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MAMMALIAN REMAINS FROM A NEW SITE NEAR THE CLASSICAL LOCALITY OF PIKERMI (ATTICA, GREECE)

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Abstract: We present the first results on the fossil mammalian fauna recovered during the first excavation season at the new site Pikermi Valley-1 (PV1). The fauna comprises two hipparionine species (*C.* cf. *mediterraneum*, *H.* cf. *brachypus*), a giraffid (*Bohlinia* cf. *attica*), five bovids (*Palaeoreas lindermayeri*, *Protragelaphus skouzesi*, *Tragoportax* cf. *amalthea*, *Gazella* sp., Bovidae indet.) and two carnivores (? *Adcrocuta eximia*, Felidae indet.). The composition of the fauna suggests a Turolian age.

Keywords: Pikermi, Late Miocene, Turolian, Mammalia

1. Introduction

Pikermi constitutes one of the oldest known (discovered in 1835 or 1836) and most famous localities of the Eurasian Late Miocene. It is perhaps the most important reference locality for the European continental Upper Miocene and for the so-called Pikermian biome due to the richness of its fauna and due to the fact that it is the type locality of several Turolian genera and species. The Pikermi fossil fauna is the product of several excavations carried out mainly during the 19th and the early 20th century. Most of the available material derives from the excavations of Albert Gaudry (1855-56 and 1860), A. Smith Woodward and Theodor Skufos (1901) and Othenio Abel (1912) (Gaudry 1855, 1862-1867; Woodward 1901; Abel 1922), but numerous other minor excavations yielded smaller fossil bone collections. After Abel's excavation there was no other research activity in the area of the classical site. In 1971 a new site has come to light during quarrying activity east of the classical site. This site, known as Kisdári or Chomaterí or Chomaterés, was partly excavated from 1972 to 1980 (Bachmayer et al. 1982).

In 2008 the major of Pikermi Mr. A. Adamopoulos started collaboration with the first author trying to raise funds for founding a local Museum, protect the fossiliferous sites and organize a presentation of the fossils *in situ*, a project pending since at least 1901, when the demand for a local museum was expressed by the mining engineer Andreas Kordellas in a newspaper article. Geological prospecting carried out in the same year by a University of Athens team, in order to locate sites for the purposes of the project, resulted in the discovery of the new fossiliferous locality "Pikermi Valley-1" (PV1). The new site is situated at the bottom of the ravine of Megálo Réma stream (locally known as Valanáris), 500 m east-southeast of the alleged location of the classical Pikermi locality and about 1700 m southwest of Chomateri site (Fig. 1). The findings come from a single fossiliferous lens on the northern bank of the stream, slightly above the present water level.

The first excavation season (June 15 – July 15,

Fig. 1. Geographical distribution of the Pikermi sites: 1, classical locality; 2, Chomateri or Kisdari; 3, Pikermi Valley-1. The plotted position of the classical site is traditionally accepted as the location excavated by Albert Gaudry, but this is not confirmed by any historical or field data. Pikermi is located 20 km east-northeast of Athens. Satellite image © 2009 Digital Globe / Google.

2009), sponsored by the Municipality of Pikermi (University of Athens Project Research Account 70/3/9494), revealed a promising fossil mammal assemblage. The specimens were rather sparse, particularly when compared to the tight accumulation observed in the classical Pikermi locality (observation based on fossiliferous blocks stored in several museums), or at Chomateri locality (Bachmayer et al. 1982). Most long bones exhibited a NE–SW orientation, which probably was the direction of the palaeocurrent (Fig. 2).

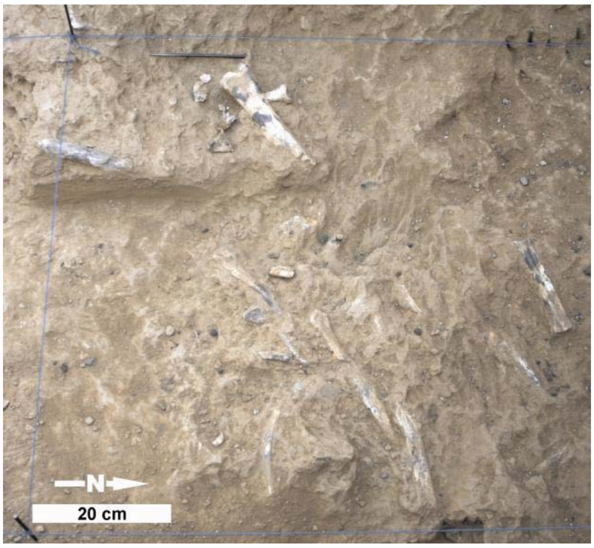

Fig. 2. Pikermi Valley-1: partly excavated bones *in situ*.

2. Material and Methods

The excavated sample consists of more than 200 specimens; the identifiable ones are described below. All material is stored in the Museum of Palaeontology and Geology, University of Athens, and was prepared in its laboratory using mechanical methods (hand and pneumatic tools). The biometric study of the equids followed the methodology of Eisenmann et al. (1988), while the artiodactyl specimens were measured according to the suggestions of Heintz (1970). All measurements are in mm. The upper and lower teeth positions are given using upper and lower case letters respectively (e.g. M1 and m1).

