The Late Miocene Mammal Faunas of the Mytilinii Basin, Samos Island, Greece: New Collection

6. Tubulidentata

by

George D. Koufos*)

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Abstract

The orycteropodids are known from Samos since the last decades of 19th century when the first mammalian fossils were found. Since 1941 there were alsmost undescribed but at that time Colbert studied the material of Brown's collection in the American Museum of Natural History and gave an extensive and detailed description of the whole skeleton. During the new field campaigns in Samos we collected a great amount of fossils and among them several orycteropodids. They were found in the fossiliferous sites Mytilinii-1A, B (MTLA, MTLB) of the Adrianos ravine and they are dated to middle Turolian; their magnetostratigraphic record suggests an age from 7.1-7.0 Ma. The new material is described and compared with the old one from Samos as well as with Eurasian and African one. It belongs to the species *Orycteropus gaudryi* a well known taxon from the Turolian of Eastern Mediterranean. The stratigraphic distribution of the orycteropodids in the Old World is also discussed in this article.

Keywords: Late Miocene, Samos, Greece, Mammalia, Tubulidentata, Systematics.

Zusammenfassung

Die Orycteropodidae sind aus Samos seit dem Ende des 19. Jahrhunderts bekannt, als die ersten fossilen Säugetiere dort gefunden wurden. Bis 1941 waren sie allerdings unbeschrieben, bis Colbert das Material aus der Sammlung Brown des American Museum of Natural History studierte und das ganze Skelett im Detail beschrieb. Während den neuen Geländearbeiten in Samos befanden sich unter den zahlreichen Fossilresten einige neue Orycteropodidae. Diese stammen aus den Fundstellen Mytilinii-1A, B (MTLA, MTLB) der Adrians Rinne und sind ins mittlere Turolium zu stellen. Die magnetostratigraphischen Ergebnisse legen ein Alter zwischen 7,1-7,0 Millionen Jahre nahe. Das neue Material wurde mit dem bereits aus Samos sowie aus Eurasien und Afrika Bekannten verglichen. Es gehört zu der gut bekannten Art *Oryctoropus gaudryi*, die man aus dem Turolium des östlichen Mittelmeeres kennt. In dieser Arbeit wird auch die stratigraphische Verbreitung der Orycteropodidae diskutiert.

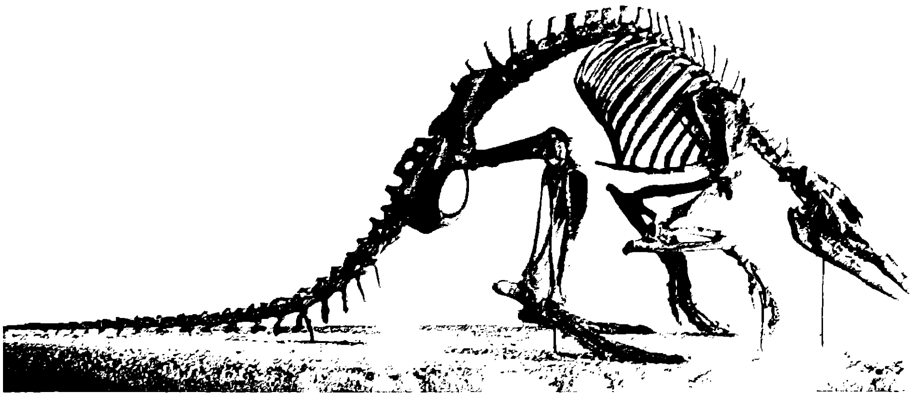
Schlüsselworte: Obermiozän, Samos, Griechenland, Mammalia, Tubulidentata, Systematik.

Introduction

Samos Island is situated in the eastern Aegean Sea and is well known for its late Miocene mammal localities since the second half of the 19th century, when Forsyth Major found and collected mammalian fossils in the island. Later, several palaeontologists and fossil dealers excavated and collected fossils from Samos. The fossils recovered from Samos localities are numerous, but they are dispersed in several museums and collections all over Europe and U.S.A. The most important collections are those of Lausanne, London and New York. A small collection from Samos was also assembled at the AMPG by Prof. T. Skoufos. Following the last excavations of B. Brown in 1925, Prof. J.K. Melentis excavated in Adrianos ravine in 1963 and made a small collection. This was on display in the city hall of Mytilinii on the Island of Samos for a long time until being transferred to the NHMA. In 1985 Prof. J.K. Melentis and the author excavated in Adrianos ravine and more exactly in the fossiliferous site Mytilinii-1A (MTLA). The collected material (mainly giraffids and hipparions) is included in the new collection.
In 1994, a group of palaeontologists from the Laboratory of Geology and Palaeontology of the Aristotle University

*) George D. Koufos, Aristotle University of Thessaloniki. Department of Geology. Laboratory of Geology and Palaeon-
GR-54124 Thessaloniki, Greece. e-mail:koufos@geo.

Figure 1: Composite skeleton of *Orycteropus gaudryi* from Samos, housed at the AMNH. It consists of the skull and mandible AMNH-SAM-20694 and the postcranial elements AMNH-SAM-22762. After Colbert (1941:fig. 19).



of Thessaloniki, leaded by the author, started a new series of excavations in Samos mammal localities. During these field campaigns, a great amount of fossils have been unearthed and are now housed in the NHMA. More details about the history of the Samos mammal fossils and their collection are given in the first chapter of this volume (Koufos, this volume). The fossiliferous localities are located in the Mytilinii area situated in the eastern Neogene basin of the Samos Island. The stratigraphy of the Mytilinii deposits has been studied by various authors; for more data about the stratigraphy and localities see Kostopoulos et al. (this volume).

Among the collected material from Samos localities there are several specimens of aardvarks. The aardvarks are referred in the first faunal lists of Samos (Forsyth Major, 1888, 1894; Andrews, 1896). The known material is abundant and includes some nice specimens, like a mounted skeleton made on the basis of various individuals and housed in the AMNH (Fig. 1). In comparison to the other Turolian localities of Eastern Mediterranean, the fossil aardvark collection from Samos is the largest. In this respect, the new collected specimens add more data about this rare animal. The studied aardvark material was found in the Adrianos ravine (locality Mytilinii-1, MTL) and more precisely in the fossiliferous sites A and B (Kostopoulos et al., this volume). The fauna of both sites suggests a middle Turolian age, MN 12. The magnetostratigraphic record indicates an age of 7.1-7.0 Ma for MTLA and MTLB. More details about the age are given in Kostopoulos et al. (2003) and Koufos et al. (2004, this volume).

Abbreviations:

AHG = Ahmet Aga or Dragi or Prokopion, Evia Island, Greece
AMNH = American Museum of Natural History
AMPG = Athens Museum of Geology and Palaeontology, University of Athens
B = Breadth
BHA = Bou Hanifia, Algeria
CA = Çandir
KTB = Kemiklitepe-B, Turkey
KTD = Kemiklitepe-D, Turkey
L = Length
MGL = Musée de Géologie de Lausanne
MNHN = Museum National d'Histoire Naturelle, Paris
MTLA = Mytilinii-1A
MTLB = Mytilinii-1B
MTA = Geological Survey of Turkey
NHMA = Natural History Museum of the Aegean, Mytilinii, Samos
NHML = Natural History Museum of London
NHMW = Naturhistorisches Museum Wien
PNT = Pentalophos-1, Axios valley, Macedonia, Greece
SAM = Samos (old collections)

The specimens from these museums and institutions, except NHMA, are reported in the text by the abbreviation of the museum or institute, the locality and their serial number.

Palaeontology

Order Tubulidentata Huxley, 1872
Family Orycteropodidae Gray, 1821

Genus *Orycteropus* Geoffroy, 1796

Orycteropus gaudryi **Forsyth Major, 1888**
(Plates 1, 2)

Localities: Mytilinii-1A, B (MTLA, MTLB), Adrianos ravine, Mytilinii Basin, Samos, Greece.
Age: Middle Turolian, MN 12 (late Miocene); 7.1-7.0 Ma.
Material:
MTLA: Partial skull and right mandibular fragment, MTLA-115; partial skull, MTLA-240; left M1, MTLA-239; left mandibular ramus with m3, MTLA-116; right mandibular ramus with p4-m3, MTLA-280; left mandibular ramus with m2-m3, MTLA-306; left m1, MTLA-18; left m2, MTLA-17.
MTLB: Right mandibular ramus with p2-m3, MTLB-49.
Measurements: The measurements of the material are given in Tabs 1-3.
Description:
Partial skull MTLA-115. The frontal part of the skull and a large part of the muzzle are preserved (Pl. 1, fig. 1). The palate is long and relatively narrow as in all *Orycteropus*.

