Ann. Naturhist. Mus. Wien	111 A	635–646	Wien, April 2009

The early Vallesian vertebrates of Atzelsdorf (Late Miocene, Austria) 12. Proboscidea

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(With 3 figures, 1 plate and 1 table)

Manuscript submitted on October 17th 2008,
the revised manuscript on December 3rd 2008

This article is dedicated to O. Schultz (NHMW) on the occasion of his 65th birthday.

Abstract

This is the first description of the proboscidean material from the locality Atzelsdorf (early Late Miocene, MN9). The material is sparse and, for the most part, fragmentary, but provides evidence of the taxa *Deinotherium giganteum* Kaup, 1829 and *Tetralophodon longirostris* Kaup, 1832. The few determinable dental remains are compared with material from other Miocene localities in Europe.

Keywords: deinotheres, *Deinotherium giganteum*, gomphotheres, *Tetralophodon longirostris*, Lake Pannon, Hollabrunn-Mistelbach Formation

Zusammenfassung

Es werden erstmals die fossilen Proboscidier aus der Lokalität Atzelsdorf (frühes Obermiozän, MN9) vorgestellt. Das überlieferte Fossilmaterial ist spärlich und überwiegend fragmentär, belegt aber dennoch die beiden Taxa *Deinotherium giganteum* Kaup, 1829 und *Tetralophodon longirostris* Kaup, 1832. Die Zahnreste werden mit Proboscidier-Material anderer miozäner Lokalitäten in Europa verglichen.

Schlüsselwörter: Deinotherien, *Deinotherium giganteum*, Gomphotherien, *Tetralophodon longirostris*, Pannon See, Hollabrunn-Mistelbach Formation

Introduction

The Atzelsdorf site is an abandoned gravel pit located about 35 km NE of Vienna in Lower Austria, It is situated at the western margin of the Vienna Basin. Geologically, the deposits of the Atzelsdorf site belong to the Hollabrunn-Mistelbach Formation, which comprises deltaic deposits that were discharged by the palaeo-Danube River into Lake Pannon during the Late Miocene.

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Biostratigraphic investigations and well-log correlations point to a correlation of the Atzelsdorf fauna with the Vienna Basin Pannonian Zone C, basal MN9, and an absolute age of about 11.2-11.1 Ma (for more details see DAXNER-HÖCK & GÖHLICH 2009, this volume; HARZHAUSER 2009, this volume).

Methods

The presented material belongs to the private collectors G. PENZ (Vienna) and P. SCHEBECZEK (Pellendorf). Significant specimens, including all figured specimens, are available as casts at the Naturhistorisches Museum Wien under the inventory numbers NHMW 2008z0055/0001 to 2008z0057/0001.

Abbreviations

Tooth abbreviations:

d	lower deciduous tooth
D	upper deciduous tooth
dext.	dextra (right)
m	lower molar
M	upper molars
P	upper premolar
sin.	sinistra (left)

Other abbreviations:

MN	Mammalian Neogene Unit
NHMW	Naturhistorisches Museum Wien, Austria
HLMD	Hessisches Landesmuseum Darmstadt
LMJ	Landesmuseum Joanneum Graz
S	colln SCHEBECZEK
P	colln PENZ
-	not preserved
*	estimated measurement

Systematic palaeontology

Order Proboscidea ILLIGER, 1811

Family Deinotheriidae BONAPARTE, 1845

Genus *Deinotherium* KAUP, 1829

Deinotherium giganteum KAUP, 1829
(pl. 1, figs 1-4)

2002a *Deinotherium giganteum* – HUTTUNEN: 242-244 [cum syn].

H o l o t y p e : Mandible with m2-m3, Hessisches Landesmuseum Darmstadt, Germany, (HLMD Din 465) from Eppelsheim, Germany, Late Miocene, MN9.