3. Systematics

Perissodactyla OWEN, 1848
Equidae GRAY, 1821
Hipparionini QUINN, 1955

The hipparionine material (Figs 3–5, Table 1) consists of a few mainly isolated teeth and some postcranial elements. The best preserved teeth belong to aged individuals. The upper teeth exhibit numerous enamel plications at the fossettes, simple pli caballin and rather shallow, V-shaped hypoconal groove. The very worn lower premolars have a shallow ectoflexid that does not penetrate the isthmus and rounded metaconid and metastylid, separated by a shallow linguaflexid. In a very worn lower molar the linguaflexid and the ectoflexid are in contact. The flexids show practically no plications. A fresh isolated lower molar has a hypsodonty index of 47 (calculated following Eisenmann et al. 1988).

The best preserved postcranial elements are four complete metapodials (two MC III and two MT III). They are long and slender. In the third meta-

Fig. 3. *Cremohipparion* cf. *mediterraneum*. Left third metacarpals (PV1/5, PV1/15), dorsal view. Graphical scale in cm.

Fig. 4. *Cremohipparion* cf. *mediterraneum*. Left third metatarsals; PV1/8, lateral view; PV1/40, dorsal view. Graphical scale in cm.

carpals, the slenderness index (3/1) is 12.3% and 12.1%; another similar index (11/1) is calculated to be 15.1% and about 16.6% in the two specimens respectively. The same indices on the two third metatarsals are 10.1% and about 10.1% (for 3/1), and 12.4% and 12.6% (for 11/1). The above specimens are plotted inside the cluster of the small sized Pikermi hipparions provided by Dermitzakis (1976, figs 6-7); their dimensions are also in accordance with the metrical data provided by Koufos (1987a, tables 33, 41) for *H. mediterraneum* from Pikermi. Based on their morphology, absolute size and proportions, these metapodials are referred to the species *Cremohipparion* cf. *mediterraneum* (ROTH & WAGNER, 1854).

A fragmentary left calcaneus (PV1/53) presents large distal maximal breadth (measurement “7” of Eisenmann et al. 1988), measuring 51.0 mm. It can be referred to *Hippotherium* cf. *brachypus* (HENSEL, 1862), since it is plotted to the cluster of the large sized Pikermi hipparions provided by Theodorou (1997) and corresponds in size to the larger values provided by Koufos (1987a) for this species.

There are two tibias, both missing their proximal ends. One of these (PV1/4) is more slender and has similar dimensions with the *C. mediterraneum* Pikermi sample studied by Koufos (1987a, 1987b). The other one (PV1/1) is larger and more robust; compared to the data provided by Koufos (1987b, fig. C-18) it is plotted inside the *H. brachypus* sample.

Fig. 5. Hipparionini indet. Proximal phalanges III (PV1/12, PV1/57), dorsal view. Graphical scale in cm.

Two complete proximal phalanges III (possibly pedal) also present similar size differences, one of them (PV1/57) being significantly more robust than the other (PV1/12), and could belong to different hipparionine species. The dimensions of the robust one plot inside the range of the *H. brachypus* sample (Koufos 1987b, fig. C-18).

Despite the inadequate hipparionine material available to date from PV1, the presence of two species —*Cremohipparion* cf. *mediterraneum* (ROTH & WAGNER, 1854) and *Hippotherium* cf. *brachypus* (HENSEL, 1862)— is documented in the site. The rest of the hipparionine material, which is not determinable to the species level, is referred to as Hipparionini indet.

Table 1: Long bone measurements of *mediterraneum* from PV-1. Measurement methodology according to Eisenmann et al. 1988. The *Hipparion* measurements in parentheses are inaccurate.

	Metacarpal III		**Metatarsal III**		**Tibia**		**Prox. Phalanx III**	
	PV1/5	**PV1/15**	**PV1/8**	**PV1/40**	**PV1/1**	**PV1/4**	**PV1/12**	**PV1/57**
1	204.4	202.5	259.5	253.3	—	—	61.8	63.7
2	196.8	196.3	251.7	245.1	—	—	56.9	58.2
3	25.2	24.5	26.1	(25.6)	40.6	38.5	24.2	27.6
4	21.1	22.7	28.7	(27.1)	29.1	27.0	35.5	39.2
5	32.6	33.9	38.9	39.1	—	—	27.2	31.0
6	24.2	23.9	28.0	—	—	—	29.1	32.7
7	28.5	29.2	36.7	(35.6)	66.7	59.2	29.0	32.2
8	—	8.8	10.3	—	44.5	41.2	18.3	22.1
9	—	3.4	8.1	—	—	—	19.1	20.3
10	31.0	34.5	35.9	36.9				
11	30.8	(33.7)	(32.2)	32.0				
12	25.3	26.3	30.3	28.5				
13	21.4	22.4	22.8	22.1				
14	21.9	23.8	26.9	25.6				
11/1	15.1	(16.6)	(12.4)	12.6				

Artiodactyla OWEN, 1848
Giraffidae GRAY, 1821
Bohlinia MATTHEW, 1929

Bohlinia cf. *attica* (GAUDRY & LARTET, 1856)

The giraffids are represented in the new material by only one specimen (PV1/72), a right radius-ulna missing its proximal part (Fig. 6). Its preserved length measures about 68 cm, the greatest width of the distal end 107 mm, and the medio-lateral diameter of the diaphysis about 63 mm. The crest that defines the lateral margin of the lunar facet is more curved and oblique than in the extant giraffe. The specimen is referable to *B. attica* based on its morphological and metrical characters (Gaudry 1862-1867; Bohlin 1926; Geraads 1974; Geraads 1979).