	Orycteropus gaudryi							*O. mauritanicus*
CRANIAL MEASUREMENTS	MTLA-115	MTLA-240	NHMW-SAM-A. 4760	NHMW-SAM-A. 4759	NHML-SAM-M.5690	AMNH-SAM-20560	AMNH-SAM-20562	MNHN-BHA-1951-9
	Samos	Samos	Samos	Samos	Samos	Samos	Samos	Algeria
	Mytilinii-1A		Location unknown	Location unknown	Location unknown	?Samos-Q5	?Samos-Q1	Bou-Hanifia
						Cast MNHN-SMS-18a	Cast MNHN-SMS-19a	
1. Length basion-P1	—	—	114.8	110.7	116.8	118.1	—	123.1
2. Length basion-choanae	—	—	60.0	57.0	—	59.7	58.2	63.8
3. Length choanae-P1	—	—	56.2	56.6	—	60.8	—	62.5
4. Length inion- anterior orbit	—	—	87.5	85.0	81.8	—	83.7	—
5. Length inion-middle line connecting orbital projections	—	—	59.2	56.4	54.5	—	53.1	—
6. Breadth of the occiput	—	—	54.5	52.4	52.0	49.5	52.3	—
7. Breadth at the base of the zygomatic arches	—	—	50.0	46.1	49.5	50.3	50.3	—
8. Breadth at postorbital constriction	—	—	39.2	40.0	36.4	—	39.7	—
9. Breadth at the anterior orbits	—	—	64.2	59.5	55.7	52.4	54.2	—
10. Palatal breadth at anterior P1	15.0	—	16.7	15.3	14.7	12.8	—	14.2
11. Idem in the middle of M1	22.0	24.0	22.1	17.2	—	—	18.4	20.5
12. Idem in the middle of M2	—	28.0	23.4	20.5	—	14.8	21.6	23.2
13. Idem at the posterior borders of M3	—	—	28.5	26.2	26.9	21.7	27.1	28.1
14. Breadth of the occipital condyles (external)	—	—	32.0	34.8	31.7	35.0	29.6	—
15. Breadth of foramen magnum	—	—	17.7	19.1	21.1	16.4	13.1	—
16. Height of foramen magnum	—	—	16.1	17.1	13.9	16.0	14.7	—
17. Height of the occiput above the foramen magnum	—	—	34.9	34.5	35.6	—	36.4	—

Table 1: Comparative cranial measurements of *Orycteropus* from various localities.

MANDIBULAR MEASUREMENTS	*Orycteropus gaudryi*									*O. seni*
	MTLA-115	MTLA-116	MTLA-280	MTLB-49	NHML-SAM-M.5690	NHML-SAM-M.4171	AMNH-SAM-20560	AMNH-SAM-20562	MNHN-KTB-94	MTA-CA-2532
	Samos	Samos	Samos	Samos	Samos	Samos	Samos	Samos	Turkey	Turkey
	Mytilinii-1A			Mytilinii-1B	Loc. unknown	Loc. unknown	?Samos-Q5	?Samos-Q1	Kemiklitepe-B	Çandir
	dex	dex	dex	dex		dex	Cast MNHN-SMS-18a	Cast MNHN-SMS-19a		sin
1. Length anterior p2-coronoid process	—	—	—	—	99.3	—	—	89.6	—	—
2. Length anterior c- condyle	—	—	—	—	103.2	—	—	93.9	—	—
3. Height inferior border at angle-coronoid	—	—	—	—	64.0	—	—	65.6	—	—
4. Height inferior border at angle-condyle	—	—	—	—	50.4	—	—	55.7	—	—
5. Height condyle-coronoid	—	—	—	—	16.3	—	—	13.6	—	—
6. Symphysis length	—	—	—	—	—	—	—	—	—	—
7. Height in front of p2	11.4	10.1	—	10.0	10.1	11.7	11.6	11.0	12.8	—
8. Idem in the middle of p3 (buccal)	11.4	11.6	—	12.6	10.0	12.2	11.8	11.8	12.3	11.8
9. Idem in p4 (buccal)	13.7	13.4	15.2	13.8	10.5	13.5	12.5	12.6	13.8	14.6
10. Idem in m1(buccal)	17.1	—	17.1	16.6	12.5	14.8	14.7	16.2	16.9	16.3
11. Idem behind m2	17.1	16.1	19.3	17.8	15.5	15.2	17.6	17.4	19.1	17.9
12. Idem behind m3	17.2	17.3	18.5	17.7	16.2	17.2	18.6	18.4	19.5	18.0

Table 2: Comparative mandibular measurements of *Orycteropus* from various localities; the measurements of *O. seni* were taken from van der Made (2003).

	Orycteropus gaudryi												
	Mytilinii-1A						Mytilinii-1A						Mytilinii-1B
UPPER TEETH	MTLA-240		MTLA-115		MTLA-239	LOWER TEETH	MTLA-116	MTLA-115	MTLA-18	MTLA-17	MTLA-280	MTLA-306	MTLB-49
	dex	sin	dex	sin				dex			dex		dex
LP1	—	—	—	3.7	—	Lp1	—	4.9	—	—	—	—	—
BP1	—	—	—	2.1	—	Bp1	—	1.4	—	—	—	—	—
LP2	5.3	5.6	—	4.5	—	Lp2	—		—	—	—	—	4.5
BP2	2.2	2.5	—	2.2	—	Bp2	—		—	—	—	—	2
LP3	5.8	5.6	5	4.7	—	Lp3	—	4.4	—	—	—	—	4.7
BP3	3.5	3.4	3.1	3.1	—	Bp3	—	2.5	—	—	—	—	2.8
LP4	—	7.2	—	6.5	—	Lp4	—		—	—	7.5	—	5.8
BP4	—	5.2	—	4.6	—	Bp4	—		—	—	4.2	—	3.8
LM1	—	12.7	—	—	11.6	Lm1	—		10	—	12.3	—	10.1
BM1 ant.	—	7.1	—	—	7.1	Bm1 ant.	—		5.6	—	6.1	—	5.2
BM1 post.	—	7.2	—	—	7.2	Bm1 post.	—	6.5	6.7	—	7.7	—	6
LM2	—	12.3	—	—	—	Lm2	—	10.8	—	10.7	12.8	13.1	10.8
BM2 ant.	—	7.7	—	—	—	Bm2 ant.	—	7.4	—	7.1	8	7.9	7
BM2 post.	—	7.5	—	—	—	Bm2 post.	—	7.6	—	7.3	8	8.2	7.5
LM3	—	8.6	8.9	—	—	Lm3	9.4	9.3	—	—	8.2	8.5	9.9
BM3 ant.	—	7	6.9	—	—	Bm3 ant.	6.8	6.6	—	—	6.5	6.6	6.2
BM3 post.	—	5.2	5.3	—	—	Bm3 post.	5.8	5.5	—	—	4.8	4.7	5.2

Table 3: Dental measurements of the studied material of *Orycteropus gaudryi* from Mytilinii (Samos).

