta antiquitatis are known to prefer a cold climate and open areas (tundra and steppe). Equus prefers a steppe biotope. Cervus elaphus, the red-deer, presently distributed through most of the deciduous and Mediterranean woodlands is highly adaptable as been discussed before. The reindeer, Rangifer tarandus is common throughout the tundras and taiga of Eurasia and North America. The large bovids Bison priscus and Bos primigenius probably did not live in the same habitat. Bison priscus which is often found in association with Mammuthus primigenius and Coelodonta antiquitatis, should have preferred an open environment while Bos primigenius probably favoured more forested habitats.

The habitats of the present species and the composition of the fauna indicate a tundra/steppe environment and a cold and rather dry climate during the period in which the fauna lived. The presence of Cervus elaphus could indicate the absence of heavy snowfalls (Stuart, 1982).

5.9. THE INFLUENCE OF HUMAN ACTIVITY ON THE COMPOSITION OF THE FAUNA FROM SITE E

The presence of man at site E is indicated by the flint artifacts (see Roebroeks, 1985). Except for the oval shaped hole in the metacarpal bone of a horse which might be man-made, no clear bone artifacts nor clear traces on the bone fragments, indicating human activity, have been recognized.

An indication for human involvement from the composition of the assemblage from site E is the high frequency of young individuals among the larger mammals. The molar fragment of the mammuth belonged to a young individual, just as the milkmolars of at least two horses and the milkmolar of a reindeer. Both M3 molars of the woolly rhino are unworn, found closely to each other, together with many bone fragments of a skull which might have been smashed by man before fossilization. The molar of the large bovid also belonged to a rather young individual. Not one of the determinable larger mammal remains belonged to full-grown and/or old individuals.

The frequency of young individuals over the limited area sampled at Site E (40 square meters), within the small number of specimens of larger mammals is interpreted as due to human interference with the concentration of these fossils. There are no clear indications for the period of year man visited the site. A relation between human activity and the presence of the smaller mammal remains is not assumed. These concentrations are rather due to activities of birds of prey like the snowy owl which is represented in the fauna-association.

5.10. THE STRATIGRAPHICAL POSITION OF THE FAUNA-ASSOCIATION BELVÉDÈRE 5

The fauna Belvédère 5 is derived from the base of Unit 6.2 which is situated above Soil III, correlated with the Eemian Sol de Rocourt (see Vandenberghe et al., 1985). Therefore, it applies that Belvédère 5 has a Weichselian age.

The mammuth-woolly rhino-reindeer association occurs in many Weichselian faunas and corresponds to the geological age indications. The reindeer is unknown from Saalian deposits in the Netherlands, such as the underlying gravels (unit 3) from the Belvédère locality and ice-pushed deposits in the central and northern part of The Netherlands. A pre-Weichselian occurrence in England is also very uncertain (Stuart, 1982).

The abundant fossils of the arctic lemming, Dicrostonyx torquatus give indications for a pre-Middle Weichselian age of the fauna (see the remarks at the description of D. torquatus). The presence of A. terrestris in ice-pushed deposits at Rhenen indicates that this species already occurs before the end of the Saalian (Van Kolfschoten, 1981). A. terrestris shows a general trend towards larger size during the Weichselian period but there is no uniform progression (Stuart, 1982). Despite that and despite the small number of specimens, the small length of the m1 molar from the site E assemblage may be used as an indication for an early Weichselian age of the fauna.

Also the horse remains, although not determined to specific level indicate a type of horse which is closer related to the type found at Chatillon St Jean (Saalian?) than to the horse from Solutré (late Middle Weichselian).

The presence of the reindeer, Rangifer tarandus, which is very abundant in Weichselian deposits in the middle of The Netherlands, suggests that the fauna from Unit 6.2 is a Weichselian one.

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T. MEIJER*

CONTENTS

* Geological Survey of The Netherlands,
P.O. Box 157,
2000 AD HAARLEM,
The Netherlands.