Fig. 6. *Bohlinia* cf. *attica*. Right radius-ulna (PV1/72), anterior view. Graphical scale: 10 cm.

Bovidae GRAY, 1821

The Bovidae material comprises dental and cranial remains, and few postcranial elements. The dental and cranial remains indicate the presence of five taxa.

Palaeoreas GAUDRY, 1861

Palaeoreas lindermayeri (WAGNER, 1848)

The material referred to this species comprises a frontlet (PV1/42) and a right mandible (PV1/25). The frontlet (Fig. 7) is badly damaged and distorted by compression. The horn-cores are in a poor state of preservation, but present an anterior and a posterior keel. The former is blunt and descends anteriorly. The latter, preserved at the distal part of the left horn-core, is acute. Only the anteroposterior basal diameter of the left horn-core can be provided, that measures about 48 mm. The postcornual fossae are deep. Between the horn-cores, the frontal region is strongly elevated above the level of the supraorbital margins and strongly bent, even if the latter is probably exaggerated by

Fig. 7. *Palaeoreas lindermayeri*. Frontlet (PV1/42), anterior view. Graphical scale in cm.

distortion. The supraorbital foramens open into deep frontal depressions and communicate with the orbital fossae. The distance between the lateral borders of the frontal depressions measures about 35 mm.

The mandible (Fig. 8) is completely preserved (Lp=25.2, Lp3-p4=19.2, Lm=41.6, Lpm=66.2, Lp3-m3=60.2). The mandibular ramus is only slightly deeper below m3 than below p2, and the premolar row is large in relation to the molar one (Lp/Lm=60.6%, Lp3-p4/Lm1-m3=46.2%). The p3 and p4 are elongated, and the p3 is long in relation to the p4 (Lp3/Lp4=90.4%). On p3 the metaconid is small. On the labial wall, the groove in front of the hypoconid is faint. The p4 is generally similar to p3. The paraconid is well separated from the parastylid. The metaconid is columnar and the 2nd and 3rd valleys of the tooth are open. The base of the 2nd valley bears a small tubercle. The groove in front of the hypoconid is well marked. The molars bear moderately developed goat fold. The ectostylids are moderately developed on m1, m2, less in m3. The specimen is metrically similar to *P. lindermayeri* from Pikermi (Fig. 9).

Fig. 8. *Palaeoreas lindermayeri*. Right mandible (PV1/25); a) occlusal view, b) lingual view. Graphical scale in cm.

Both specimens exhibit all characters of *P. lindermayeri* (Bouvrain 1980; Bouvrain 1992; Geraads et al. 2003) and are referred to this species.

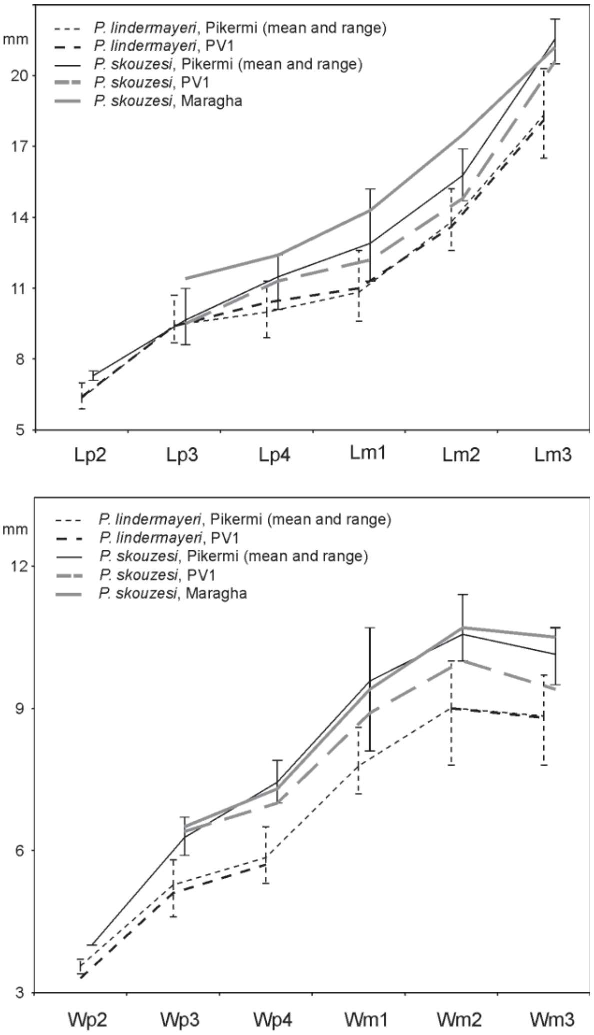

Fig. 9. Comparison of *P. lindermayeri* and *P. skouzesi* from PV1 with specimens from Pikermi and Maragha. Based on personal data.

