Proboscidea

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urn:lsid:zoobank.org:pub:71BAE61A-7831-4F51-AF55-526A0C3B0D5F

Tassy P. 2016. — Proboscidea, *in* Sen S. (ed.), Late Miocene mammal locality of Küçükçekmece, European Turkey. *Geodiversitas* 38 (2): 261-271. http://dx.doi.org/10.5252/g2016n2a7

KEY WORDS
Late Miocene,
Vallesian,
Turkey,
Proboscidea,
Deinotherium,
Choerolophodon,
tetralophodont.

ABSTRACT

The proboscideans found at West-Küçükçekmece (Turkey) are represented by three species, *Deinotherium* cf. *giganteum* Kaup, 1829, *Choerolophodon pentelici* (Gaudry & Lartet, 1856) and "tetralophodont form, gen. and sp. indet.". This association is characteristic of late Vallesian/Turolian levels in eastern Mediterranean area.

RÉSUMÉ

Proboscidea.
Les proboscidiens découverts à Küçükçekmece Ouest (Turquie) sont décrits et rapportés à trois espèces, *Deinotherium* cf. *giganteum* Kaup, 1829, *Choerolophodon pentelici* (Gaudry & Lartet, 1856) et « forme tétralophodonte, gen. et sp. indet. » Le dinothère est représenté par une portion de défense massive et faiblement incurvée appartenant à un vieil individu. Le choerolophodonte est représenté par une portion d'hémimandibule avec m3, une portion de branche montante et 17 dents jugales dont 8 fragmentaires. La complexité moyenne de la choerodontie et de la ptychoïdie est interprétée comme compatible avec le niveau évolutif de l'espèce *C. pentelici* au Vallésien supérieur/Turolien inférieur. La forme tétralophodonte indéterminée est représentée par six molaires, dont quatre (M2 et M3) appartiennent à un même individu. Leur grade tétralophodonte est indiscutable mais le pattern des lophes est relativement généralisé vis-à-vis de celui des molaires de l'espèce dénommée « '*Mastodon*' *grandincisivus* » ou bien *Konobelodon atticus* au sens de Konidaris *et al.* (2014) et, plus encore, de celui de l'autre tétralophodonte, appelé « forme grandincisivoïde » par Mazo & Montoya (2003). La première espèce citée est connue au Vallésien et au Turolien en Turquie d'Europe et dans la partie nord de Méditerranée orientale. Cependant comme les caractères diagnostiques manquent à Küçükçekmece Ouest, notamment la défense inférieure, l'attribution taxinomique du tétralophodonte de Küçükçekmece Ouest reste ouverte. En tout état de cause, l'association des trois proboscidiens indiquerait un âge Vallésien supérieur/Turolien inférieur, soit MN10-MN11, à Küçükçekmece Ouest. La contemporanéité avec les autres gisements de la région de Küçükçekmece (plus à l'Est) est possible mais non attestée.

MOTS CLÉS
Miocène supérieur,
Vallésien,
Turquie,
Proboscidea,
Deinotherium,
Choerolophodon,
tetralophodont.

INTRODUCTION

In this article are briefly described fossils discovered by Nicolas (1978) at West-Küçükçekmece (Turkey) (elsewhere spelled W-K). The former proboscidean remains described by Malik & Nafiz (1933) come from another locality situated along the eastern shore of the Küçükçekmece lagoon. Nicolas' collection is housed in the Muséum national d'Histoire naturelle, Paris. Three proboscidean species can be recognized based on dental material (postcranial material is not described here). These fossils are mainly isolated specimens although one can identify anatomical and logical connections between some of them (especially a palate of "tetralophodont form, *gen* and *sp indet*"). This is probably due to both taphonomy (dissolution of bone in the sandy and ferruginous sediments) and recent factors (damage during digging).

SYSTEMATICS

Order PROBOSCIDEA Illiger, 1811
Family DEINOTHERIIDAE Bonaparte, 1845
Genus *Deinotherium* Kaup, 1829

Deinotherium cf. ***giganteum*** Kaup, 1829
(Fig. 1)

MATERIAL EXAMINED. — Incomplete lower tusk MNHN.F.TRQ183.

DESCRIPTION

The tusk MNHN.F.TRQ183 is robust, relatively short and massive (Fig. 1A). It is broken toward the tip. The length of the portion is 400 mm. Complete the tusk could have measured 600 mm. The maximum diameter is 115 × 37 mm. The curve is not very pronounced. The tusk found at W-K belongs to an old individual: the pulpal cavity is partly resorbed (Fig. 1B).

DISCUSSION

Because of its size, curve and lamellar dentinal structure without Schreger lines, this tusk belongs to a deinothere. The allocation of the lower tusk to *Deinotherium* cf. *giganteum* is due to its robust proportions and its curve less accentuated than in the smallest middle Miocene species *Prodeinotherium bavaricum* (von Meyer, 1831).

The postcranial remains found at W-K (not described here), are large, especially metapodials. Part of this postcranial material belongs possibly to *Deinotherium*. Yet the largest individuals of *Deinotherium giganteum* found in Turolian localities have also been allocated to different species, such as *Deinotherium gigantissimum* Stefanescu, 1892, *Deinotherium proavum* (Eichwald, 1831) and *Deinotherium thraceiensis* Kovachev & Nikolov, 2006, likely synonyms (Konidaris & Koufos 2013). Because the lower tusk described here cannot be the starting point of a discussion of the intraspecific variability of *D. giganteum* and the evolutionary level of Turolian specimens compared to Vallesian specimens, the deinothere from West-Küçükçekmece is then identified as *Deinotherium* cf. *giganteum*.

The genus *Deinotherium* is listed at Küçükçekmece by Malik & Nafiz (1933) based on an excavated molar interpreted as an m3 but the apparent trilophodonty of the tooth fits better with M1 or dP4. According to Malik & Nafiz (1933) the length of this tooth is 77 mm.

Suborder ELEPHANTIFORMES Tassy, 1988
Infraorder ELEPHANTIDA Tassy & Shoshani, 1998
Family CHOEROLOPHODONTIDAE Gaziry, 1976
Genus *Choerolophodon* Schlesinger, 1917

Choerolophodon pentelici (Gaudry & Lartet, 1856)
(Figs 2, 3; Tables 1, 2)

MATERIAL EXAMINED. — **Deciduous teeth**: Right dp3 MNHN.F.TRQ283, first lophid of left dp4 TRQ292, damaged germ of left dp4 TRQ287.
Molars: Fragmentary maxilla with right M1-M2 MNHN.F.TRQ300, fragmentary maxilla with right M3 TRQ307, left M3 and distal part of M2 broken at cervix TRQ298 (the M3 has been sectioned at mid-height), ? left M3 on fragmentary maxilla (pathologic M3 or supernumerary molar) TRQ302, damaged left M3 TRQ294, distal part of left M2 (disto-lingual area) TRQ295, distal part of right M3 TRQ286, distal part of right m3 TRQ297, right m2 T 293, left m2 TRQ282, portion of left hemimandible with m3 TRQ301, portion of left ascending ramus with distal part of alveolus of m3 TRQ309, posterior loph of right M1 TRQ288, fragment of molar TRQ285, fragment of molar TRQ289, excavated fragment of molar TRQ290.