M a t e r i a l : Upper teeth: D2 sin. (NHMW 2008z0055/0001, cast of S101); D4 dext. (2008z0055/0003, cast of S139); P3 dext. (2008z0055/0004, cast of S170); P3 sin. (S167). Lower teeth: d4 sin. (2008z0055/0002, cast of S171); m2 dext. fragment (S168); two fragmentary tusk remains (S165, S166). Cranial bones: portion of a mandibular symphysis (colln PENZ, no No.).

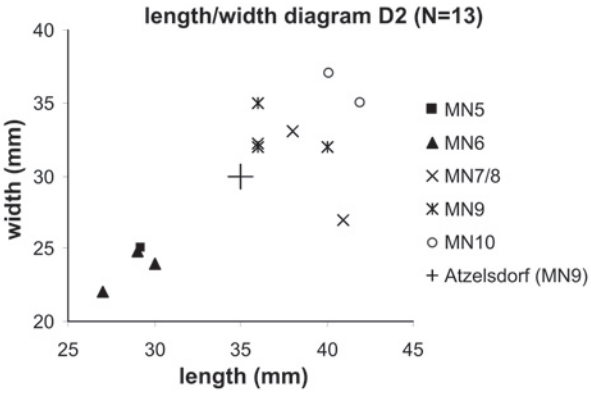

Fig. 1. Metrical comparisons of D2s of deinotheres from Atzelsdorf (MN9) and other European localities (MN5 – Pontlevoy, MN6 – Thannhausen, MN7/8 – Hinterauerbach bei Erding, Massenhausen, MN9 – Eppelsheim, MN10 – Montredon). All measurements from HUTTUNEN (2002b).

D e s c r i p t i o n : D2 sin. (pl. 1, fig. 1): The specimen is an unworn deciduous crown of a D2 having a triangular outline with four distinct cones and a pointed anterior cingulum. Labially, the para- and metacones are connected by a loph whereas the lingual proto- and hypocones are separated by a deep valley. There is also an unworn cingulum posteriorly.

D4 dext. (pl. 1, fig. 3): The D4 is an unworn crown fragment consisting of half a protoloph and complete meta- and tritolophs. Each loph has distinct posterior cristae. Lingually the cristae are more medially oriented than on the labial side. There is a small posterior cingulum.

P3 dext. (pl. 1, fig. 4) and sin.: The P3 dext. has a nearly rectangular outline becoming slightly narrower lingually. There are no distinct cones visible as the tooth is heavily worn and the parallel cones both anteriorly and posteriorly have been interconnected by

Tab. 1. Measurements (in mm) for the dental remains of *D. giganteum* and *T. longirostris* from the locality Atzelsdorf. Width I-V: width over first to fifth loph(id).

Tooth position	max. length	width I	width II	width III	width IV	width V
D. giganteum						
D2 sin.	35	30				
D2?-fragm.	35*	-	-			
D4 dext.-fragm.	63*	-	51	45		
P3 dext.	67	65				
P3 sin.	75	71				
d4 sin.-fragm.	45*	-	37	40		
m2 dext.-fragm.	-	-	78			
T. longirostris						
M1 dext.-fragm.	-	-	-	57	-	
M3 sin.	203	91	92	94.5	89.5	52

wear into transverse facets. The tooth is more worn posteriorly than anteriorly and carries a posterior contact facet for the P4. There is a small anterior cingulum.

The P3 sin. also has a nearly rectangular outline. The tooth has been so deeply worn that the crown has one single wear facet without any distinct cones. The wear facet inclines strongly labially.

d4 sin. (pl. 1, fig. 2): The specimen is a d4 fragment missing the protolophid. The valley between the hypo- and tritolophids is elongated. There are short protocristids extending medially. Those on the buccal side bear small wear facets, those on the lingual side are unworn. There is a small posterior cingulum.

m2 dext.: The specimen is a hypolophid fragment with a thin and even posterior cingulum. There are cristids extending anteriorly, that of the labial side being more worn than that of the lingual side.