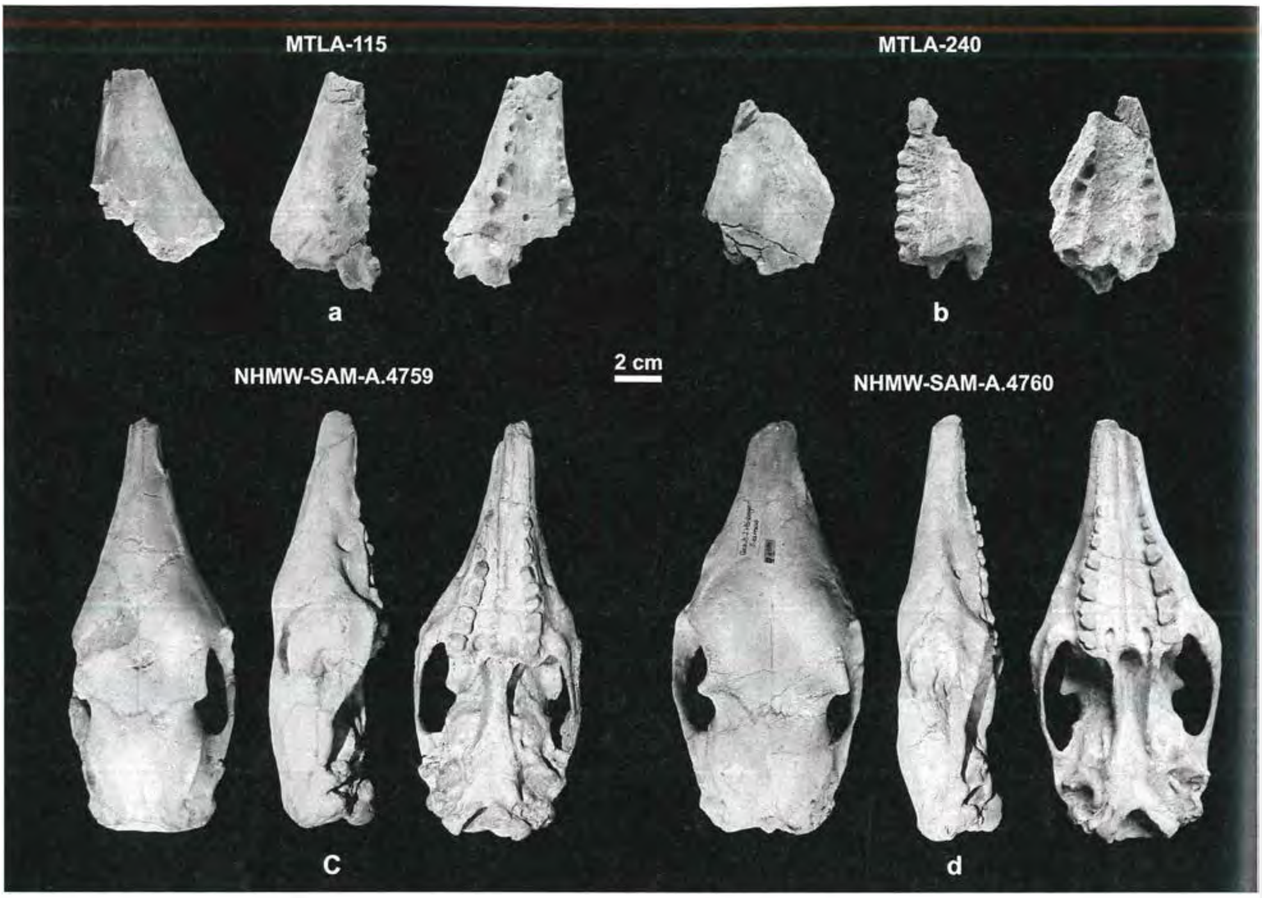


Figure 2: Comparison of the Mytilinii cranial material of *Orycteropus gaudryi* with other specimens from Samos.

a. partial cranium MTLA-115 in dorsal, lateral (right), and ventral view; **b**. partial skull MTLA-240 in dorsal, lateral (left), and ventral view; **c**. skull NHMW-SAM-A.4759 in dorsal, lateral (right), and ventral view; **d**. skull NHMW-SAM-A.4760 in dorsal, lateral (right), and ventral view.

The nasals are elongated and wide and they are separated by a shallow groove running sagittally between them, along the suture. The frontal region is bulging (Pl. 1, fig. 1c). The preserved dentition consists of the tooth row P1-P4 sin and the isolated P3 and M3 dex (Pl. 1, fig. 1d). The tooth row is curved after the P4. There are small diastemas between the premolars. The presence of the canine is not ascertained as the maxilla in this area is broken on both sides and it is difficult to recognize the presence or absence of an alveolus. The premolars are small and narrow except for the P4, which is wide. The P1 and P2 have one lobe and their occlusal surface shows a single wearing facet inclined distally. The P3 and P4 have also one lobe, but their occlusal surface depicts a sharp angle between their mesial and distal wearing facets (Pl. 1, fig. 1d). The M1 and M2 are absent but the alveolus of the M2 is the largest of the tooth row. The M3 is smaller, triangular-shaped with deep buccal groove and almost straight lingual wall.

Partial skull MTLA-240. It represents more or less the same part of the skull as MTLA-155; however a larger part of the distal palate and a shorter part of the muzzle are preserved (Pl. 1, fig. 3). The palate is long and narrow but slightly wider than that of MTLA-115 (Tab.1). The anterior border of the choanae is situated at the level of the distal lobe of the M3. The anterior border of the post-palatine groove is situated at M3 but its anterior part is at the level of the distal lobe of the M2. The greater part of the nasals is broken but the groove following the suture between them is slightly deeper than that of MTLA-115 (Pl. 1, fig. 3c). The frontals are bulging more than in MTLA-115. The crista facialis is also stronger than in MTLA-115. The skull is slightly compressed dorsoventrally but this deformation cannot justify the greater width of the skull. The preserved dentition consists of the tooth row P2-M3 sin, and the isolated P2 and M3 dex, but most of the teeth are badly preserved. The tooth row is slightly curved and is characterized by the dominance of the M2. This character is not distinct however, as the M2 is partially broken. There is no trace of a canine and the diastemas between the premolars are absent. The anterior molars are bilobed, 8-shaped whereas the M3 is smaller and triangular-shaped. The morphology of the other teeth is similar to that of MTLA-115, except for the slenderer P4 and the smaller M3.

Mandibular fragment MTLA-115. It is the right mandibular corpus lacking the ascending ramus, but preserving p3, m1-m3; the mesial lobe of the m1 is absent. The alveoli of the other premolars are distinct, whereas it seems to

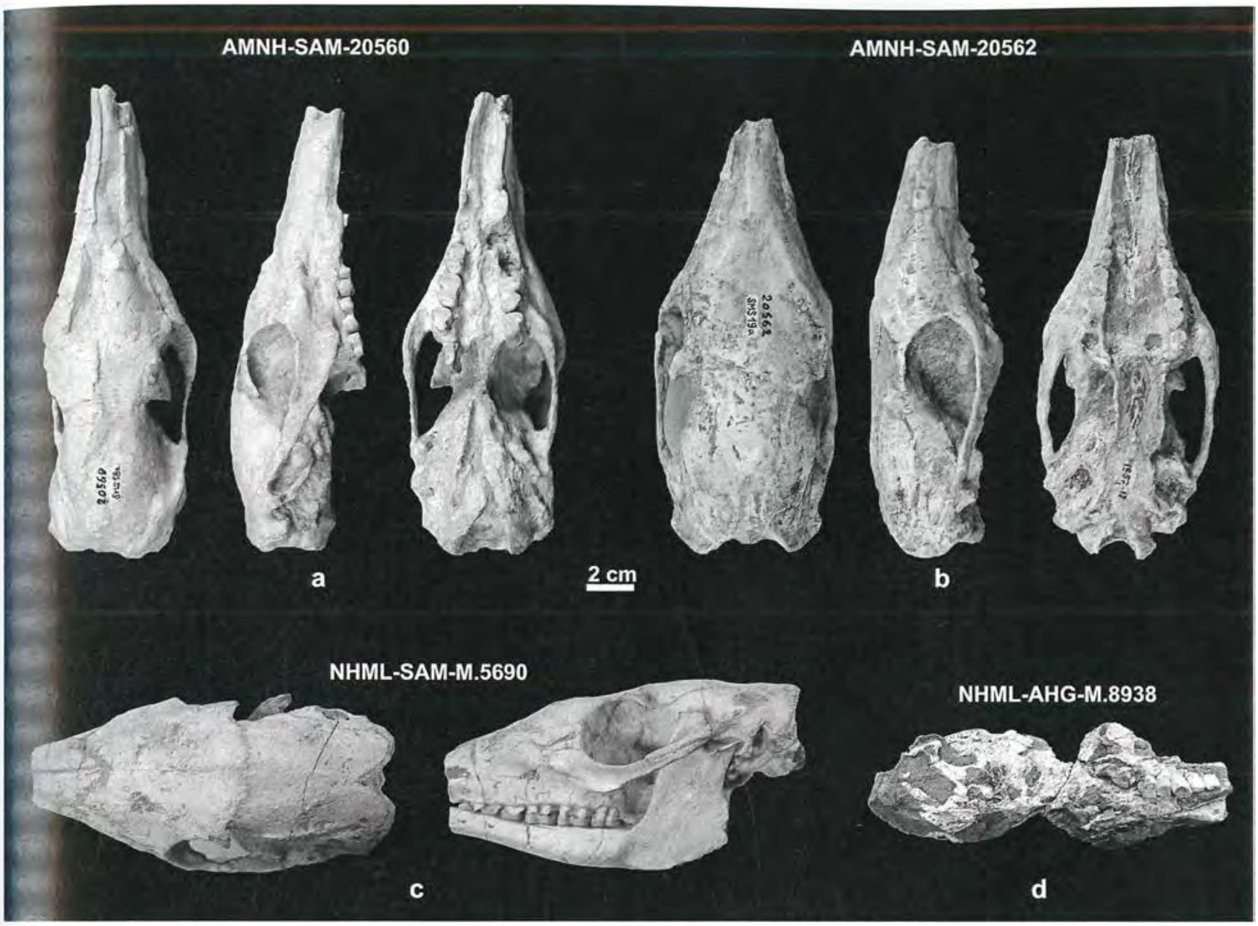


Figure 3: Comparison of the Mytilinii cranial material of *Orycteropus gaudryi* with other specimens from Samos and Evia.

a. cast of the skull AMNH-SAM-20560 in dorsal, lateral (right), and ventral view; **b.** cast of the skull AMNH-SAM-20562 in dorsal, lateral (right), and ventral view; **c.** skull NHML-SAM-M.5690 in dorsal, and lateral (left) view; **d.** partial skull and endocast NHML-AHG-M.8938 in ventral view.

be no alveolus for a canine (Pl. 1, fig. 2). The mandibular corpus is elongated with a height increasing from the p3 to m3. The ventral border of the mandibular corpus is slightly concave (Pl. 1, fig. 2a). There are no large diastemas between the premolars. The molars are bilobed and 8-shaped with deep grooves. The mandibular corpus is thicker in the area of the molars, showing its greatest thickness at the m2-m3 level (Pl. 1, fig. 2c). The m2 is the largest tooth of the tooth row and the m3 has a narrow distal lobe.