DESCRIPTION

Maxilla

The fragments of maxilla are reduced to the bony part that contains the molars.

Mandible

The two specimens found at W-K lack the rostral part. The partial left hemimandible MNHN.F.TRQ301 belongs to an adult with worn m3 (Fig. 2). The other specimen is a left ascending ramus (TRQ309) which belongs to another individual. It is slightly smaller than TRQ301, a difference either due to sexual dimorphism or to individual age. The preserved alveolus indicates that the m3 was erupted, but perhaps fresh or less worn than TRQ301.

The main characters seen on these mandibles are the low *angulus mandibulae* (derived trait), and the relatively reduced retro-molar space. Beside this reduction, the m3 is entirely visible in lateral view.

The height of the *corpus mandibulae* of TRQ301 taken at m3 is 150 mm; the width of the *corpus mandibulae* taken at the m3 is 96.6 mm, and 128.3 mm taken at the root of the ascending ramus.

Deciduous premolars

The dp3 MNHN.F.TRQ283 is much worn and its distal part is broken. Only the anterior border of the distal root is

Fig. 1. — *Deinotherium* cf. *giganteum* from West-Küçükçekmece, late Miocene, lower tusk MNHN.F.TRQ183: **A**, lateral view; **B**, hind view. Scale bar: 10 cm.

preserved, so that the entire postcingulum is missing. It is not possible to draw any conclusion about the development of the postcingulum, if it was simple or complex.

The two dp4s are germs. MNHN.F.TRQ292 preserves only the anterior lophid. TRQ287 is complete but much damaged, the anterior half of the first lophid and much of the third lophid are missing. The enamel is destroyed on the labial and lingual sides.

MNHN.F.TRQ292 is large and high. The precingulum is strong. The main pretrite cusp of the lophid is longitudinally enlarged and subdivided into three cusps.

Although MNHN.F.TRQ287 is damaged, it is very likely that the morph of the tooth is rather derived. The crown is relatively high. In the first interlophid the anterior pretrite central conule 2 is large, much larger than the posterior central conule 1. The mesoconelets are reduced, a primitive state compared to the dp4 of the lectotype of *C. pentelici* from Pikermi (Greece) described by Gaudry (1867: pls 22, 23, fig. 1). The pretrite main cusp of the second lophid is longitudinally enlarged (as for TRQ292). This derived trait is more frequent on the complex *pentelici* morph, more common in Turolian

TABLE 1. — Deciduous premolars measurements (in mm) of *Choerolophodon pentelici* (Gaudry & Lartet, 1856) from W-K. Abbreviations: **e**, enamel thickness (with indication of the half-loph(id) in superscript); **H**, height (with indication of the half-loph(id) in superscript); **I**, robustness index=100W/L; **IH**, height index=100H/W; **L**, length; **maxW**, maximum width (with indication of the loph(id) number in superscript); **po**, posttrite; **pre**, pretrite. The sign **+** indicates that the specimen is incomplete.

Tooth	Specimen	L	maxW	H	I	IH	e
Rt dp3	MNHN.F.TRQ283	35.2+	$24.8+^{2}$	–	–	–	–
Rt dp4	MNHN.F.TRQ292	–	$31.^{1}$	$29.9^{56.+}$	–	–	–
Lt dp4	MNHN.F.TRQ287	56.+	27.4+	$28.3+^{\text{pre2}}$	–	–	3.2^{pre2}

TABLE 2. — Molar measurements (mm) of *Choerolophodon pentelici* (Gaudry & Lartet, 1856) from W-K. Abbreviations: see Table 1.

Tooth	Specimen	L	maxW	H	I	IH	e
Rt M1	MNHN.F.TRQ300	78.6	53.84^{2}	–	68.5	–	–
Rt M2	MNHN.F.TRQ300	114.9	71.1^{2}	51.2^{pre2}	62.0	72.0^{pre2}	–
Lf M2	MNHN.F.TRQ295	84+	$64+^{2}$	–	–	–	4.7^{pre2}
Lt M3	MNHN.F.TRQ298	131.	$71.4^{1,2}$	59.6^{pre2}	–	83.5^{pre2}	–
Lt M3	MNHN.F.TRQ294	102.7+	$66.4+^{3}$	–	–	–	6.1^{pre3}
Rt M3	MNHN.F.TRQ286	–	69.5^{4}	–	–	–	6.5^{pre3}
Rt M3	MNHN.F.TRQ307	154.	85.5^{2}	–	56.5	–	–
Lt m2	MNHN.F.TRQ282	101.1+	60.8^{3}	–	–	–	–
Rt m2	MNHN.F.TRQ293	100.9+	$60.2+^{3}$	–	–	–	4.3^{pre3}
Rt m3	MNHN.F.TRQ297	113.4+	$56.3+^{3}$	–	–	–	$6.^{\text{pre4}}$
Lt m3	MNHN.F.TRQ301	176.	77.5^{3}	–	44.0	–	–

mammal zones (MN12-13), but not constant. The dp4 of the lectotype of *C. pentelici* from Pikermi is primitive from this viewpoint.

Upper Molars

The morphology of M1 and M2 is the same, showing a rather simple morph, or medium complexity. Choerodonty and ptychoidy are relatively modest. On the third loph of M1 MNHN.F.TRQ300 the mesoconelet and the anterior pretrite central conule are not fused, a morphology also seen on the third loph of M2 (Fig. 3A). On the contrary on the second loph of M2 TRQ300 the anterior central conelet and the mesoconelet are fused. On TRQ295 and TRQ300 the posttrite half-lophs are relatively simple with weak posttrite conules.

The five M3s display an important variation in size and morphology.