Tusk remains: Both tusk remains are too fragmentary to yield significant information. Because of the lack of guillochage (Schreger lines) in the preserved portions of cross sections, the tusk remains can be attributed to deinotheres.

Fragment of mandible: The fragmentary ventral portion of a mandibular symphysis including parts of the alveoli of both the lower tusks clearly indicate the down-curved rostrum and thus allow its identification as a deinothere.

D i s c u s s i o n : A usual diagnostic feature for the determination of species within the genus *Deinotherium* is the size of their teeth (see latest discussions by ATHANASSIOU 2004 and GASPARIK 2004). The material from Atzelsdorf allows comparisons with other European localities for D2 and P3 for which complete teeth are available.

For the D2 there are altogether 13 teeth available from the Mammalian Neogene biochronology Zones MN5 to MN10. Comparison indicates that the tooth from Atzelsdorf is within the range variation of specimens from localities from MN7/8 to MN10. It is situated at the lower end of the range of metric variation (fig. 1).

For the two P3 teeth, a considerably greater quantity of teeth is available for comparisons (N=96). The comparative measurements group into two different size categories. The first one being from MN4 to MN7/8, including also MN9 specimens from the German Dinotheriensande. The second size group is from MN9 to MN10. As for the D2, the Atzelsdorf P3s fall at the lower end of the range of variation of the larger size category (fig. 2).

The size comparisons of the Atzelsdorf teeth support the identification of the material as the species *D. giganteum*. In general, the species *D. giganteum* has been recorded in the literature from Middle Miocene to Late Miocene (see e.g. HARRIS 1978; HUTTUNEN & GÖHLICH 2002). This corresponds to MN7/8 to MN10, the earliest and latest appearances still not being precisely determined.

O c c u r r e n c e : Austria, Bulgaria, France, Georgia, Germany, Greece, Hungary, Moldavia, Romania, Serbia and Montenegro, Spain, Switzerland, Turkey, and Ukraine (according to NOW database).

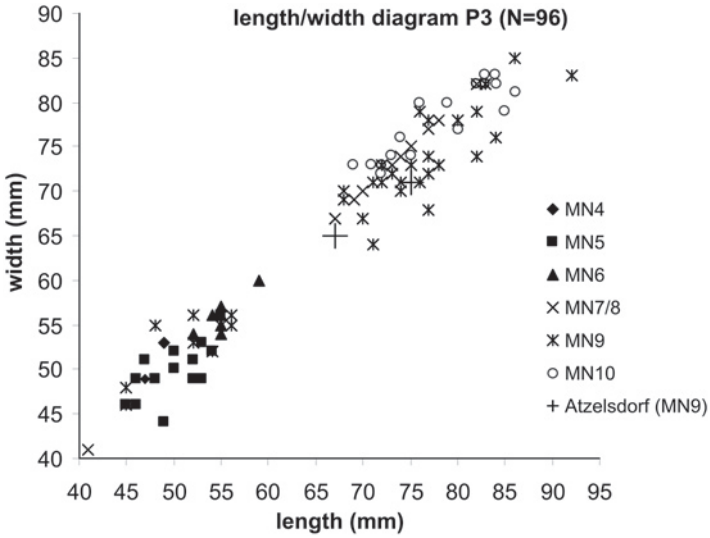

Fig. 2. Metrical comparisons of P3s of deinotheres from Atzelsdorf (MN9) and other European localities (MN4 – Salgotarjan, Chevilly, MN5 – Tavers, Pontlevoy, Castelnau d'Arbieu, Carla-Bayle, MN6 – Aulzhausen, Thannhausen, Pfaffenzell bei Derching, Osseltshausen, Sansan, Pépieux, MN7/8 – La Grive St. Alban, Francon, Fabas, Hinterauerbach bei Erding, Massenhausen, MN9 – Achldorf, Gauweinheim, Westhofen, Eppelsheim, Esselborn, N-Ebing Inn, Wolfsheim, Dintesheim, Wissberg, Sprendlingen, MN10 – Montredon). All measurements from HUTTUNEN (2002b).