Protragelaphus DAMES, 1883

Protragelaphus skouzesi DAMES, 1883

A frontlet with both horn-cores (PV1/69; Fig. 10) is referred to *P. skouzesi*. This specimen could belong to a not fully grown individual since its horn-cores' surface is porous. The horn-cores are moderately separated (about 27.5 mm) and diverge from the sagittal plane by an angle of about 30°, and they are slightly compressed mediolaterally at their bases (DAP×DT=(44.0)×35.8 mm, left horn-core). The horn-core axis is almost straight, the torsion follows a close spiraling, and there is no anterior keel. The posterior keel can be traced in two revolutions. The left horn-core is almost completely preserved and measures about 210 mm in length (in straight line). There are moderately deep postcornual fossae. The intercornual region is on a higher level than the supraorbital margins. The parietofrontal suture is open. The interfrontal suture cannot be traced since the specimen is damaged along it. The supraorbital foramens are small, not sunken in frontal depressions, and open about 27 mm below the horn-cores' bases. The frontlet PV1/69 is quite similar to other specimens referred to *P. skouzesi*, though, its horn-cores are slightly less robust compared to already known Pikermi specimens (Fig. 11; Roussiakis 2009).

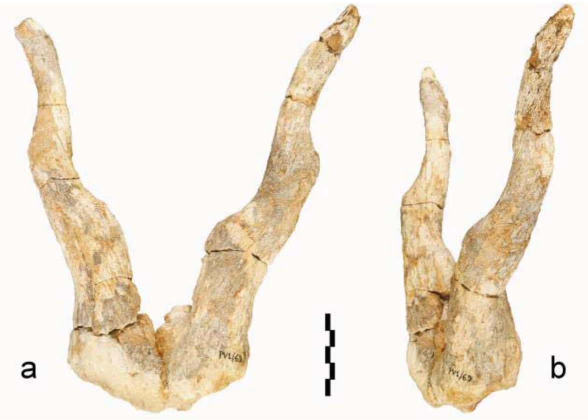

Fig. 10. *Protragelaphus skouzesi*. Frontlet (PV1/69); a) anterior view, b) anterolateral view. Graphical scale in cm.

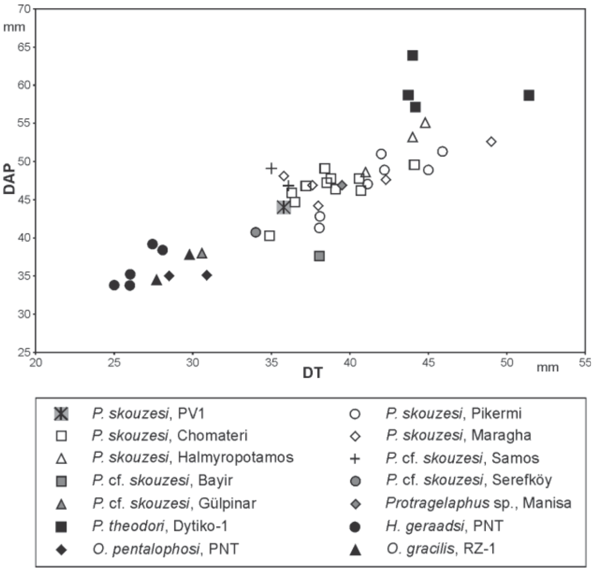

Fig. 11. Comparison of the basal horn-core dimensions (DT *vs* DAP) of *P. skouzesi* from PV1 with *Protragelaphus*, *Ouzocerus* and *Helladorcas* species from various localities. Data according to Bouvrain (1978, 1997), Geraads and Güleç (1999), and Roussiakis (2009). PNT: Pentalophos-1, RZ1: Ravin des Zouaves-1.

A left mandible (Fig. 12; PV1/68; Lp3-p4=20.8, Lm=48.9, Lp3-m3=68.0) can also be attributed to *P. skouzesi*. The premolars are short in relation to the molars (Lp3-p4/Lm=42.5%). The p3 is rather triangular and clearly smaller than the p4 (Lp3/Lp4=84.1%). The metaconid is oblique and extends distolingually, closing the distal part of the lingual wall of the tooth. The 2nd valley remains open, while there is no groove in front of the hypoconid on the labial wall of the tooth. The p4 is similar to p3, but the metaconid forms a mesiodistally directed wall that also constricts the 2nd valley of the tooth. The groove in front of the hypoconid is moderately marked. On the molars, the ectostylids are rather strong on m1 and m2, less on m3. There is a faint goat fold on m1 and m2. The lower dentition of *P. skouzesi* is not definitely known. Pilgrim and Hopwood (1928, pl. 9, fig. 3), followed by Gentry (1971, pl. 6), referred some mandibular rami from Pikermi to *P. skouzesi*, while Mecquenem (1925, pl. 6, fig. 1) referred to this species a mandibular ramus from Maragha. In addition, to the same species might belong two mandibular ra-

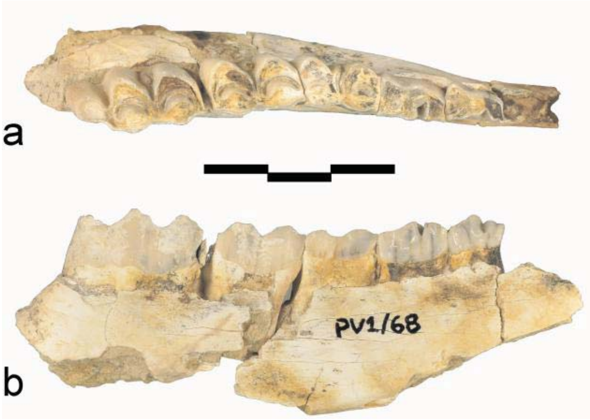

Fig. 12. *Protragelaphus skouzesi*. Left mandible (PV1/68); a) occlusal view, b) lingual view. Graphical scale in cm.