The smallest M3? (MNHN.F.TRQ302) is remarkably simple (Fig. 3B). Despite its size, the overall shape of the molar fits with that of an M3 and not of an M2. It is strictly trilophodont without enlargement of the postcingulum. The cusps of the second and third lophs are thin, the central conules are weak. On the first posttrite half-loph two labial cusps, antero-posteriorly aligned, are present, which is an unusual morphology. Cristae are present on the posterior side of the second and third posttrite half-lophs and on the posterior side of the second pretrite half-loph. The lingual cingulum is inflated and on the labial side the cingulum is thick at the basis of the second loph. This is the simplest choerolophodont M3 known so far. Even in the stem species of the genus *Choerolophodon* (the species *C. kisumuensis* (MacInnes, 1942) from East Africa) the postcingulum is enlarged and divided into three cusps (Tassy 1986: pl. 5, fig. 2). It is likely that the strange association of the characters of TRQ302 is due to an abnormal development: a pathologic M3 or perhaps a supernumerary tooth.

The other M3s are tetralophodont with a subdivided postcingulum with thick (MNHN.F.TRQ307) or weak (TRQ298, TRQ286) cusps (Fig. 3C, D). The distal part of the heavily worn TRQ294, badly broken, is missing. The anterior pretrite central conules are enlarged, especially on the third loph (TRQ307, TRQ294) but not on TRQ298. A posterior pretrite central conule is enlarged on the second loph of TRQ307 but there is no contact between posttrite half-loph 2 and the pretrite half-loph 3, contrary to TRQ294.

The unworn molar MNHN.F.TRQ298 (just erupted) is largely covered by cement. A section of the crown taken at mid height displays the pattern of the lophs. The morphology is simple (and reminiscent of that of the M2 TRQ300). No posterior pretrite central conules; on the third loph, no anterior pretrite central conule; no longitudinal enlargement of the main cusps. On the basis of these traits, this molar fits with *C. kisumuensis*. Yet, there is a fused anterior pretrite central conule/mesoconelet on the third loph.

The association at W-K of the morphs displayed by MNHN.F.TRQ294, TRQ298 and TRQ307 proves the contemporaneity of relative "primitive" and "derived" traits on M3s rather explained by intraspecific variation than by evolutionary stages. Not unexpected, since M3s are known to be highly variable in gomphotheres in general (i.e. *Gomphotherium angustidens*, see Tassy 2014).

Lower molars

The two m2s found at W-K are worn, MNHN.F.TRQ282 is excavated. Ptychoidy and choerodonty are marked more than

Fig. 2. — *Choerolophodon pentelici* from West-Küçükçekmece, late Miocene: **A**, left hemimandible with m3 MNHN.F.TRQ301, lateral view; **B**, its m3, occlusal view. Scale bar: 10 cm.

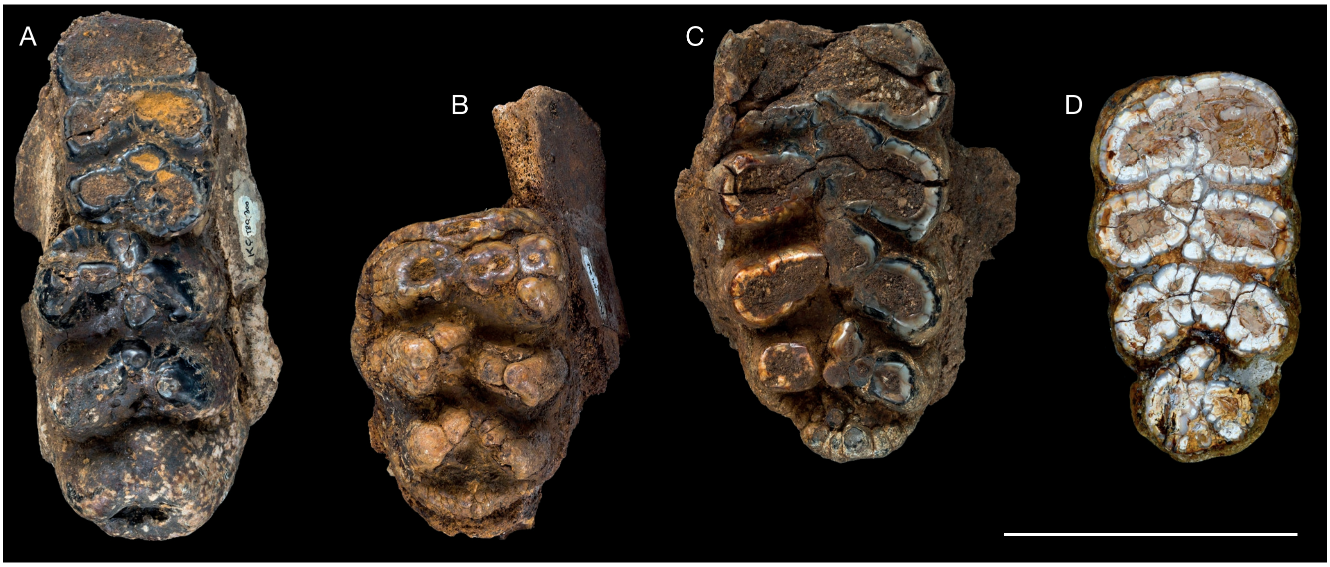

Fig. 3. — *Choerolophodon pentelici* from West-Küçükçekmece, late Miocene: **A**, right M1-M2 MNHN.F.TRQ300; **B**, left ?pathologic M3 or supernumerary molar, MNHN.F.TRQ302; **C**, right M3 MNHN.F.TRQ307; **D**, section of left M3 MNHN.F.TRQ298. All specimens are shown in occlusal view. Scale bar: 10 cm.

on upper molars and lower m3s (see below). On the right m2 TRQ293, less worn, the derived shape of the main pretrite cusps is seen (longitudinal orientation).

The only complete m3 is MNHN.F.TRQ301 which belongs to a partial left hemimandible (Fig. 2). Choerodonty and ptychoidy are less accentuated than on the m2s. The

TABLE 3. — Molar measurements (mm) of “tetralophodont form, gen. and sp. indet.” from W-K. Abbreviations, see Table 1.

Tooth	Specimen	L	maxW	H	I	IH	e
Lt M1	MNHN.F.TRQ209	88.4+	54.1^{3}	–	–	–	5.0^{po1}
Rt M2	MNHN.F.TRQ305	158.3	87.8^{3}	–	55.5	–	–
Lt M2	MNHN.F.TRQ306	158.2	85.9^{2}	–	54.3	–	–
Rt M3	MNHN.F.TRQ304	200.0	98.2^{2}	78.6^{pre2}	49.1	80.0	–
Lt M3	MNHN.F.TRQ308	208.5	101.0^{2}	$72+^{pre2}$	48.4	–	–
Lt M3	MNHN.F.TRQ303	209.0	91.6^{2}	–	43.8	–	6.2^{po1}

molar is pentalophodont. The fifth lophid is narrow but fully achieved, each half-lophid is made up of only one cusp. There is a distinct postcingulum made up of one median cusp. The longitudinal extension of the main pretrite cusp is seen on the second and fourth lophid, not on the third (the first is too worn). The pretrite trefoils are complete in the three anterior interlophids. There are two anterior pretrite conules 5. The molar has no posttrite conules. The partial m3 TRQ297, anteriorly broken was probably tetralophodont with a strong postcingulum. On the third loph, contrary to TRQ301, the trefoil is not complete and contains a fused mesoconelet/anterior pretrite central conule.