Family Gomphotheriidae HAY, 1922

Genus *Tetralophodon* FALCONER, 1857

***Tetralophodon* cf. *longirostris* (KAUP, 1832)**
(pl. 1, figs 5-6)

M a t e r i a l : M3 sin. (NHMW 2008z0056/0001, cast of colln. PENZ, no No.), M1 dext.-fragment (2008z0056/0002, cast of S172);

D e s c r i p t i o n : M1 dext.-fragment (pl. 1, fig. 6): The posterior half of a heavily worn intermediate molar comprising 2½ lophs is preserved. Even if incomplete, the tooth is considered to have been tetralophodont because of the extension of the preserved posterior root. The wear stage and wear pattern allows no detailed description of the crown morphology except for the presence of a posttrite posterior crescentoid on the third loph. The crown width of 57 mm indicates that the tooth fragment is an M1.

M3 sin. (pl. 1, fig. 5): The tooth is complete and only the first two lophs are slightly worn. The roots are broken off. The crown comprises 4½ lophs with the posterior one being very low and irregular; thus, it can be interpreted as possessing 4 lophs plus a strong talon. Each of the four lophs consists of seven to eight cones. In lophs I and II the main cusp is stronger than the mesoconelets, whereas in lophs III and IV the main cone

and mesoconelets are similar in size. The median sulcus is weak in loph III and absent in loph IV and V. Lophs I and II have very strong pretrite central conules, in loph III and IV they are reduced. The anterior pretrite conules on lophs I and II are strong and bulky and in loph II are attached to the labial mesoconelet. The posterior central conules of lophs I and II form a crenulated bulge (line of smaller cusps) emanating from the main cone. On the anterior pretrite flanks of lophs III and IV respectively, two and three small central conules positioned side by side. Posttrite central conules are present in the first three lophs, developed as crenulated adaxial bulges, originating from the most median mesoconelet and decreasing in dimensions from the first to the third loph. A peculiar and unique feature of this tooth is the occurrence of two strong cusps situated side by side in the first posttrite valley; they are not conules as they are not attached to either the posterior or the anterior flanks of the posterior halflophs. They recur in weaker versions in the second posttrite valley. The tooth has a strong labial cingulum and the valleys (especially the posterior ones) are covered with cement. The valleys are relatively narrow anteroposteriorly. Due to the equal size of the main cones and mesoconelets and the reduced or completely suppressed median sulcus in the three posterior lophs, the rear half of this M3 has a somewhat "stegodont" aspect.

D i s c u s s i o n : The reconstructed number of four lophs in the Atzelsdorf M1 identifies the tooth as a tetralophodont gomphothere. The M3 from Atzelsdorf, however, cannot be referred unequivocally either to tri- or to tetralophodont gomphotheres by means of its size and/or presence of 4½ lophs (or 4 lophs plus a strong talon). Large trilophodont gomphotheres such as *G. steinheimense* (Klähn, 1922) and *G. pyrenaicum* (Lartet, 1859), as well as tetralophodont taxa such as *T. longirostris*, *T. gigantorostris* (Klähn, 1922) and others have to be taken into consideration when making comparisons.

Similar dimensions and loph numbers can be found in several M3s of *G. steinheimense* from Steinheim (Germany, MN7) and Massenhausen (Germany, MN7/8) (Göhlich 1998) and of *G. pyrenaicum* from St. Frajou (France, MN7). However, the Atzelsdorf M3 differs from G. *steinheimense* and *G. pyrenaicum* by its slightly narrower crown (fig. 3), by the development of cement, and by the lack of abaxial, vertical bulges on the posttrite halflophs (Göhlich 1998). It differs furthermore from *G. steinheimense* by the lack of a series of vertical furrows on the lingual base of the crown and from *G. pyrenaicum* by the development of a stronger talon (Göhlich 1998).