mi from Pikermi stored in AMPG: one of this, PA1842/91, was referred to *P. skouzesi* by Roussiakis (1996), while the other (Π89/740) was recently located in the AMPG Pikermi collections. On these specimens the Lp3-p4/Lm ratio ranges from 40.3% to 45.1% and the metaconid of p4 tends to be fused with the paraconid. This tendency is also exhibited by PV1/68 that appears comparable in size and proportions to the Pikermi specimens referred to *P. skouzesi* but slightly smaller compared to the Maragha specimen (Fig. 9).

Tragoportax PILGRIM, 1937

Tragoportax cf. *amalthea* (ROTH & WAGNER, 1854)

We refer to *T.* cf. *amalthea* a left mandibular ramus (PV1/38; Fig. 13), with the complete dentition preserved (Lp=45.7, Lp3-p4=32.3, Lm=60.7, Lp3-m3=91.0, Lpm=104.3). The mental foramen opens about 40 mm in front of p2. The premolar series is elongated (Lp/Lm=75.3%, Lp3-p4/Lm=53.2%). On p3, the 2nd valley is widely open while the 3rd one is narrow. The paraconid is transverse to the mesiodistal axis of the tooth and rather bulbous towards its base. The metaconid is distolingually directed. The groove in front of the hypoconid is faint. On p4, the 2nd and 3rd valleys are narrow due to the mesiodistally directed T-shaped metaconid. The paraconid is well separated from the parastylid and directs distolingually. The groove in front of the hypoconid is strong. A trace of goat fold is observed on m1. The ectostylid is well developed on m1, but decreases towards the m3. The m1 and m2 bear a lingual basal pillar between the paraconid and metaconid; this is faint on m3.

Fig. 13. *Tragoportax* cf. *amalthea*. Left mandible (PV1/38); a) occlusal view, b) lingual view. Graphical scale in cm.

Metrically PV1/38 is comparable to the larger Pikermi specimens of *Miotragocerus valenciennesi* and the smaller of *T. amalthea* (Fig. 14). However, the rather wide p3 and the T-shaped metaconid of p4 are typical characters of *Tragoportax* (Spassov and Geraads 2004; Kostopoulos 2005), so we tentatively refer this specimen to *T. amalthea*.

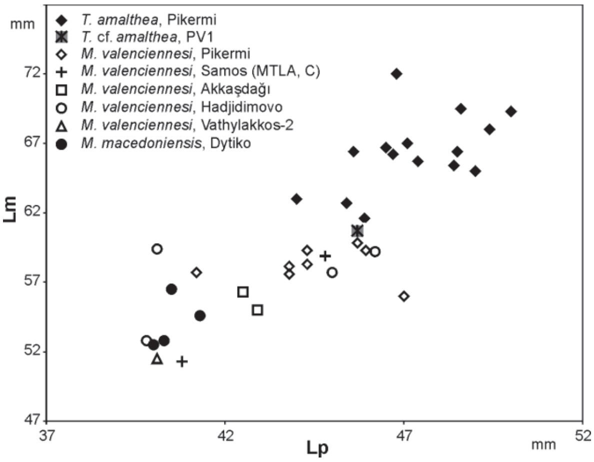

Fig. 14. Premolar *versus* molar length (lower dentition) in *Tragoportax* and *Miotragocerus* from various localities. Based on personal data, Kostopoulos (2005, 2009, pers. com.), Spassov and Geraads (2004) and Bouvrain (2001).

Gazella sp.

An isolated but damaged horn-core (PV1/70; Fig. 15) with preserved length of about 85 mm (in straight line) can be referred to *Gazella* sp. The surface of the horn-core is deeply grooved. The lateral surface is flatter than the medial, and the posterior surface appears gently curved in lateral view. The base of the horn-core is badly broken and no measurements can be provided. However, 2 cm above the base the cross section of the horncore

Fig. 15. *Gazella* sp. Right horn-core (PV1/70), medial view. Graphical scale in cm.

is subelliptical (DAP×DT=24.0×21.4 mm) while about 7 cm above the base is more circular (L×W=17.1×16.6 mm). The general characters of this specimen show similarities to *Gazella capricornis* (WAGNER, 1848), but a specific determination cannot be established because of the scantiness of the available material.

Bovidae indet.

A right maxilla fragment (PV1/36; Fig. 16) preserving the complete dentition (LP=38.7, LM=48.1, LP3-P4=25.4, LPM=80.4) is characterized by the long premolar series in relation to the molars (LP/LM=80.5%, LP3-P4/LM=52.8%). P2 is elongated (L×W=14.0×10.1). Its parastyle is thin, while the paracone rib is thick, labially projected and rather mesially situated. The protocone projects lingually slightly more than the hypocone. It is separated from the latter by a deep lingual groove located opposite the paracone rib. P3 is only slightly larger in length than in width (L×W=13.9×12.8). The parastyle and paracone rib are strong. The metastyle is stronger and projects labially more than the parastyle and the paracone rib. Lingually it is strongly bilobated, as P2, but the hypocone projects lingually much more than the protocone. P4 is larger transversely than mesiodistally (L×W=11.6×13.6). The parastyle, paracone rib and metastyle are moderately developed. The hypocone bears a hypoconal spur that forms a hypoconal islet. The upper molars are characterized by the strong parastyle, paracone rib and mesostyle, while the metacone rib and the metastyle (apart from M3) are weak. A hypoconal islet is present on M2 and a free hypoconal spur on M3. A central islet is not observed. A slightly developed entostyle is present on M1. It is faint on M2 and absent on M3.

