Giraffidae (Mammalia, Artiodactyla) from the late Miocene of Akkaşdağı, Turkey

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KEY WORDS
Mammalia,
Giraffidae,
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ABSTRACT

A few dental and several postcranial giraffid remains from the late Miocene locality of Akkaşdağı (Central Anatolia, Turkey) have been identified as belonging to *Helladotherium* sp., *Palaeotragus rouenii* Gaudry, 1861 and *Samotherium* cf. *major* Bohlin, 1926. The comparison of the material with several Eurasian representatives of the three genera indicates a middle-late Turolian age.

MOTS CLÉS
Mammalia,
Giraffidae,
Palaeotragus,
Samotherium,
Helladotherium,
Miocène supérieur,
Turolien,
Akkaşdağı,
Anatolie Centrale,
Turquie.

RÉSUMÉ

Giraffidae (Mammalia, Artiodactyla) du Miocène supérieur d'Akkaşdağı, Turquie.

Quelques restes dentaires et postcraniens de giraffidés, provenant du Miocène supérieur de la localité d'Akkaşdağı (Anatolie centrale, Turquie) sont déterminés comme appartenant à *Helladotherium* sp., *Palaeotragus rouenii* Gaudry, 1861 et *Samotherium* cf. *major* Bohlin, 1926. La comparaison du matériel turc avec les représentants eurasiatiques de ces trois genres permet de le dater du Turolien moyen-supérieur.

INTRODUCTION

In contrast to the contemporaneous mammal associations of Eastern Europe, giraffids seem to be rare at the late Miocene locality of Akkaşdağı (Central Anatolia, Turkey; Kazancı *et al.* 1999). The available material of 24 identifiable specimens comes from 11 bone-pockets of a single stratigraphic horizon. The material labelled as AK comes from bone pockets excavated between 1997 and 2001 or from surface collection (AKK); this material is stored at the Natural History Museum in Ankara. A few specimens labelled GOK derive from the excavation led by Émile Heintz in 1971 and are preserved at the Muséum national d'Histoire naturelle in Paris.

Although insufficiently documented, three forms have been recognized: a large Sivatheriinae Zittel, 1893 ascribed to *Helladotherium* Gaudry, 1860, a small sized Palaeotraginae Pilgrim, 1911 referred to *Palaeotragus rouenii* Gaudry, 1861 and a larger form of the latter subfamily, similar to *Samotherium major* Bohlin, 1926 from Samos.

ABBREVIATIONS

Museums and localities

AeMNH	Aegean Museum of Natural History-Zimalis Foundation, Samos island, Greece;
AK (A, B, K, 1-14)	Akkaşdağı new collection;
BMNH	Natural History Museum, London;
DIT	Dytiko 3, Axios valley, Greece;
GOK	Akkaşdağı Heintz' collection;
KTA,B,D	Kemiklitepe A,B,D, Turkey;
LGPUT	Museum of the Geological Department, Aristotle University of Thessaloniki;
MGL	Musée cantonal de Géologie, Lausanne;
MNHN	Muséum national d'Histoire naturelle, Paris;
MTA-MA	Maden Tetkik ve Arama Museum (General Directorate of Mineral Research and Exploration, Natural History Museum), Ankara;
MTLA,B	Mytilinii-1 A and B, Samos, Greece;
NKT & NIK	Nikiti-1 & 2, Greece;
PIK	Pikermi, Greece;
RPl	Ravin de la Pluie, Axios valley, Greece;
RZO	Ravin des Zouaves-5, Axios valley, Greece;
VAT	Vathylakkos 3, Axios valley, Greece.

Measurements

DAP	anteroposterior diameter;
DT	transverse diameter;
H	height;
L	length;
W	width;
alv	alveolar;
art	articular;
diaph	diaphysis;
dist	distal;
lat	lateral;
max	maximal;
med	medial;
occl	occlusal;
prox	proximal.

SYSTEMATICS

Family GIRAFFIDAE Gray, 1821
Subfamily SIVATHERIINAE Zittel, 1893

Genus *Helladotherium* Gaudry, 1860

TYPE SPECIES. — *Helladotherium duvernoyi* (Gaudry & Lartet, 1856). Type locality: Pikermi, Greece.

Helladotherium sp.