In tetralophodont gomphotheres the fifth loph in M3 is usually well developed and is followed by a talon or even a sixth loph. However, some *T. longirostris* M3s also possess only 4½ lophs, such as the M3 from Atzelsdorf. Such specimens are known even from the type locality Eppelsheim (Germany, MN9) (e.g. HLMD Din 516), as well as from other early Late Miocene localities e.g. from Kornberg (Austria, e.g. LMJ 60.114) or from Breitenfeld (Austria, e.g. LMJ 59.644+59.643). In dimensions, the M3 from Atzelsdorf matches best with *T. longirostris* (fig. 3) and falls within the size range of the sample from the type locality Eppelsheim. Also its morphology corresponds best with *T. longirostris*. However, most *T. longirostris* specimens have less cement than the M3 from Atzelsdorf and such extremely strong additional cusps in the first and second posttrite valleys are unknown. The Atzelsdorf M3 is smaller than those referred to *T. gigantorostris* from Rudabánya (Hungary, MN9) (Gasparik 2004), the taxonomic validity of which is still under debate (Göhlich 1998) and it is also considerably smaller than

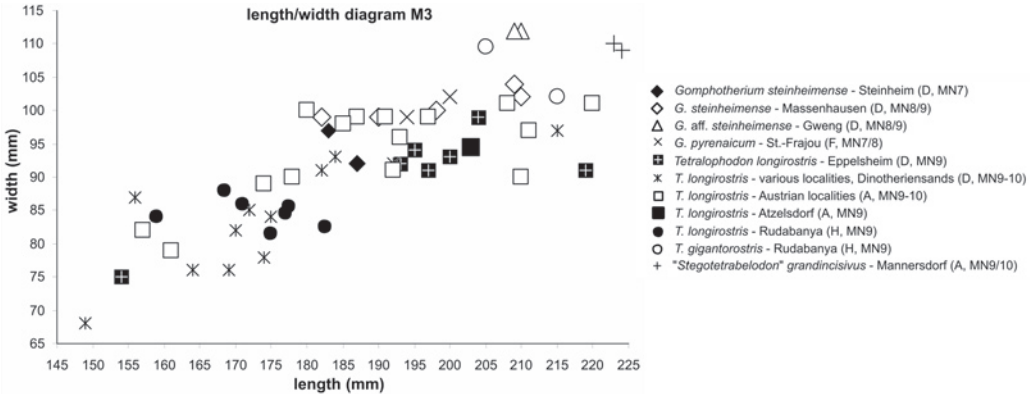

Fig. 3. Metrical comparison of M3 of different tri- and tetralophodont gomphotheres from type localities (Steinheim, St.-Frajou, Eppelsheim) and additional European localities ranging from MN7 to MN10 (all own measurements, partly published in GÖHLICH 1998).

those of "*Stegatetrabelodon*" *grandincisivus* (SCHLESINGER, 1917) from Mannersdorf (Austria, MN9/10) (SCHLESINGER 1917, pl. XV) (fig. 3). The latter specimen also differs in possessing more lophs (five lophs plus a talon). However, the M3 of "*S.*" *grandincisivus* resembles that from Atzelsdorf in showing tendencies of "stegodont" morphology in the posterior lophs (meaning suppressed median sulcus, suppressed conules, conelets of each loph about equal in size, absence of chevroning) (SCHLESINGER 1917: 121).

In summary, in comparison with the more or less contemporary gomphothere taxa in Europe, the M3 from Atzelsdorf matches most closely those of *T. longirostris*, but it seems primitive in having a low number of lophs, but progressive in having a notable amount of cement and in developing a somewhat "stegodont" morphology in the posterior lophs. The strongly developed accessory cusps in the first and second posttrite valleys seem to be a unique feature of the Atzelsdorf M3. Whether this combination of features reflects intraspecific variability or whether it is of systematic significance cannot be deduced on the basis of the scanty material available.