Mandibular fragment MTLA-116. The mandibular corpus and a small part of the ascending ramus are preserved (Pl. 2, fig. 1). A single and large mental foramen is situated almost in front of the p1. The ascending ramus forms a wide angle (~123°) with the mandibular corpus. The other features of the mandible, as well as that of the sole preserved m3 are similar to those of MTLA-115.

Mandibular fragment MTLA-280. It bears the tooth row p4-m3 (Pl. 2, fig. 2). The mandibular corpus of MTLA-280 and MNHN-KTB-94 is the deepest of the comparative set (Tab. 2). The anterior border of the masseteric fossa is situated at the level of the distal border of the m3. The morphology of the mandibular corpus is like that of MTLA-115. The molars are 8-shaped with the distal lobe wider than the mesial one in the anterior molars. The m2 is the largest tooth of the tooth row, whereas the m3 is smaller than in the other specimens, triangular-shaped with narrow distal lobe. Both the lingual and buccal groove of the molars is well developed but the lingual one is slightly deeper. In the m1 and m2, the occlusal surface of the mesial lobe has two wearing facets, a narrow anterior and a larger posterior forming an angle between them. The molars are larger than in the other specimens except for the m3; in this feature seems to be similar with the skull MTLA-240.

Mandibular fragment MTLA-306. It is a small mandibular fragment, bearing badly preserved m2-m3 sin (Pl. 2., fig. 3). The mandibular corpus is deep and the m3 is as small as in MTLA-280.

Mandibular fragment MTLB-49. It is a mandibular fragment with well preserved p2-m3 dex (Pl. 2, fig. 4). The size and morphology of the mandibular corpus, as well as the dental morphology, are similar to those of MTLA-115, 116.

Discussion: The systematics of the aardvarks is still discussed and there are several debates (Patterson, 1978; Pickford, 1975; Lehmann, 2007). Certainly the aim

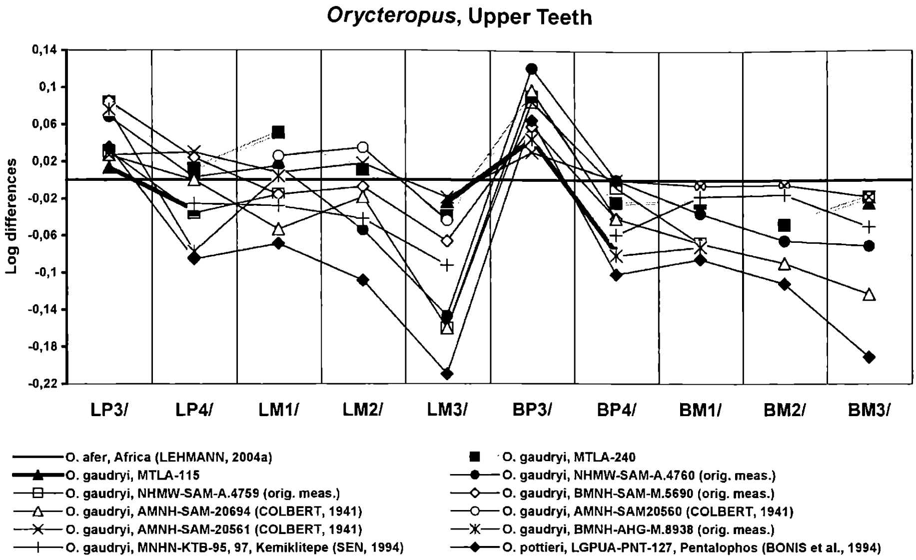
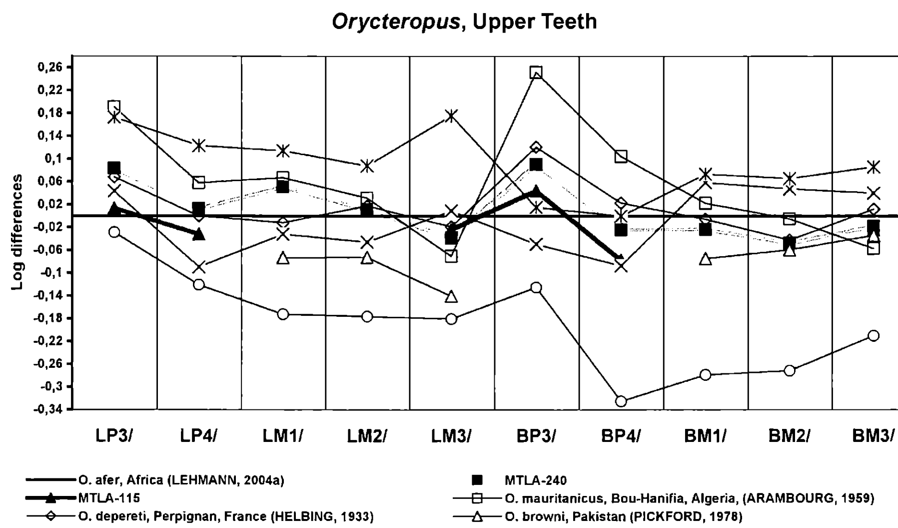


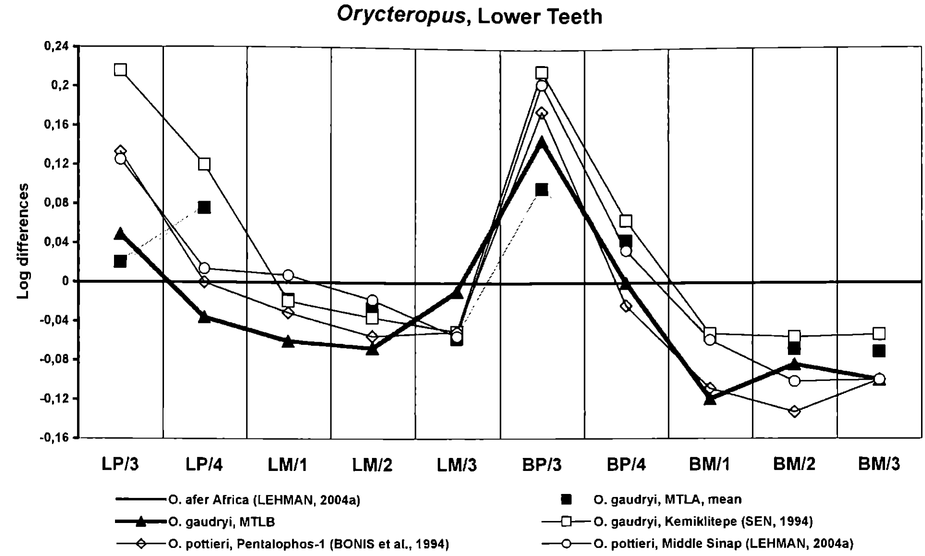
Figure 4: a. Logarithmic ratio diagram comparing the upper teeth of the Mytilinii material with *Orycteropus gaudryi* and *Orycteropus pottieri*. b. Logarithmic ratio diagram comparing the upper teeth of the Mytilinii material with various orycteropodids.

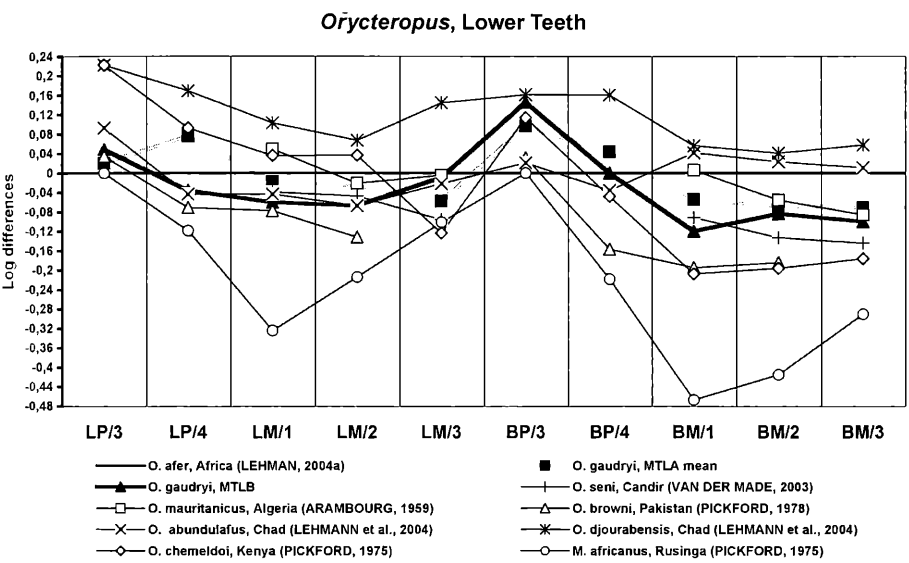


of this paper is not to discuss these issues but it is necessary to give some information. The order Tubulidentata consists of the sole family Orycteropodidae, which according to PATTERSON (1975, 1978) is separated in two sub-families Plesiorycteropodinae and Orycteropodinae. The status of the first sub-family is debated (PATTERSON, 1975, 1978; MACPHEE 1994). The second sub-family includes the following genera: *Myorycteropus*, *Leptorycteropus* and *Orycteropus*. The last one includes all the Eurasian aardvarks, as well as the modern *O. afer*. However, the taxomonic status of the Eurasian material of the genus *Orycteropus* is doubted (LEHMANN, 2004). The last author suggests that the Eurasian aardvarks belong to another genus, but he did not give a name. In the meantime, the name *Orycteropus* still remains and will be used in the present paper.