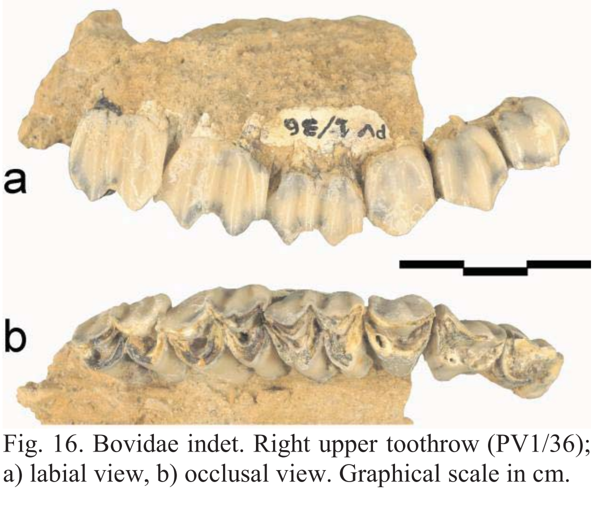

Fig. 16. Bovidae indet. Right upper toothrow (PV1/36); a) labial view, b) occlusal view. Graphical scale in cm.

A left mandibular ramus with p3-m3 (Fig. 17; PV1/17; Lp3-m3=77.8, Lp3-p4=28.2, Lm=51.1) agrees dimensionally, proportionally and morphologically to the above described upper toothrow. The p3 and p4 are elongated in relation to the molar series (Lp3-p4/Lm=55.2%). The toothrow length is estimated to 85 mm and the premolar length to 35 mm. The p3 is elongated relative to its width (L×W=19.4×7.1). The paraconid is independent from the parastylid and does not project lingually. The metaconid is distolingually directed but does not fuse with the entoconid. A faint groove is present in front of the hypoconid. The p4 is similar to p3 but the metaconid appears stronger. The m1 and m2 bear a weakly developed goat fold. The parastylid and metastylid are weak on all molars. A moderated developed ectostylid is present on m1; it is faint on m2 and absent on m3.

Fig. 17. Bovidae indet. Left mandible (PV1/17); a) occlusal view, b) lingual view. Graphical scale in cm.

The maxilla PV1/36 exhibits similarities to a specimen from Maragha referred to *Prostrepsiceros houtumschindleri* (RODLER & WEITHOFER, 1890) by Mecquenem (1925, pl. 5, fig. 5) on its relative long premolar series and elongated and bilobated P2, but it is larger in size. The mandible PV1/17 is very similar to NHML M13007 from Pikermi, referred by Gentry (1971), with reservation, to *Prostrepsiceros rotundicornis* (WEITHOFER, 1888), but the latter is smaller (Lp3-m3=65.8), presents stronger goat fold and a deep groove in front of the hypoconid. PV1/17 also exhibits similarities to *P. rotundicornis* from Akkaşdağı that ranges in p2-m3 length from 68.8 to 75.1 mm (Kostopoulos 2005).

Carnivora BOWDICH, 1821
Hyaenidae GRAY, 1821
? *Adcrocuta eximia* (ROTH & WAGNER, 1854)

Hyaenids are represented by a right P2 and a right upper canine (PV1/49, PV1/22). The canine (L×W=17.3×13.5 mm) presents a moderately developed mesiolingual crest as well a distal one. The P2 (L×W=16.2×11.1 mm) is rectangular in outline. It presents two accessory cusps: a strong distal one on the long axis of the tooth, and a smaller one situated mesiolingually. Both specimens can be provisionally referred to *Adcrocuta eximia*.

Felidae FISCHER DE WALDHEIM, 1817

Felidae indet.

The proximal half of a proximal phalange (PV1/71; preserved length=29.6 mm, DTprox×DAPprox = 17.9×16.2 mm) has typical felid morphology. Its dimensions indicate a large felid, larger than *Metailurus parvulus* (HENSEL, 1862) (Roussiakis et al. 2006). It may belong to *Metailurus major* ZDANSKY, 1924 or *Machairodus giganteus* (WAGNER, 1848).