MATERIAL EXAMINED AND MEASUREMENTS (in mm). — P3 left (AK7-29): L_{occl} = 34.0, W_{occl} = 26.0, W_{alv} = 38.5; M2 right (AK2-441): L_{occl} = 46.8, $W_{\text{max-anterior lobe}}$ = 44.0, $W_{\text{max-posterior lobe}}$ = 41.0; radius left (AK7-64): L_{max} = 580.0, DT_{prox} = 123.0, DAP_{prox} = 73.0, DT_{diaph} = 78.8, DAP_{diaph} = 60.0, $DT_{\text{dist-art}}$ = 101.3, $DAP_{\text{dist-art}}$ = 62.2; tibia right (AK7-129): L = 540.0, $DT_{\text{prox-max}}$ = 166.5, DAP_{prox} = 130+, DT_{diaph} = 74.5, DAP_{diaph} = 53, DT_{dist} = 106.2, DAP_{dist} = 82.4); part of calcaneus (GOK-200): $L_{\textit{sustentaculum tali}}$ = 167.0; talus (GOK-197): L_{lat} = 115.5, L_{med} = 99.3, DT_{dist} = 76; cubonavicular (AK7-101): DT_{max} = 100.0, DAP_{max} = 99.0; phalanx I (AK7-152): L = 114.0, DT_{prox} = 53.2, DAP_{prox} = 58.2, DT_{dist} = 47.2, DAP_{dist} = 35.3; (AK3-310): L = 109.2, DT_{dist} = 42.5, DAP_{dist} = 33.7; (GOK-201): L = 115.0, DT_{prox} = 52.5, DAP_{prox} = 56.3, DAP_{dist} = 41.2; phalanx II (AK7-35a): L = 62.5, DT_{prox} = 45.3, DAP_{prox} = 46.2, DT_{dist} = 40.8, DAP_{dist} = 44.5; (AK7-27): L = 65.4, DT_{prox} = 46.4, DAP_{prox} =

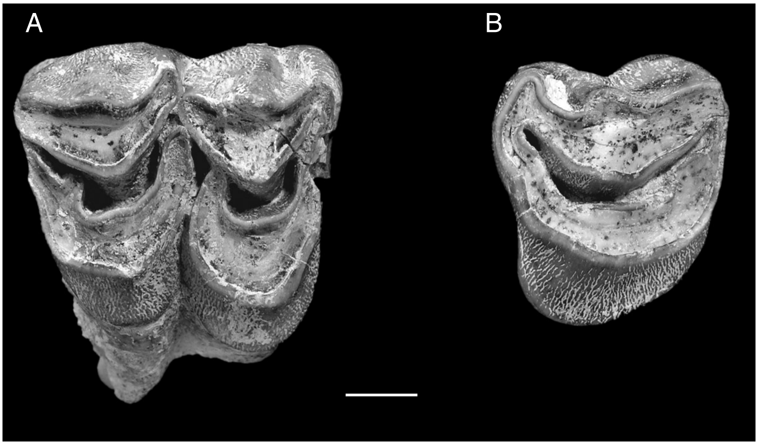

FIG. 1. — *Helladotherium* sp., Akkaşdağı, Turkey, occlusal view; **A**, M2 right; **B**, P3 left. Scale bar: 1.5 cm.

46.2, DT_{dist} = 43.5, DAP_{dist} = 44.5; phalanx III (AK7-35b): DT_{art} = 35.0, H_{art} = 58.6.
Provisionally ascribed: metacarpal III+IV of immature individual (AK7-65): DT_{prox} = 87.5, DAP_{prox} = 55.0, DT_{diaph} = 50.0, DAP_{diaph} = 42.5.

DESCRIPTION AND DISCUSSION (FIGS 1-4)
The cranial elements are limited to two isolated teeth with finely rippled enamel and barely visible cingulum (Fig. 1). The P3 is large with strong parastyle and well developed paracone rib. The internal side of the labial crescent is weakly divided into paracone and metacone. The occlusal surface looks sub-quadrangular with an antero-lingual protuberance of the lingual wall and a clear hypoconal spur on the central cavity (Fig. 1). The M2 has simple morphology with strong parastyle, slim but well built mesostyle, weak metastyle and strong paracone rib. The lingual wall of the protocone is rounded, while the hypocone is slightly narrower and more angular lingually. The anterior flange of the protocone is connected with the parastyle; its posterior flange is short, curves anteriorly and do not confine the posterior flange of the hypocone. A relatively strong hypoconal spur is present (Fig. 1).