The four lower molars found at W-K show an important variation which implies all major characters: choerodonty and ptychoidy, number of lophids (m3s), trefoils with fusion (or not) of mesoconelet/anterior pretrite central conule, degree of longitudinal extension of main pretrite cusps.

DISCUSSION

If the simple and complex morphs displayed by choerolophodont molars of the *Choerolophodon pentelici* lineage (Gaziry 1976; Tassy 1994; Sanders 2003; Konidaris & Koufos 2013; Konidaris *et al.* 2016) bear a taxonomic and biostratigraphic information, the sample from W-K occupies an intermediate position. What has been concluded for the lower molars in the previous section can be extended to the whole dentition. Variation implies all major characters: choerodonty and ptychoidy, number of loph(id)s, trefoils with fusion (or not) of mesoconelet/anterior pretrite central conule, degree of longitudinal extension of main pretrite cusps, notwithstanding differences in size. On the one hand, the W-K sample does not belong to the most derived *C. pentelici* morphs recognized in the MN12-13 zones; on the other hand, the dental material from W-K is beyond the simplest morphs recognized in *Choerolophodon anatolicus* (Ozansoy, 1965) of the MN9 zone (Konidaris & Koufos 2013; Konidaris *et al.* 2016) or MN9-MN10 zones (Sanders 2003; Geraads *et al.* 2005). For instance, the m3 MNHN.F.TRQ301 matches with the m3 of *C. pentelici* from Xirochori-1 (Greece, MN10 according to Konidaris *et al.* [2016: fig. 4G]). Moreover, based on Vallesian and Turolian material from Greece, Konidaris *et al.* (2016) described in details the important variation of the choerolophodont molars and a somehow morphological continuity between *C. anatolicus* (MN9), “*C. pentelici* primitive” (MN10) and “*C. pentelici* advanced” (MN11-13).

Compared to the choerolophodont material described by Malik & Nafiz (1933) at Küçükçekmece, it seems that W-K extends the range of the variation in the Küçükçekmece area. But it is difficult to conclude if the two samples are different from taxonomic and, consequently, biostratigraphic viewpoints.

The dP2 and dP3 from Küçükçekmece described by Malik & Nafiz (1933: pl. 7, fig. 3) as “*Mastodon Pentelici*” are simple and fit with *C. anatolicus sensu* Konidaris *et al.* (2016). The m3 described as “*Mastodon* sp.” (Malik & Nafiz 1933: pl. 6) has four lophids (simple morph, contrary to MNHN.F.TRQ301) and trefoils with fused anterior central conules and mesoconelets (comparable to TRQ297 if this tooth is really tetralophodont), so that it fits with both *C. anatolicus sensu* Konidaris *et al.* (2016) and *C. pentelici*.

Among the key points are characters of the mandible. The first is the angulation of the ventral border of the symphyseal rostrum. The partial mandible MNHN.F.TRQ301 does not bring any information. With its symphysis extending the horizontal corpus *Choerolophodon pentelici sensu stricto* contrasts with *Choerolophodon chioticus* Tobien, 1980. It contrasts also with the most eastern species *Choerolophodon corrugatus* (Pilgrim, 1913) where the symphysis is bent downward (Tassy *et al.* 1989), on both juvenile and mature growth stages. Based on a mandible with a slightly bent symphysis, Tassy *et al.* (1989) described the subspecies *C. pentelici lydiensis* Tassy, Sen, Jaeger, Mazin & Dalfes, 1989 in the Vallesian (MN9) of Eşme-Akçaköy (Turkey). Sanders (2003), followed by Geraads *et al.* (2005) and Konidaris *et al.* (2016), synonymized this subspecies with the species *Choerolophodon anatolicus*. Yet the Vallesian (MN10) mandibles of *C. anatolicus* described from Sinap 83 (Sinap Formation, Turkey) by Sanders (2003) and at Yulafli (Turkey) by Geraads *et al.* (2005) have a horizontal symphysis (at least what is left of the symphysis). Maybe the presence or absence of the ventral angulation of the symphysis is variable and without taxonomic implication. The complete mandible of *C. pentelici* with m3 described at Küçükçekmece by Malik & Nafiz (1933) as “*Mastodon* sp.” has been destroyed. Unfortunately the photographs given by Malik & Nafiz (1933: pls 4, 5) are ambiguous because the mandible is seen in perspective from above and from the front. In any case the angulation, if it exists, cannot be very strong. Surprisingly enough, Viret (1953) compares it to “*Synconoloplus propathanensis*”, that is *Choerolophodon corrugatus*, characterized by a strong angulation.

The second is the retro-molar space behind m3. It is enlarged in *C. pentelici* (including the Eşme-Akçaköy (Vallesian) mandible)). Here it is reduced but the m3 is entirely visible in lateral view. Perhaps the mandible described by Malik & Nafiz (1933) is comparable but it is not certain due to the