As it was mentioned in the introduction, *Orycteropus gaudryi* is known from Samos since the last decades of the 19th century (FORSYTH MAJOR, 1888, 1894). The comparison of the present material with the old one from Samos is quite useful. For this reason, the new material was compared to the old one housed at the NMHW and NHML, as well as to some casts of the AMNH collection stored in the MNHN. Two skulls of *O. gaudryi* from Samos are stored in the MNHW and one in the NHML; their origin is unknown as there are not locality indications. Those of NHMW (NHMW-SAM-A.4756, 4760) have labels referring that they were purchased, while that of NHML (NHML-SAM-M.5690) belongs to Forsyth Major's collection, which was bought by the Museum. It is reported that this collection comes from a site named Vryssoula (SOLOUNIAS, 1981); but this is not sure as the author mentions that it is impossible for Forsyth Major to be in Samos and not to visit Adrianos ravine, the richest fossiliferous area of the Mytilinii Basin. The morphology of these skulls (narrow palate, shape of the tooth row, dental morphology, dominance of the M2 and m2) as well as the size are similar to both studied cranial fragments (Figs 2, 3, Tab. 1). Despite their similarities, the specimen MTLA-240 seems to be slightly larger than the other Samos skulls (Figs 2, 3, Tab.1). Likewise, the proportions of the teeth are similar to the ones compared to but the MTLA-240 teeth are among the largest (Fig. 4). The morphology of the studied skulls and mandibles fits quite well with those of the Samos material housed at the AMNH and described by COLBERT (1941). The comparison of the studied material with the casts from the AMNH indicates similar morphology and a slightly larger size (Fig. 3; Tab. 1). Likewise, the proportions of the teeth of the AMNH material are very similar to those of the studied specimens (Fig. 4). According to these observations, there is noticeable size variation in *O. gaudryi* from Samos. This variation is probably intra-specific as no sexual dimorphism is observed in the recent aardvarks

Figure 5: a. Logarithmic ratio diagram comparing the lower teeth of the Mytilinii material with *Orycteropus gaudryi* and *Orycteropus pottieri*. b. Logarithmic ratio diagram comparing the lower teeth of the Mytilinii material with various orycteropodids.





(Shoshani et al. 1988; Lehmann, 2004). *Orycteropus gaudryi* is also reported from three other Greek localities (Achmet Aga, Dytiko, Kerassia). A badly preserved skull (NHML-AHG-M.8938) is known from the late Miocene locality of Achmet Aga (Drazi or Prokopion) of Evia Island (Woodward, 1901). The skull is very deformed and weathered (Fig. 3d). Because Woodward's article is entitled "On the bone-beds of Pikermi, Attica and the similar deposits in Northern Euboea", the specimen was wrongly considered to come from Pikermi. I have seen the specimen at the NHML and compared it with the studied material. On the specimen, a label states that it comes from the locality of Dragi from the Evia Island and it is clearly reported in the text of Woodward (1901; p. 485). The confusion of its origin gave rise to the inclusion of *Orycteropus* in the Pikermi fauna. In the major collections from Pikermi, which I have seen in European museums as well as in AMPG, there is no evidence for the presence of *Orycteropus* in Pikermi. The preservation of the skull NHML-AHG-M.8938 does not allow a comparison with the new material, but its dental dimensions are similar to those of the Mytilinii specimens and falls into the range of variation of *O. gaudryi* (Fig. 4a).

A small mandibular fragment with p4-m1 is known from the Turolian locality of Dytiko-1 (DTK) of Axios Valley, Macedonia, Greece (Bonis et al., 1994). The size of its teeth is similar to that of the Mytilinii material. Recently, *Orycteropus* was recognized in the locality of Kerassia, Evia Island (Theodorou et al., 2003) but no description of the material was given till now.

Orycteropus gaudryi is also recorded from the Turkish locality of Kemiklitepe (Sen, 1994). The morphology and dimensions of the present material is similar to that of the Kemikilitepe (KTA-B) material (Fig. 4a). It is also reported, without description, from the Turkish localities of Kuçuk Çekmece, Mahmutgazi and Kayadibi (Sen, 1994). Besides *Orycteropus gaudryi*, several other tubulidentate species are known from Eurasia and Africa. Their comparison with the studied material from Samos is given below:

***Orycteropus pottieri* Ozansoy, 1965.** This taxon was originally described from the Vallesian levels of the Middle Sinap, Turkey (Ozansoy, 1965). Although Ozansoy listed a mandible, a maxilla and some isolated teeth, he described only the mandible. Later, additional material of *O. pottieri* was found in the Sinap (Sen, 1994; Bonis et al., 1994). This taxon is also known by some maxillary and mandibular fragments from the Vallesian locality of Pentalophos-1 (PNT, Axios Valley, Macedonia, Greece) (Bonis et al., 1994). Recently, new material of *O. pottieri* has been described from the Vallesian localities of the Sinap Formation (Turkey), dated from 10.1-9.6 Ma (Fortelius et al., 2003). The Mytilinii material differs from *O. pottieri* by the larger upper teeth (Fig. 4b), the larger and deeper mandibular ramus (Tab. 2), the absence of canines, the absence or very small diastemas between the upper and lower premolars, the longer and wider P4, the dominance of the M2 and m2 in the tooth row, the relatively deep labial and the shallow lingual grooves in the upper molars.

Orycteropus seni **Tekkaya, 1993.** It was originally described from the middle Miocene locality of Çandir (Turkey), while later it was recognized in the middle Miocene Turkish locality of Paşalar (Fortelius, 1990; Tekkaya, 1993; van der Made, 2003). Recently, comparable specimens were found at the Loc. 64 of the Sinap, dated to Vallesian (Fortelius et al., 2003). In his description of the Çandir material, van der Made (2003) noted that "a smaller average size might be a justification for the species *O. seni*". A comparison between the mandible from Çandir (van der Made, 2003; pl. 1) and the Mytilinii ones does not show any morphological difference; likewise, the size of the mandible and teeth of the Samos material and *O. seni* is similar (Fig. 5, Tab. 2).

Orycteropus depereti **Helbing, 1933.** The taxon is based on a single skull, found in the early Pliocene (MN 15) locality of Perpignan, France. The skull of *O. depereti* is larger than that of *O. gaudryi*; in comparison, the Mytilinii skulls are smaller than the skull of *O. depereti* and thus different (Tab. 1). The palate of *O. depereti* is broader than *O. gaudryi* (Arambourg, 1939; Patterson, 1975) and in this feature differs clearly from the studied skulls of Samos. Although the skull of *O. depereti* is larger than *O. gaudryi*, its upper teeth are shorter than it, while their breadth is close to it (Fig. 4b). On the other hand there are some similarities between the Mytilinii skulls and *O. depereti*, like the bulging frontals, the elongated and curved tooth row, the absence of diastemas between the premolars and the similar morphology of the molars. As there is only one skull of *O. depereti*, its comparison is limited and more material is necessary in order to ascertain its similarities or differences from *O. gaudryi*; thus it could be referred separately from *O. gaudryi*, at the moment.

Siwaliks *Orycteropus*. The tubulidentata are reported from the Siwaliks area, Pakistan by two species: *O. browni* and *O. pilgrimi* (Colbert, 1933). The first species was originally described from a maxillary fragment with M2-3, before additional material was found (Colbert, 1933; Pickford, 1978). According to Colbert (1933) *O. pilgrimi* was erected on a single right m2 but later a skull was described under the same name (Lewis, 1938). Currently, the two species are synonymized under the name *O. browni* (Lehmann, 2004, 2007). The Siwaliks material is poor and fragmentary and cannot allow extensive comparison with the studied one. The dental size of the Siwaliks aardvark is clearly smaller than the Mytilinii material (Fig. 4b) and can thus be distinguished from *O. gaudryi*. Two other differences with *O. gaudryi* are noticed from. The post-palatine foramen is situated between M2 and M3 in *O. browni*, whereas in *O. gaudryi* it is situated at the level of the M3. Noticeably, in the partial skull MTLA-240, the post-palatine foramen is situated at the level of the M3 but its anterior part is situated at the distal lobe of the M2 (Pl. I; fig. 3d). Second, the origin of the zygomatic arches is situated above the mesial lobe of the M2, whereas in *O. gaudryi* it begins above the distal lobe. In the studied skull MTLA-115, the zygomatic arches originate above the M3. Finally, a fragmentary skull of an aardvark has been discovered in the early Turolian Bulgarian locality of Kocherinovo-1 and was referred to as *O.* cf. *browni* (Spassov et al., 2006).