4. Discussion

The recently discovered PV1 locality, though very promising, has not yet yielded a large number of specimens and taxa; however, all findings come from a single fossil accumulation, a fact that is important for the study of the complicated local biostratigraphy. The Pikermi fauna is commonly considered as chronologically and taxonomically homogenous, though the early authors already noticed that the fossils occur in at least two stratigraphic levels. This was first observed by Gaudry (1855; 1862-1867, p.14), who mentioned the presence of two fossiliferous horizons. Later, Woodward (1901) referred to two or locally three horizons, which is well documented in a photograph by Th. Skufos, published by Abel (1922, fig. 132). According to this photograph the two lower horizons have a level difference of about 2 m, while the third (upper) lays less than 1 m above the second. In spite of these observations, the stratigraphic provenance of the excavated material at the classical site is not specified in the relevant museum collections and publications, raising considerations on the exact faunal content of each level (e.g. Theodorou and Nicolaides 1988; Theodorou 1997). Moreover, the various excavators during the 19th and early 20th centuries collected material from different quarries at undefined positions in the broader area of Pikermi (Woodward 1901; Abel 1922), which are impossible to locate today. This means that what is known as “Pikermi classical site” is in reality a complex of quarries and stratigraphic levels along or close to the ravine, and that many Pikermian museum collections may comprise heterogeneous faunal samples, mixing two or more quarries or stratigraphic levels. The old collections may represent a fairly homogeneous palaeocommunity, only if the sedimentation and the fossil accumulation have been very rapid, lasting just a few thousand years, and providing “snapshots” of the same fauna in slightly different time slices.

The importance of the new site PV1 consists in its potential to provide new stratigraphic data on the relationship of the two/three fossiliferous horizons, in case the recently discovered accumulation is rich enough to produce an adequate statistical sample. A direct stratigraphic correlation of PV1 with the alleged classical site or Chomateri is not possible at the moment, as the ravine sections are disturbed, mainly by agricultural activities, and because of the lack of any lithologically characteristic horizon. The rapid urban development of the Pikermi area also hinders the stratigraphic correlation.

Despite the unknown stratigraphic provenance of the Pikermi fauna, its age is collectively considered as middle Turolian (MN12) (Koufos 2006). The newly excavated PV1 sample —though still poor— does not differ taxonomically from the classical fauna, as it is also the case with the Chomateri fauna. All the taxa recognized at PV1 are already known in the Pikermi fauna.

Palaeoreas lindermayeri, a bovid geographically confined to Greece, S. Bulgaria and W. Turkey, is known from localities dated to middle–late Turolian (MN12–MN13), while closely related forms (*P. zouavei* Bouvrain, 1980) are known from early Turolian (MN11) (Geraads and Güleç 1999; Geraads et al. 2003; Koufos 2006). *Protragelaphus skouzesi* is a rarer Late Miocene faunal element, but it spans a wider palaeogeographic area. It is known mainly from the middle Turolian of Greece (Pikermi, Chomateri, Halmyropotamos), as well as from Maragha (Iran), but it is also reported from the early Turolian locality of Novoelisavetovka-2 in Ukraine (Gentry et al. 1999). Closely related or identical forms also occur in Samos and W. Turkey (Andree 1926; Geraads and Güleç 1999; Roussiakis 2009). The rest of the referred PV1 taxa (*Tragoportax* cf. *amalthea*, *Bohlinia* cf. *attica*, *Adcrocuta* cf. *eximia*) point generally to Turolian or even late Vallesian age.

Despite the faunal similarity with classical Pikermi fauna, a biochronologic attribution of PV1 to middle Turolian cannot be supported for the moment, since the faunal list is still rather short and insufficient for a detailed study. The biochronological data for the currently available material allow a preliminary biostratigraphic attribution of PV1 to Turolian (MN11–MN13). Future excavations at PV1 will hopefully enrich the faunal and stratigraphic data available for this site.

5. Conclusion

The material excavated during the first field season documents the presence of the following taxa in PV1: *Cremohipparion* cf. *mediterraneum*, *Hippotherium* cf. *brachypus*, *Bohlinia* cf. *attica*, *Palaeoreas lindermayeri*, *Protragelaphus skouzesi*, *Tragoportax* cf. *amalthea*, *Gazella* sp., Bovidae indet., ? *Adcrocuta eximia* and Felidae indet.

In spite of the limited number of available specimens, PV1 presents close taxonomic similarity with the classical Pikermi fauna, as all taxa are common between the two sites. This allows us to date the new site in the Turolian. A more precise dating requires more material, as well as a resolution of the stratigraphic problems of the classical site.

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References

Abel O., 1922. Lebensbilder aus der Tierwelt der Vorzeit. Jena, 644p.

Andree J., 1926. Neue Cavicornier aus dem Pliocän von Samos. Palaeontographica, 67, 135-175.

Bachmayer F., Symeonidis N. and Zapfe H., 1982. Die Ausgrabungen in Pikermi-Chomateri bei Athen. Eine Dokumentation. Annalen des Naturhistorischen Museums in Wien, 84, 7-12.

Bohlin B., 1926. Die Familie Giraffidae. Palaeontologia Sinica, 4, 1-178.

Bouvrain G., 1978. *Protragelaphus theodori* n. sp. (Mammalia, Artiodactyla, Bovidae) du Miocène de Macédoine (Grèce). Géologie Méditerranéenne, 5, 229-236.

Bouvrain G., 1980. Le genre *Palaeoreas* (Mammalia, Artiodactyla, Bovidae), systématique et extension géographique. Paläontologische Zeitschrift, 54, 55-65.

Bouvrain G., 1992. Antilopes à chevilles spiralées du Miocène supérieur de la province gréco-iranien : Nouvelles diagnoses. Annales de Paléontologie (Vertébrés-Invertébrés), 78, 49-65.

Bouvrain G., 1997. Les Bovidés du Miocène supérieur de Pentalophos (Macédoine, Grèce). Münchner Geowissenschaftliche Abhandlungen, 34, 5-22.