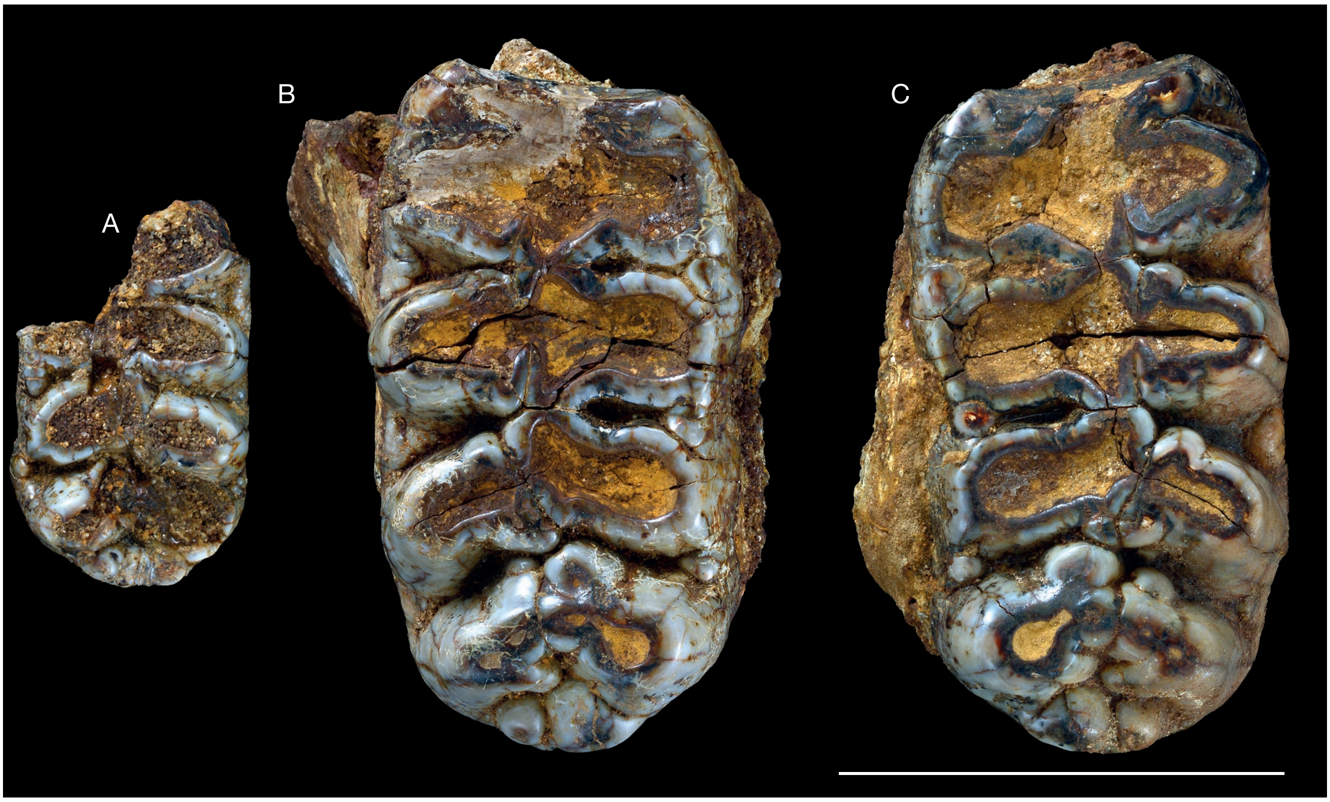

Fig. 4. — Tetralophodont form, gen. and sp. indet. from West-Küçükçekmece, late Miocene: **A**, left M1 MNHN.F.TRQ209; **B**, right M2 MNHN.F.TRQ305; **C**, left M2 MNHN.F.TRQ306. All specimens are shown in occlusal view, Scale bar: 10 cm.

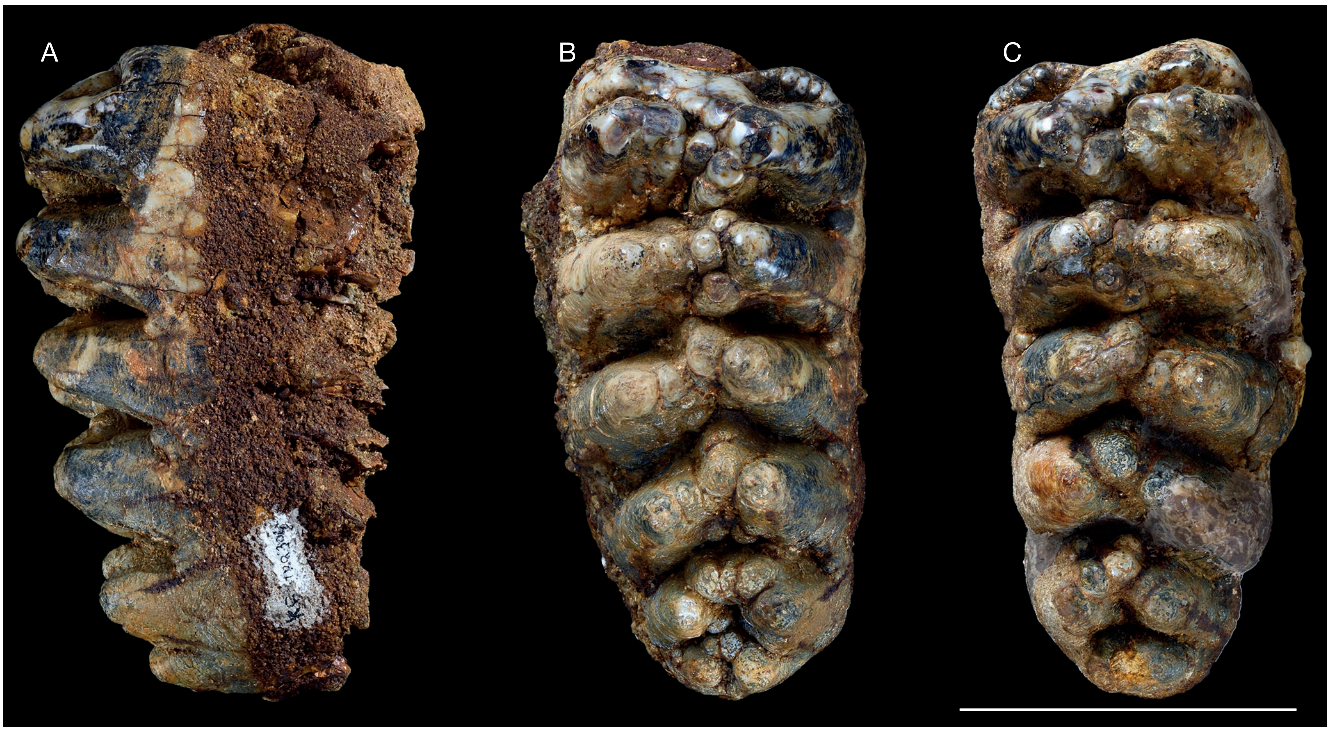

Fig. 5. — Tetralophodont form, gen. and sp. indet. from West-Küçükçekmece, late Miocene: **A**, right M3 MNHN.F.TRQ304 in labial view; **B**, the same specimen in occlusal view; **C**, left M3 MNHN.F.TRQ308 in occlusal view. Scale bar: 10 cm.

photographic problem raised above. It is also enlarged in *C. anatolicus* from Pentalophos-1 (Vallesian [MN9] of Greece) according to Konidaris *et al.* (2016: fig. 4H, I). Maybe the enlargement of the retro-molar space is variable and without taxonomic implication.

The taxonomic conclusion about W-K is that the choerolophodont belong to *C. pentelici*, maybe "*C. pentelici* primitive" (*sensu* Konidaris *et al.* [2016]), although I assume that choerolophodont teeth from late Vallesian (MN10 "primitive") and early Turolian (MN11 "derived") could be united, based on morphological continuity.