African Orycteropodids. The aardvarks are slightly more frequent in the Neogene of Africa and are represented by several species. The oldest known species is *O. minutus* from the early Miocene of Kenya (Pickford, 1975). The taxon is mainly represented by postcranial elements (Pickford, 1975) and the comparison with the Mytilinii material is thus impossible. Another early Miocene African species is *Myorycteropus africanus* MacInnes, 1956, which is significantly smaller than the studied material from Samos (Figs 4b, 5b). *O. chemeldoi* is known from the middle Miocene of Kenya. It was originally described on a hemimandible with p2-m3 from the localities of Ngorora and Fort Ternan (Pickford, 1975). Its teeth are longer and narrower than those of the Mytilinii ones (Fig. 5b). There are small diastemas between the premolars like in several specimens of *O. gaudryi*, but the slenderer teeth of *O. chemeldoi* help distinguishing the two taxa. Some material (skull, mandibular fragments, postcranials) referred to as *O. mauritanicus* are known from the Vallesian locality of Bou Hanifia, Algeria (Arambourg, 1959). *O. mauritanicus* differs from the studied material in having: diastemas between the premolars, canines, as well as the M1 and m1 larger than the M2 and m2 (Figs 3b, 4b), respectively. Its teeth are larger than those of the studied material (Figs 4, 5). Two new species of *Orycteropus* have recently been described from Chad (Lehmann et al., 2004, 2005, 2006). *O. djourabensis* comes from the early Pliocene and is close in size to the recent *O. afer* from which it differs in having longer premolars, longer lower molars and shorter-slenderer hands (Lehmann et al., 2004). It is different from the studied material in having a larger general size and teeth (Fig. 4, 5), and diastemas between the molars (Lehmann et al., 2004; fig. 2). Although the teeth of *O. djourabensis* are not well preserved (Lehmann et al., 2004, fig. 2) the lingual groove of the upper molars is deeper than that of the studied material. The other Chadian species is *O. abundulafus*, dated between 7.0 Ma and the Mio-Pliocene boundary (~5.3 Ma) and characterized by very robust teeth. This species shows similarities with the European *O. gaudryi* (Lehmann et al., 2005, 2006). In fact, the size of its teeth is very close to the one of the studied material from Samos, but the length of the upper teeth is slightly smaller and the breadth slightly larger (Figs 4, 5). These features are in agreement with the observation of Lehmann et al. (2005) that *O. abundulafus* has robust teeth. The upper molars of the Mytilinii material are more symmetric showing more clear 8-shaped occlusal outline, whereas in *O. abundulafus* they are more asymmetric (Lehmann, et al. 2005; fig. 2). The P1 and p1 are absent in *O. abundulafus* (Lehmann et al., 2005; fig. 2), whereas they are present in the Mytilinii material.

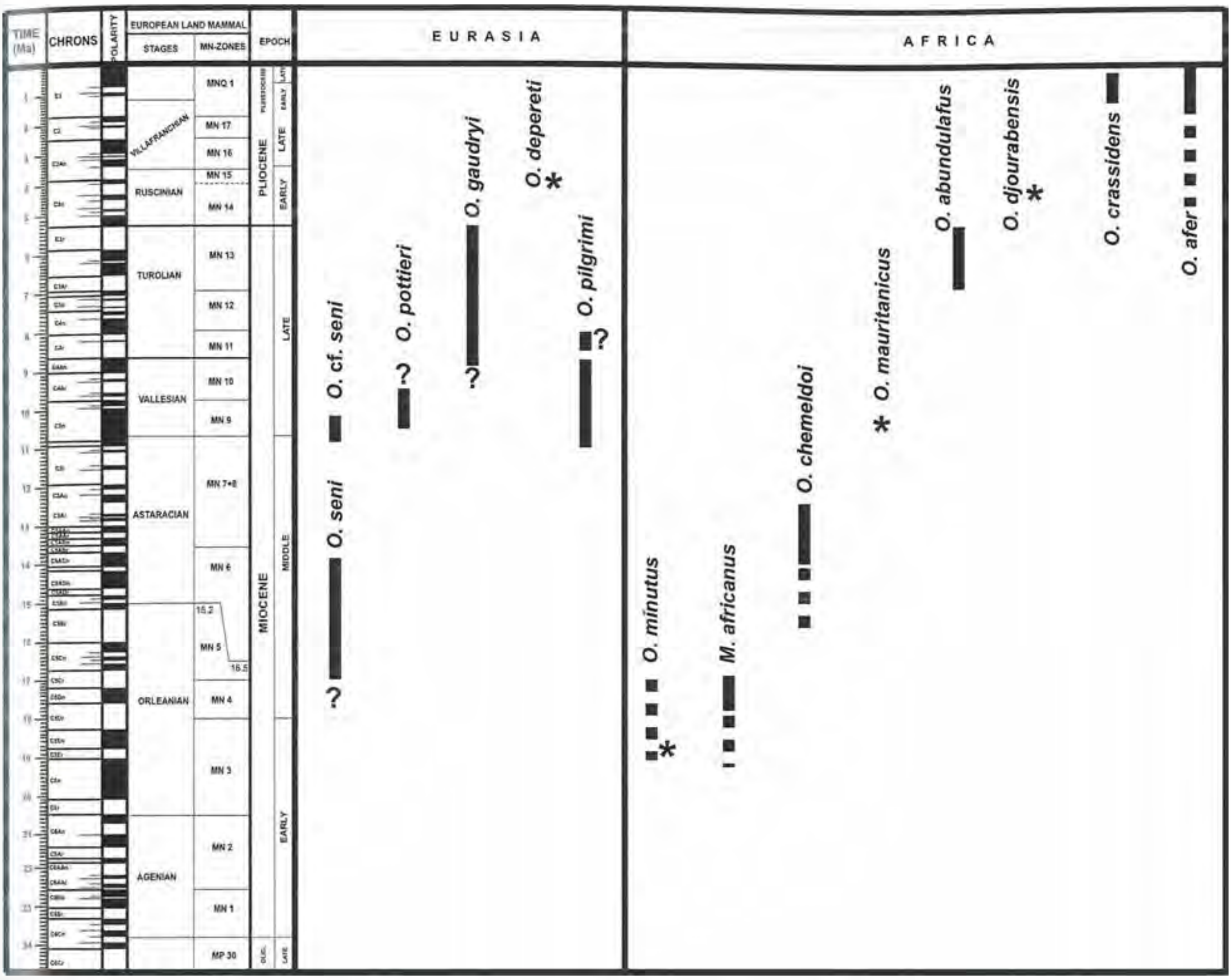


Figure 6: Stratigraphic distribution of the orycteropodids in the Old World; see also text.

3. Biostratigraphy and Chronology of the Orycteropodids

The orycteropodids are quite common in the Old World and they probably originated from Africa. A very small aardvark, named *Orycteropus minutus* has been described from the early Miocene locality of Songhor, Kenya (Pickford, 1975); according to the last author the Songhor fauna is dated at 19.0 Ma. A similar age between 18.0-20.0 Ma is also given for the Songhor locality in NOW (2007). The species is also reported from other Kenyan localities as Nyanza-12, 25 dated to early Orleanian (MN 3) according to the European Land Mammal Ages (ELMA), Mfwangano and Rusinga, dated to middle Orleanian, MN 4 (Pickford, 1975; NOW, 2008). It is worth mentioned here that the European land mammal ages application in the African Neogene has not proved but it is used here in order to have comparable data between the two continents. Recent K-Ar data from Kenya suggest for the Rusinga group a mean age of 17.9 Ma but the available data for the Mfwangano are not enough as no biotite with sufficient K content exists (Drake et al., 1988). According to NOW (2007) the youngest appearance of *O. minutus* is known from the Kenyan locality Nyanza-2 (Chantwara-34) dated to early Turolian ELMA, MN 13. The species was recently recognized in the locality of Arrisdrift, Namibia dated to 17.5 Ma (Pickford, 2003). However van der Made (2003) considers that *O. minutus* is a synonym of *Myorycteropus africanus*, an opinion which seems to be accepted by Lehmann (2006) too. The last author refers to *O. minutus* only the type material from Songhor, doubting also its fossorial way of life and myrmecophagous diet. Thus, *O. minutus* appeared at the end of early Orleanian ELMA (~19.0 Ma), it is present during middle Orleanian (dashed line in Fig. 6) and probably existed at the end of Miocene with a great gap. If we accept its synonymy with *M. africanus*, then its stratigraphic span is restricted at the sole locality of Songhor at about 19.0 Ma; its position is given by a star in Fig.6. Its presence at the end of Miocene is questionable and it is better not to give it in Fig. 6.
Another Early Miocene African orycteropodid is *Myorycteropus africanus* reported from Rusinga, Kenya (MacInnes, 1956) Later it was recognized in the localities Mfwangano and Kathwanga dated to middle Orleanian ELMA, MN 4 (Pickford, 1975; NOW, 2008). As it was referred above the K-Ar dating indicates an age of 17.9 Ma for the Rusinga group, while the dating of Mfwangano is not clear (Drake et al., 1988). The stratigraphic distribution of *M. africanus* spans in middle Orleanian, MN 4 but if we accept the synonymy with *O. minutus*, then it is

extended to early Orleanian, MN 3 (dashed line in Fig. 6). Besides the systematic problems the oldest traces of the orycteropodids have been recognized in the early Miocene of Africa at ~19.0 Ma.