O c c u r r e n c e of *T. longirostris* (according to NOW database): Austria, France, Georgia, Germany, Greece, Hungary, Moldova, Russia, Spain, Switzerland, Turkey, and Ukraine.

S t r a t i g r a p h i c r a n g e of *T. longirostris*: Late Middle Miocene to Late Miocene (GÖHLICH 1999).

Proboscidea indet.

M a t e r i a l : Fragment of tooth loph of a premolar or molar of a proboscidea (NHMW 2008z0057/0001, cast of S36); small tooth fragment of possibly a deciduous tooth of a possible gomphothere (S37); scapula dext. (S162); corpus vertebra (S163); fragment of possible MtV or McV (S164).

D i s c u s s i o n : The fragmentary preservation of some tooth and bone fragments from Atzelsdorf does not permit certain affiliation to either deinotheres or gomphotheres.

The scapula dext. even if incomplete, is the best preserved of the proboscidean bones; angulus cranialis and caudalis and margo cranialis and caudalis are broken off. The spina scapulae is missing the acromion and the metacromion. The scapula is divided by the spina scapulae into ca. 1/4 of fossa supraspinata and 3/4 of fossa infraspinata. The cavitas glenoidalis is almost rectangular in outline and strongly concave (in lateral view). The tuberculum supraglenoidale extends distally below the cavitas glenoidalis. There are two tuberosities on both the cranial and caudal sides of the cavity. Measurements of cavitas glenoidalis: max. width: 108 mm, max. length: 202 mm.

Very little is known so far about possible morphological differences in the scapula of deinotheres and gomphotheres. No description of any scapula is published so far, which belongs with certainty to either *T. longirostris* or *D. giganteum*. Only a scapula of the deinothere species *Prodeinotherium bavaricum* (von Meyer, 1831) from Unterzolling was described so far (Huttunen & Göhlich 2002: 495). In comparison with this scapula (MN6, Southern Germany) the outline of the cavitas glenoidalis of the specimen from Atzelsdorf differs in being more elongated (Huttunen & Göhlich 2002: 495).

Conclusion

The scanty proboscidean material from Atzelsdorf confirms the contemporaneous and sympatric occurrence of *D. giganteum* and *T. longirostris* in the early Late Miocene of Europe.

As shown by Calandra et al. (2008) based on microwear analyses of the molars, such a sympatric coexistence of these large megaherbivores is enabled because they probably occupied different ecological niches and because of dietary differences between deinotheres and gomphotheres. The assignment of the gomphothere remains to *T. longirostris* is made with reservation as some features of the crown morphology deviate slightly from the rather “typical” molar design of this species.

Acknowledgments

We are grateful to G. Penz (Vienna) and P. Schebeczek (Pellendorf) for providing their Atzelsdorf fossils for this study, A. Schumacher (NHMW) for taking the photographs, and A. Englert and A. Fürst (both NHMW) for making casts of the specimens. We thank A. Athanassiou (Athens, Greece) and M. Pickford (MNHN Paris) for critically reviewing the manuscript and M. Pickford for improving the English. For comparative studies UBG was supported by a Synthesys fellowship to the NHMB Budapest (HU-TAF-2098).

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Plate 1

Proboscidean teeth from the early Late Miocene of Atzelsdorf (Lower Austria).

***Deinotherium giganteum* KAUP, 1829**

Fig. 1. D2 sin., NHMW 2008z0055/0001.

Fig. 2. d4 sin., NHMW 2008z0055/0002.

Fig. 3. D4 dext., NHMW 2008z0055/0003.

Fig. 4. P3 dext., NHMW 2008z0055/0004.

***Tetralophodon* cf. *longirostris* (KAUP, 1832)**

Fig. 5. M3 sin., NHMW 2008z0056/0001.

Fig. 6. M1 dext., NHMW 2008z0056/0002.

All teeth in occlusal view. Scale bar equals 3 cm.


1
2
3
4
3 cm
5
6