Infraorder ELEPHANTIDA Tassy & Shoshani, 1998

Tetralophodont form, gen. and sp. indet.
(Figs 4, 5; Table 3)

Material examined. — Left M1 MNHN.F.TRQ209, right M2 TRQ305, left M2 TRQ306, right M3 TRQ304, left M3 TRQ303, left M3 TRQ308 (the specimens TRQ304, TRQ305, TRQ306 and TRQ308 belong to the same individual).

Description

The tetralophodont form found at West-Küçükçekmece is represented by three individuals. Firstly, a dismembered palate with right and left M2-M3, secondly, one left M1, and thirdly, one left M3.

The tetralophodont grade is fully achieved on these teeth, with no tendency toward a pentalophodont grade. The posterior cingulum of M2 is made of two cusps connected on the pretrite side to the fourth pretrite main cusp. This postcingulum does not form a fifth loph. All M3s have five lophs and a postcingulum made of three to four cusps. On the right M3 MNHN.F.TRQ304, the postcingulum is divided into four cusps arranged as a sixth loph, contrary to the left M3 TRQ308 (same individual) (Fig. 5).

The left M1 MNHN.F.TRQ209 is worn. The hind side is broken labially. The postcingulum is connected to the fourth pretrite main cusp. The tooth is small compared to the M2s. Its size fits with that of a dP4. Yet the thickness of the enamel is not that of a decidual tooth.

The two M2s MNHN.F.TRQ305 and TRQ306 both display a fully developed pretrite trefoil (Fig. 4B, C). On each trefoil the anterior pretrite central conule is larger than the posterior one. On the one of two M2s the posttrite conules are present but weak. On the right M2 there is an anancoid contact mainly due to the weak development of the third posterior pretrite central conule. This contact is absent on the left M2.

The associated M3s MNHN.F.TRQ304-TRQ308 and the isolated M3 TRQ303 are very alike and surely belong to only one species. The respective height of the lophs is the source of the sole difference. The lophs are high but on the M3s of the palate the fifth loph is lower, the difference being less marked on the isolated M3 TRQ303.

On these M3s the pretrite trefoil is fully developed (Fig. 5). An anancoid contact is seen on the third interloph, between the fourth anterior pretrite central conule and the third posterior posttrite central conule. In each interloph posttrite conules are present; they are low and less developed than the pretrite conules. Posterior posttrite central conules 3 and 4 are present on both M3s of the palate. Slight differences are seen on the right and left M3s: an anterior posttrite central conule 2 is present on the left, a posterior posttrite central conule 4 is present on the right.

Discussion

The meaning of "Tetralophodont form, *gen.* and *sp. indet.*" is tetralophodont-grade taxon, not taxon related to *Tetralophodon* Falconer, 1857.

These large molars (except M1, relatively short, even for a M1) belong to one tetralophodont form without a doubt. The so-called anancoid contacts seen of M2s and M3s is not of the kind seen on molars of the genus *Anancus* Aymard, 1855 due to the disconnection of the half-lophs. As a consequence these teeth belong to one of the two tetralophodont species present in the late Miocene of the Mediterranean area. One is a tetralophodont gomphothere (perhaps related to the elephantid *Stegotetrabelodon* Petrocchi, 1941), described by Mazo & Montoya (2003) as *Tetralophodon* cf. *longirostris* 'grandincisivoid form'; one is a tetralophodont amebelodontid recently allocated to *Konobelodon atticus* (Wagner, 1857) by Konidaris *et al.* (2014).

The taxonomy of these two tetralophodont species is one of the most complicated questions relative to late Miocene elephantoids (detailed discussions in Tobien 1978; Tassy 1999; Mazo & Montoya 2003; Konidaris *et al.* 2014; not repeated here). Yet, Konidaris *et al.* (2014) focus only on the amebelodontid, not on the tetralophodont gomphothere.

Five main criteria are responsible to the confusion of both species.

The first is the ancient allocation of all molars that display tetralophodont grade to *Tetralophodon longirostris* (Kaup, 1832), or at least to *Tetralophodon*.

The second is the scarcity of direct association of tusks and molars, especially of lower tusks. Although flat, lower tusks with dentinal tubules associated to tetralophodont molars have been described at Kerch, Eastern Crimea (Turolian) as early as 1903 (Pavlow 1903) and allocated by Pavlow to "*Mastodon* cf. *longirostris*". Since 1929 (Osborn 1929) flat lower tusks and dentinal tubules are known to be characters of the amebelodontid genus *Platybelodon* Borissiak, 1928. But, when present, the tetralophodonty of the molars of *Platybelodon* is clearly of a different kind. No one can mix the molars of *Platybelodon* and *Tetralophodon*.

The third is the relation of deciduous teeth to permanent teeth. The tetralophodont grade species *Mastodon atticus* Wagner, 1857 is based on a juvenile palate with dP2-3 found at Pikermi (Greece, MN12). At Pikermi, only one permanent molar of a tetralophodont grade species is known, a M3 described by Vacek (1867) and discussed further. The first proof of direct association at Pikermi of flat tusks with deciduous dp2-dp3 of a tetralophodont grade species is given by Konidaris *et al.* (2014).

The fourth is that the direct association of molars of tetralophodont grade and lower tusks with lamellar dentine and piriform-oval-round cross section in Turolian layers has long been underestimated on the northern shore of the Mediterranean Sea, although *Stegotetrabelodon* has been described from Southern Italy, indicating a possible connection during the late Miocene between Africa and Eurasia (Ferretti *et al.* 2003). Mazo & Montoya (2003) demonstrated in the Turolian of Spain, at Crevillente, region of Alicante, the occurrence of this taxon. The molars combine derived elephantid traits (lophs and lophids with aligned cusps of equal size, nearly pentalophodont grade) not seen in *T. longirostris*, and gomphotheres characters such as complete pretrite trefoils, 'anancoid' contact and occurrence of posttrite cusps. The endemism of this taxon in Spain is very unlikely.

The fifth is a nomenclatural problem. The name *Mastodon* (*Bunolophodon*) *grandincisivus* Schlesinger, 1917 is based on a large lower tusk with dentinal tubules found at Maragha (Iran, Turolian). The specific epithet has been unfortunately used in association with the genera *Tetralophodon* and *Stegotetrabelodon* (see Tobien 1978) known to have lower tusks with piriform/round cross section and lamellar dentine, before the erection of the amebelodontid hypothesis by Tassy (1983). If this latter hypothesis is now fully accepted (Konidaris *et al.* 2014), the association of the type-specimens of both species "*Mastodon atticus*" and "*Mastodon* (*Bunolophodon*) *grandincisivus*" is a matter of debate. Last but not least, even if the synonymy detailed by Konidaris *et al.* (2014) is followed, the binom *Konobelodon atticus* is another debate.