Orycteropus chemeldoi is the only middle Miocene orycteropodid known from Africa. It was originally described from Ngorora Formation, Tugen Hills, Kenya, dated to latest Astaracian ELMA, MN 7+8 (PICKFORD, 1975). According to NOW (2008) the species is referred from the Kenyan sites Maboku and Fort Ternan dated to early Astaracian ELMA, MN 5 and to latest Astaracian, MN 7+8 respectively. The Maboku material consists of two metapodial fragments which cannot be certainly identified, making questionable the presence of *Orycteropus* in this site (LEHMANN, pers. comm.); for this reason its span at MN 5 is given by dashed line in Fig. 6.

During late Miocene two African orycteropodids are known. *Orycteropus mauritanicus* was found in the Vallesian locality of Bou Hanifia, Algeria (ARAMBOURG, 1959). Recently a new species *Orycteropus abundulafus* was described from the Chadian sites Kossom Bougoudi and Toros Menalla dated to 7.0 Ma and close to Mio-Pliocene boundary (~5.3 Ma) respectively (LEHMANN et al., 2005; LEHMANN, 2006). In Pliocene the sole known African orycteropodid is *Orycteropus djourabensis* described from the fossiliferous sector of Kolle, Chad dated to early Pliocene (5.0-4.0 Ma), (LEHMANN et al., 2004). The species is also known from Ethiopia and Kenya (LEHMANN, 2006).

During Pleistocene two species of orycteropodids are known from Africa: *Orycteropus afer* and *Orycteropus crassidens*. The previous one is that living up to now; its first appearance is discussed. Some orycteropodid remains from the early Pliocene locality of Langenbaanweg have been attributed to *O. afer* (PICKFORD, 2005). However LEHMANN (2006) does not agree to this determination of the Langenbaanweg material; thus its presence in the Pliocene is given by dashed line in Fig. 6. *O. crassidens* was originally described from Kenya and it is dated from 1.8-0.01 Ma (MAC INNES, 1956). However, its systematic value is under discussion as it is considered either as synonym of *O. afer* (PICKFORD, 1975, 2005) or as a separate species (VAN DER MADE, 2003; LEHMANN et al., 2005; LEHMANN, 2006).

The oldest known appearances of orycteropodids in Eurasia are traced in the middle Miocene Turkish localities of Çandir and Paşalar with *Orycteropus seni*. The former is dated to late Orleanian ELMA, MN 5 (NOW, 2007) but VAN DER MADE (2003, 2005) suggested a younger age for it (Early Astaracian ELMA, MN 6). The locality of Paşalar is dated from late Orleanian to early Astaracian ELMA, MN 5-6 (NOW, 2007). Thus, the orycteropodids appeared in Eurasia during late Orleanian ELMA, MN 5 or at the end of Burdigalian. According to RÖGL (1999) the Tethyan Seaway (the marine branch connecting the Mediterranean Sea to the Indo-Pacific Ocean) closed for the first time at the end of early Miocene (Burdigalian) and more precisely around 19.0-18.0 Ma. The "*Gomphotherium*-landbridge" allows the first dispersal of mammals from Africa to Eurasia and vice-versa. During the Langhian (MN 5-6), the Tethyan Seaway re-opened but its opening was interrupted by several closures, which corresponds to several mammalian migration waves. During one of these migration waves, *Orycteropus* probably entered Eurasia. During this period, signs of migration waves were found on the Greek island of Chios such as the suoid *Sanitherium schlagintweiti*, the giraffid *Georgiomeryx georgalasi* and the ctenodactylid *Sayimys intermedius*. The biochronological data for the Chios fauna suggests a late Orleanian (MN 5) age, whereas the magnetostratigraphy indicates an age of ~15.5 Ma (KOUFOS et al., 1995; BONIS et al., 1997a, b, 1998; LOPEZ-ANTONANZAS et al., 2005). Moreover, the faunas of the Turkish localities, including *O. seni*, have relations to the African ones confirming the above hypothesis. The above mentioned data suggest that the orycteropodids dispersed into Eurasia some 16.0-15.0 Ma ago and then spread over the whole area. Besides Çandir and Paşalar, a form referred to *O.* cf. *seni* is known from the Turkish locality of Sinap 64, dated to early Vallesian ELMA, MN 9 and magnetostratigraphically estimated around 10.7 Ma (KAPPELMAN et al., 2003). It is quite possible, thus, that the stratigraphic distribution of *O. seni* extends up to the beginning of late Miocene (Fig. 6). Another Eurasian taxon is *O. pottieri*, a species restricted to the Vallesian so far (Fig. 6). It is known from the localities of Sinap 12, 72 and 108 dated at ~10.59 Ma, ~10.08 Ma and ~10.13 Ma respectively (KAPPELMAN et al., 2003), suggesting an early Vallesian age (MN 9). *O. pottieri* is also known from the locality of Pentalophos-1 (PNT, Axios Valley, Macedonia, Greece). The fauna of PNT is peculiar, but a biochronological age at the end of early Vallesian ELMA, MN 9 or the beginning of late Vallesian ELMA, MN 10 is quite possible (KOUFOS, 2006).

The distribution of the well known *O. gaudryi* spans over the whole Turolian (Fig. 6). The taxon is certainly known from several Greek and Turkish sites (WOODWARD, 1901; COLBERT, 1941; BONIS et al., 1994; SEN, 1994 and included bibliography; THEODOROU et al., 2003). Some orycteropodid remains reported as *O.* cf. *gaudryi* are known from the Late Turolian (MN 13) locality of Brishigella, Italy (ROOK & MASSINI, 1994) and from the middle Turolian level of Maragheh, Iran (MEQUENEM, 1925). Although the species is mentioned in the faunal lists of several localities of Moldova and Ukraine (NOW, 2007), its presence is dubious as all these old collections need a revision. Its older appearance is traced in the locality Kuçuk Çekmece (Turkey) dated probably to late Vallesian (MN 10). The taxon makes its last appearance in the Greek locality of Dytiko, dated to late Turolian (MN 13), (BONIS et al., 1994). The species *Orycteropus depereti* is known from Perpignan (France), dated to early Pliocene (MN 15), (HELBING, 1933). However, a more detailed comparison of this species with *O. gaudryi* is necessary in order to specify its systematic position. The Perpignan aardvark is the last appearance of the orycteropodids in Eurasia, which are later restricted to Africa.

Besides these ascertained appearances of the orycteropodids in Europe, there are several traces of the family in various European localities from Turkey, Georgia and

Hungary (NOW, 2007). However, the available material is too poorly preserved to allow accurate identification and is often referred to as *Orycteropus* indet., e.g. in the middle Miocene Georgian locality of Belometchetskaja an undetermined orycteropodid is referred to as *Orycteropus* sp. (Gabunia, 1956); however van der Made (2003) refers that its identification to *Orycteropus* is quite dubious.
In the Siwaliks (Pakistan), the orycteropodids are known by a single species *Orycteropus browni* found in the fossiliferous levels, dated toVallesian, MN 9-10 (Colbert, 1933), (Fig. 6). This taxon is also referred from the early Turolian locality of Kocherinovo-1, Bulgaria by a skull known from illustrations (Spassov et al., 2006).

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PLATE 1

***Orycteropus gaudryi*, Mytilinii-1A (MTLA), Samos, Greece, middle Turolian (MN 12).**

Fig. 1. Partial skull, MTLA-115; a. right lateral, b. left lateral, c. dorsal, and d. occlusal view.

Fig. 2. Right mandibular fragment with p3 and m1-m3 associated with the skull, MTLA-115; a. buccal, b. lingual, and c. occlusal view.

Fig. 3. Partial skull, MTLA-240; a. right lateral, b. left lateral, c. dorsal, and d. occlusal view.