Bouvrain G., 2001. Les bovidés (Mammalia, Artiodactyla) des gisements du Miocène supérieur de Vathylakkos (Grèce du Nord). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, 220, 225-244.

Dermitzakis M.D., 1976. Observations on the metapodials of *Hipparion* from Pikermi (Attica, Greece). Proceedings of the Koninklijke Akademie van Wetenschappen, 79 (1), 18-28.

Eisenmann V., Alberdi M.T., De Giuli C. and Staesche U., 1988. Methodology. In: Studying fossil horses, Woodburne M. and Sondaar P. (eds), Brill, Leiden, 1-71.

Gaudry A., 1855. Sur les premiers résultats de la mission qui lui a été confiée par l'Académie pour l'exploration du gîte fossilifère de Pikermi (Attique). (Extrait d'une lettre de M. A. Gaudry à M. le Secrétaire perpétuel). Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 41, 894-897.

Gaudry A., 1862-1867. Animaux fossiles et géologie de l'Attique. F. Savy, Paris, 475p.

Gentry A.W., 1971. The earliest goats and other antelopes from the Samos *Hipparion* fauna. Bulletin of the British Museum of Natural History (Geology), 20, 231-296.

Gentry A.W., Rössner G.E. and Heizmann E.P.J., 1999. Suborder Ruminatia. In: The Miocene land mammals of Europe, Rössner G.E. and Heissig K. (eds), Dr. Friedrich Pfeil, München, 225-258.

Geraads D., 1974. Les Giraffides du Miocène supérieur de la region de Thessalonique (Grèce). Doctorat de 3ème cycle, Université de Paris VI, 103p.

Geraads D., 1979. Les Giraffinae (Artiodactyla, Mammalia) du Miocène supérieur de la région de Thessalonique (Grèce). Bulletin du Muséum national d'Histoire naturelle, 1, 377-389.

Geraads D. and Güleç E., 1999. On some spiral-horned antelopes (Mammalia: Artiodactyla: Bovidae) from the Late Miocene of Turkey, with remarks on their distribution. Paläontologische Zeitschrift, 73, 403-409.

Geraads D., Spassov N. and Kovachev D., 2003. *Palaeoreas lindermayeri* (WAGNER, 1848) (Mammalia, Bovidae) from the upper Miocene of Bulgaria, and a revision of the species. Geodiversitas, 25, 405-415.

Heintz E., 1970. Les Cervidés villafranchiens de France et d'Espagne. Mémoires du Muséum National d'Histoire Naturelle, 22 (1, 2), 1-303, 1-206.

Kostopoulos D.S., 2005. The Bovidae (Mammalia, Artiodactyla) from the late Miocene of Akkaşdağı, Turkey. Geodiversitas, 27, 747-791.

Kostopoulos D.S., 2009. The Late Miocene Mammal Faunas of the Mytilinii Basin, Samos Island, Greece: New Collection. 14. Bovidae. Beiträge zur Paläontologie, 31, 345-389.

Koufos G.D., 1987a. Study of the Pikermi hipparions. Part I: Generalities and taxonomy. Bulletin du Muséum national d'Histoire naturelle, 9, 197-252.

Koufos G.D., 1987b. Study of the Pikermi hipparions. Part II: Comparisons and odontograms. Bulletin du Muséum national d'Histoire naturelle, 9, 327-363.

Koufos G.D., 2006. The Neogene mammal localities of Greece: faunas, chronology and biostratigraphy. Hellenic Journal of Geosciences, 41, 183-214.

Mecquenem R. de, 1925. Contribution à l'étude des fossiles de Maragha. Annales de Paléontologie, 14, 1-34.

Pilgrim G.E. and Hopwood A.T., 1928. Catalogue of the Pontian Bovidae of Europe in the Department of Geology. British Museum (Natural History), London, 106p.

Roussiakis S.J., 1996. Contribution to the study of the mammals of the classical locality of Pikermi. PhD Thesis, University of Athens, 259p. (in Greek).

Roussiakis S.J., 2009. *Prostrepsiceros* and *Protragelaphus* (Artiodactyla, Mammalia) from the Late Miocene locality of Chomateri (Attica, Greece). Annales de Paléontologie, 95, 181-195.

Roussiakis S.J., Theodorou G.E. and Iliopoulos G., 2006. An almost complete skeleton of *Metailurus parvulus* (Carnivora, Felidae) from the late Miocene of Kerassia (Northern Euboea, Greece). Geobios, 39, 563-584.

Spassov N. and Geraads D., 2004. *Tragoportax* PILGRIM, 1937 and *Miotragocerus* STROMER, 1928 (Mammalia, Bovidae) from the Turolian of Hadjidimovo, Bulgaria, and a revision of the late Miocene Mediterranean Boselaphini. Geodiversitas, 26, 339-370.

Theodorou G.E., 1997. Observations on the carpus and tarsus of *Hipparion* from Pikermi (Attica, Greece). Annales Géologiques des Pays Helléniques, 37, 921-980.

Theodorou G.E. and Nicolaides S.N., 1988. Stratigraphic horizons at the classic mammal locality of Pikermi, Attica, Greece. Modern Geology, 13, 177-181.

Woodward A.S., 1901. On the bone beds of Pikermi, Attica and on similar deposits in Northern Euboea. Geological Magazine, 8, 481-486.