The amebelodontid genus *Konobelodon* Lambert, 1990 (as a subgenus) is based on the North American species *Amebelodon* (*Konobelodon*) *britti* Lambert, 1990. The holotype of the species is a partial mandible with broken symphysis lacking tusks, and double trefoiled m3s; this latter character is a usual trait in *Amebelodon* Barbour, 1927 and amebelodontids. The paratype is a right lower tusk which matches with the holotype of another North American species, *Torynobelodon loomisi* Barbour, 1929 (type species of the genus). Hence *K. britti* is likely the same as *T. loomisi* and *Konobelodon* a junior synonym of *Torynobelodon*. As a consequence, if one supports Konidaris *et al.* (2014)'s approach and conclusions, from a nomenclatural viewpoint *Konobelodon atticus* should be *Torynobelodon atticus*.

At Küçükçekmece, only molars are available. No tusk is found, especially lower tusk. Although the molars are undoubtedly of tetralophodont grade, this is not enough to reach a firm taxonomic conclusion.

The M3s with five lophs are less derived than that of "*Tetralophodon* cf. *longirostris* 'grandincisivoid form'" with six lophs described by Mazo & Montoya (2003). Their generalized tetralophodont gomphothere pattern does not show any tendency toward a kind of elephantid trend as seen on the taxon described by Mazo & Montoya (2003); the taxon from Crevillente 2 shows a multiplication of cusps (cones and conelets), absent here.

The M3s from W-K are also different from the M3 from Pikermi (Vacek 1877), a tooth described as a m3 by Markov & Vergiev (2012) and Konidaris *et al.* (2014: fig. 2-E). This molar is narrow, with proportions which, indeed, rather fit that of an m3. But it has two characters of upper molars. Firstly there are two anterior roots, one is mesio-labial and the other is lingual; secondly, although broken, the anterior cingulum is seen at the basis of the first posttrite (labial) main cusp, a constant trait among elephantimorphs (or elephantoids) (Tassy 1995). With its columnar cusps and its six lophs, this tooth is more reminiscent of a derived tetralophodont gomphothere tooth than that of an amebelodontid. On this tooth, posttrite central conules in the first and second interlophs are present but their shape is that of weak bumps. They do not form a second trefoil. There is no 'anancoid' contact on the Pikermi tooth contrary to the W-K molars (even if, in that case, this contact is not prominent). A situation also different to what is seen in the upper and lower molars of "*Tetralophodon* cf. *longirostris* 'grandincisivoid form'" where the 'anancoid' contact is regularly seen on both upper and lower molars. It is of major importance that Mazo & Montoya (2003) have proved the existence of a derived tetralophodont form with molars showing 'anancoid' contacts associated to somehow pre-elephantid loph(id)s and lower tusks with piriform/round cross section. Indeed, intraspecific variation is probably the source of all these differences between Küçükçekmece and Pikermi and other Turolian localities with tetralophodont forms, but it is remarkable that these characters cross the two tetralophodont taxa, whatever their names are. For instance, Geraads *et al.* (2005) allocated two M2s from Yulafli (Turkish Thrace) to *T. longirostris* and to *Amebelodon grandincisivus*. The difference between the two being the larger size and more complex cingulum of the M2 of *A. grandincisivus*. Two characters of this latter M2 match rather well with these of "tetralophodont form, gen. and sp. indet.": same size, same loph-pattern. But one does not fit, the postcingulum of W-K 305-306 is simple. This variation means either that two tetralophodont-grade taxa are associated at Yulafli with respective molars difficult to identify, or that the molars and the flat lower tusk found at Yulafli both belong to one tetralophodont amebelodontid.

As a consequence the Küçükçekmece tetralophodont taxon is not identified at the genus and species level. The pattern of the crowns of M2 and M3 from W-K is more reminiscent of the amebelodontid taxon (if it is an amebelodontid) than of the "grandincisivoid form" described by Mazo & Montoya (2003). Extrinsic data such as the paleogeography are also in favour of "*Konobelodon*/*Torynobelodon atticus*/*grandincisivus*", this taxon being present in northern part of the Eastern Mediterranean area (including North Tethys shore and Eastern and Western Paratethys), from Hungary in the West up to Crimea in the East (see synthesis by Konidaris *et al.* 2014). Yet I surmise that the two tetralophodont taxa (or members of their respective lineages) are present in the Eastern Mediterranean area and, possibly, associated in the same localities. And one clue is missing at Küçükçekmece: the lower tusk.

GENERAL DISCUSSION AND BIOSTRATIGRAPHIC CONCLUSION

When comparing the « Pikermien » faunas from Turkey, Ozansoy (1965) listed at Küçükçekmece three proboscidean taxa (original spelling respected): « *Dinotherium* sp., *Trilophodon* (*Choerolophodon*) *pentelici*, *Synconolophus serridentinoides* ». The two latter species are synonyms. The proboscideans from West-Küçükçekmece (W-K) described in this paper are the same, *Deinotherium* cf. *giganteum*, *Choerolophodon pentelici*, plus a tetralophodont taxon, here labelled "*gen* and *sp indet.*".

The contemporaneity of the W-K and Küçükçekmece locality first described by Malik & Nafiz (1933) is possible but not proved based on proboscideans only.

The association of these three species at W-K can be either late Vallesian or (early) Turolian. *Deinotherium* cf. *giganteum* can be either Vallesian or Turolian. The evolutionary level of *Choerolophodon pentelici* found at W-K possibly indicates a late Vallesian/early Turolian age (MN10-MN11). Yet, as emphasized above, the variability of choerolophodont teeth is so important that caution is necessary. In Eastern Europe and Middle East, the association of *C. pentelici* and a form of tetralophodont grade (of various taxonomic names, the latest being *Konobelodon atticus*, *sensu* Konidaris *et al.* (2014)) usually considered an amebelodontid, is mostly known in Turolian localities, but already present in Vallesian (i.e. Yulafli). As explained above, a second tetralophodont form described in the Turolian of Western Europe ("grandincisivoid form" of Mazo & Montoya 2003) makes the situation more complicated. Yet the molars of this form are more derived than these of the tetralophodont from W-K. As a consequence, if the derived pattern is related to the late Turolian age, the tetralophodont from W-T is more likely early Turolian or late Vallesian, whatever its taxonomy is. An interesting conclusion, if I can say, on the sometimes difficult relations between taxonomy and stratigraphy, notwithstanding circular reasoning.