PLATE 1

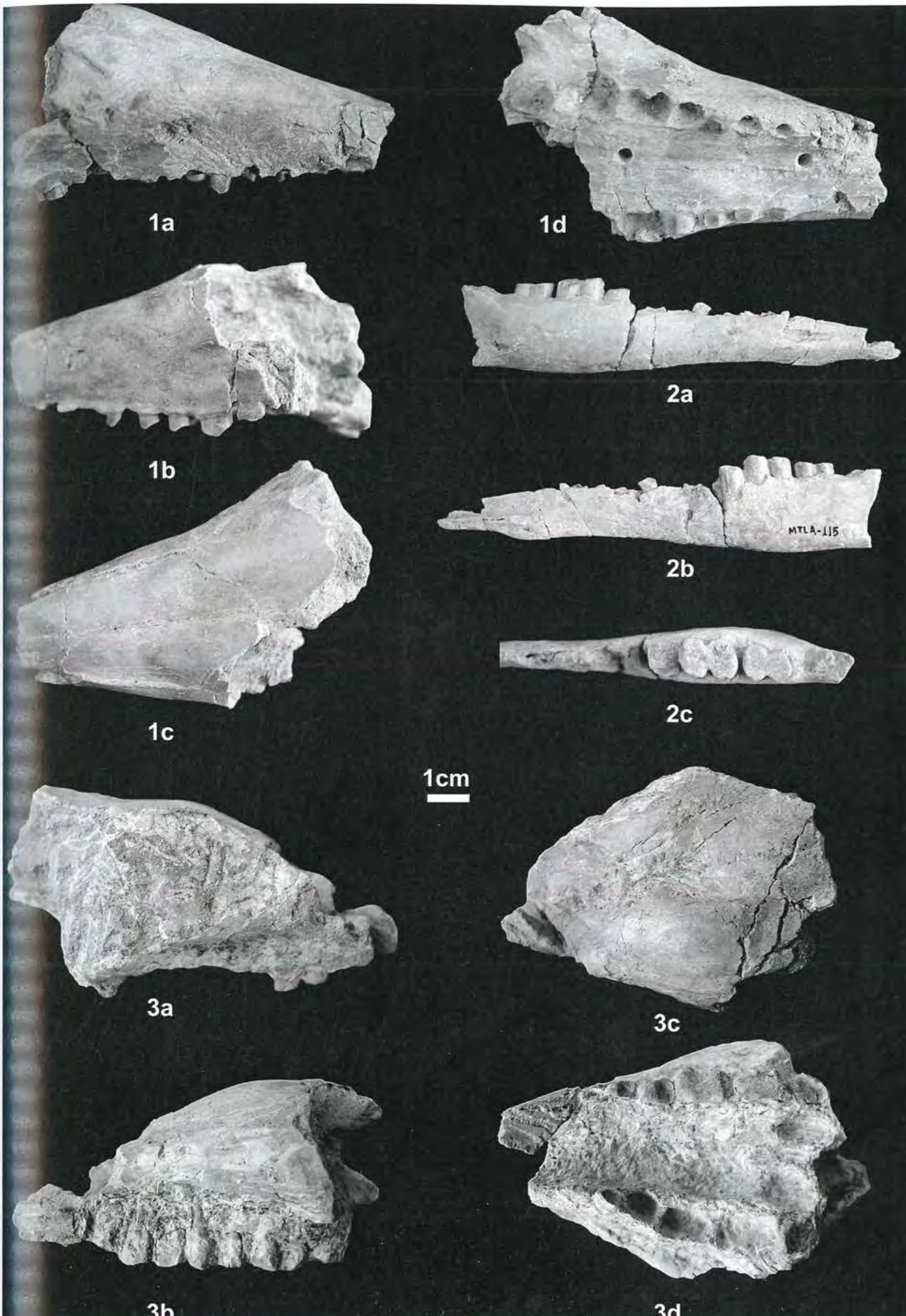


PLATE 2

***Orycteropus gaudryi*, Mytilinii-1A, B (MTLA, MTLB), Samos, Greece, middle Turolian (MN 12).**

Fig. 1. Left mandibular fragment with m3, MTLA-116; a. buccal, b. lingual, and c. occlusal view.

Fig. 2. Right mandibular fragment with p4-m3, MTLA-280; a. buccal, b. lingual, and c. occlusal view.

Fig. 3. Left mandibular fragment with m2-m3, MTLA-306; a. buccal, b. lingual, and c. occlusal view.

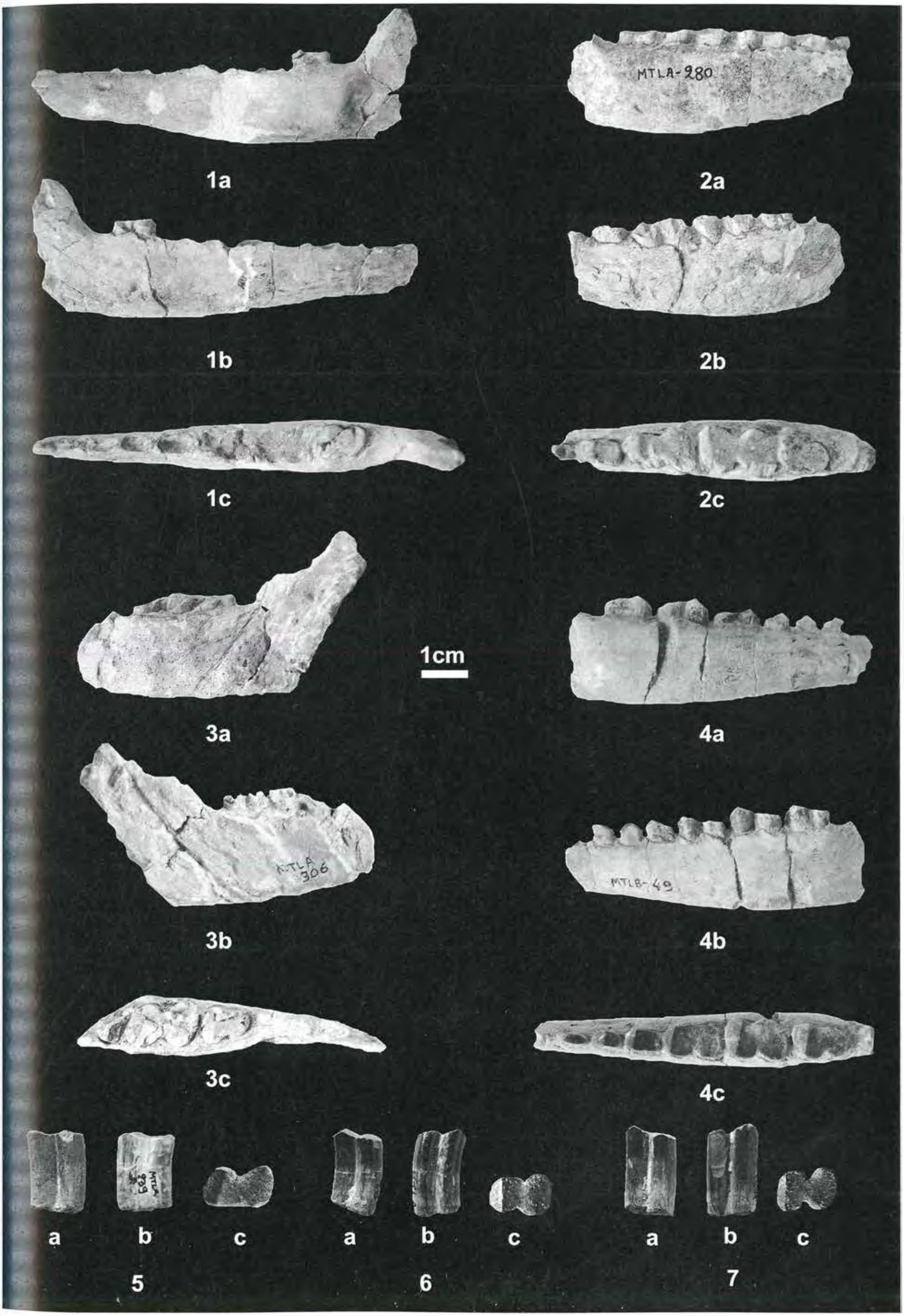
Fig. 4. Right mandibular fragment with p2-m3, MTLB-49; a. buccal, b. lingual, and c. occlusal view.

Fig. 5. Left M1, MTLA-239; a. buccal, b. lingual, and c. occlusal view.

Fig. 6. Left m1, MTLA-18; a. buccal, b. lingual, and c. occlusal view.

Fig. 7. Left m2, MTLA-17; a. buccal, b. lingual, and c. occlusal view.

PLATE 2


1a
2a
MTLA-280
1b
2b
1c
2c
3a
1cm
4a
3b
MTLA 306
4b
MTLB-49
3c
4c
a
b
c
a
b
c
a
b
c
5
6
7