Acknowledgements

I would like to thank Sevket Sen who convinced me to study the proboscidean material found at Küçükçekmece, gave me invaluable information and revised the manuscript. The illustration is due to Lilian Cazes (MNHN). Writing this article benefited from past discussions with G. Markov and G.E. Konidaris about late Miocene proboscideans, even if my taxonomic approach is rather more conservative. Last but not least the ultimate version of the manuscript benefited again from Markov and Konidaris' reviews. Errors remain mine.

REFERENCES

Ferretti M. P., Rook L. & Torre D. 2003. — *Stegotetrabelodon* (Proboscidea, Elephantidae) from the late Miocene of Southern Italy. *Journal of Vertebrate Paleontology* 23: 659-666.

Gaudry A. 1867. — *Animaux fossiles et géologie de l'Attique. Atlas*. F. Savy, Paris. http://gallica.bnf.fr/ark:/12148/bpt6k9606262x

Gaziry A. W. 1976. — Jungtertiäre Mastodonten aus Anatolien (Türkey). *Geologisches Jahrbuch* B 22: 1-109.

Geraads D., Kaya T. & Mayda S. 2005. — Late Miocene large mammals from Yulafli, Thrace region, Turkey, and their biogeographic implications. *Acta Palaeontologica Polonica* 50: 523-544.

Konidaris G. E. & Koufos G. D. 2013. — Late Miocene Proboscidea (Mammalia) from Macedonia and Samos Island, Greece: preliminary results. *Paläontologische Zeitschrift* 87 (1): 121-140. http://dx.doi.org/10.1007/s12542-012-0147-z

Konidaris G. E., Roussiakis S., Theodorou G. & Koufos G. D. 2014. — The Eurasian occurrence of the shovel-tusker *Konobelodon* (Mammalia, Proboscidea) as illuminated by its presence in the late Miocene of Pikermi (Greece). *Journal of Vertebrate Paleontology* 34 (6): 1437-1453. http://dx.doi.org/10.1080/02724634.2014.873622

Konidaris G. E., Koufos G. D., Kostopoulous D. S. & Merceron G. 2016. — Taxonomy, biostratigraphy and palaeoecology of *Choerolophodon* (Proboscidea, Mammalia) in the Miocene of SE Europe-SW Asia: implications for phylogeny and biogeography. *Journal of Systematic Palaeontology* 14 (1): 1-27. http://dx.doi.org/10.1080/14772019.2014.985339

Malik A. & Nafiz H. 1933. — Küçükçekmece fosil fikrali hayvan mecmuasi (Vertébrés fossiles de Küçükçekmece). *Istanbul Darülfünunu Geologie Enstitüsü nesrivatindan (Publication de l'Institut de Géologie de l'Université d'Istanbul)* 8: 1-119 (en turc, résumé français).

Markov G. N & Vergiev S. 2012. — *Tetralophodon* (Mammalia: Proboscidea) from the vicinities of Varna, Northeast Bulgaria. *Historia naturalis bulgarica* 20: 151-156.

Mazo A. V. & Montoya P. 2003. — Proboscidea (Mammalia) from the Upper Miocene of Crevillente (Alicante, Spain). *Scripta Geologica* 126: 79-109.

Nicolas P. J. 1978. — Un nouveau gisement de vertébrés dans le Chersonien : Kutchuk-Tchekmedjè Ouest (Thrace turque). *Comptes rendus de l'Académie des Sciences* 287: 455-458.

Osborn H. F. 1929. — New Eurasiatic and American proboscideans. *American Museum Novitates* 393: 1-23.

Ozansoy F. 1965. — Étude des gisements continentaux et des mammifères du Cénozoïque de Turquie. *Mémoires de la Société géologique de France* 102: 1-92.

Pavlow M. 1903. — *Mastodon angustidens* Cuv. et *Mastodon* cf. *longirostris* Kaup, de Kertch. *Annuaire géologique et minéralogique de la Russie* 4: 129-139.

Sanders W. J. 2003. — Proboscidea, *in* Fortelius M., Kappelman J., Sen S. & Bernor R. L. (eds), *Geology and Paleontology of the Miocene Sinap Formation, Turkey*. Columbia University Press, New York: 202-220.

Tassy P. 1983. — Les Elephantoidea miocènes du Plateau du Potwar, Groupe de Siwalik, Pakistan. 1ère partie : introduction, cadre chronologique et géographique, mammutidés, amébélodontidés. *Annales de Paléontologie* 69: 99-136.

Tassy P. 1986. — *Nouveaux Elephantoidea (Mammalia) dans le Miocène du Kenya; essai de réévaluation systématique*. Cahiers de Paléontologie – Travaux de paléontologie est-africaine. CNRS, Paris, 135 p.

Tassy P. 1994. — Les gisements de mammifères du Miocène supérieur de Kemiklitepe, Turquie : 7. Proboscidea (Mammalia). *Bulletin du Muséum national d'Histoire naturelle*, série 4, C, 16: 143-157.

Tassy P. 1995. — Origin and differentiation of the Elephantiformes (Mammalia). *Verhandlungen des naturwissenschaftlichen Vereins in Hamburg* 34 (1994): 73-94.

Tassy P. 1999. — Miocene elephantids (Mammalia) from the Emirate of Abu Dhabi, United Arab Emirates : palaeobiogeographic implications, *in* Whybrow P. J & Hill A. (eds), *Fossil Vertebrates of Arabia*. Yale University Press, New Haven: 209-233.

Tassy P. 2014. — L'odontologie de *Gomphotherium angustidens* (Cuvier, 1817) (Proboscidea, Mammalia) : données issues du gisement d'En Péjouan (Miocène moyen du Gers, France). *Geodiversitas* 36 (1): 35-115. http://dx.doi.org/10.5252/g2014n1a2

TASSY P., SEN S., JAEGER J.-J., MAZIN J.-M. & DALFES N. 1989. — Une sous-espèce nouvelle de *Choerolophodon pentelici* (Proboscidea, Mammalia) à Eşme Akçaköy, Miocène supérieur d'Anatolie occidentale. *Comptes rendus de l'Académie des Sciences de Paris* 309: 2143-2146.

TOBIEN H. 1978. — On the evolution of Mastodonts (Proboscidea, Mammalia). Part 2: The bunodont tetralophodont groups. *Geologisches Jahrbuch Hessen* 106: 159-208.

VACEK M. 1877. — Über Österreichische Mastodonten und ihre Beziehungen zu den Mastodonarten Europas. *Abhandlungen der K. K. Geologischen Reichanstalt* 7: 1-45.

VIRET J. 1953. — Observations sur quelques dents de mastodontes de Turquie et de Chine. *Annales de l'Université de Lyon, Section C* 7: 51-62.

Submitted on 9 July 2015;
accepted on 1st February 2016;
published on 24 June 2016.