The absence of cranial or more complete dental material makes the identification of the largest giraffid from Akkaşdağı quite difficult. Similar sized Turolian forms are usually referred to the genera *Samotherium* Forsyth-Major, 1888 and *Helladotherium* Gaudry, 1860 which however, belong to different phylogenetic lineages, the Palaeotraginae and Sivatheriinae respectively (Bohlin 1926; Hamilton 1978; Geraads 1986). Geraads & Güleç (1999) mention that the type specimen of *Helladotherium duvernoyi* Gaudry, 1860, type species of the genus, belongs to a female individual of a different genus and, recalling Matthew's statement (Matthew 1929: 550 *fide* Hamilton 1978: 218) they suggest a provisional synonymy of *Helladotherium* with *Bramatherium* Falconer, 1845. Although quite possible, this synonymy is not yet formally founded and, following Hamilton (1978), we shall continue to use *Helladotherium* as a valid taxon.

According to Bohlin (1926) and Geraads (1974), *Helladotherium* differs from *Samotherium* in the larger premolar row relatively to the molars, the unmolarized p3, the less developed styles on the cheek teeth and the more massive limbs.

At first sight the large P3 from Akkaşdağı, significantly larger than usually recorded in *Samotherium* and notably large comparatively to M2, indicate the presence of *Helladotherium* (Fig. 2). In contrast to the studied specimen and *Helladotherium*, the P3 of *Samotherium* is more rounded and presents stronger metastyle and more centrally placed paracone-metacone pillar. The M2 structure (thin mesostyle, posterior

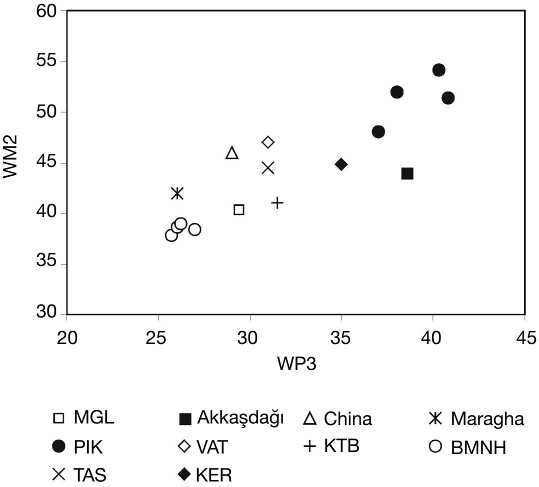

FIG. 2. — Scatter diagram “Width of P3 against Width of M2” of *Helladotherium* sp., Akkaşdağı, Turkey (■) in comparison with *Helladotherium duvernoyi* from Kerassia (KER), Pikermi (PIK, several collections); *Samotherium major* from Vathylakkos (VAT), Kemiklitepe B (KTB), Taşkınpaşa (TAS); *Samotherium boissieri* from Samos (MGL and BMNH collections); *S. sinense* (China) and *S. neumayri* (Maragha) (data from Bohlin 1926; Şenyürek 1954; Geraads 1974, 1994; Iliopoulos 2003; and pers. data).

FIG. 3. — *Helladotherium* sp., Akkaşdağı, Turkey, anterior view; **A**, left radius AK7-64; **B**, right tibia AK7-129. Scale bar: 5 cm.

flange of the protocone, presence of hypoconal spur, etc.) also differentiates the studied specimen from *Samotherium*, supporting close relationships with Gaudry’s genus. However, the available M2 appears relatively narrower than that of the type species *Helladotherium duvernoyi* from Pikermi (MNHN, BMNH, LGPUT) and closer to the Maragha (Iran; MNHN, BMNH) and Kerassia (Greece; Iliopoulos 2003) samples.

Although more robust, the dimensions of the postcranials of *Helladotherium* are usually hardly distinguished from those of the large samotheres (e.g., *S. major* Bohlin, 1926 and *S. sinense* Bohlin, 1926). The limb proportions of the studied specimens from Akkaşdağı are placed between those of *Samotherium* and *Helladotherium*, being closer to the second genus.

Differently from *Samotherium boissieri* Forsyth-Major, 1888 and *S. major*, the proximal articulation of the preserved metacarpal, provisionally ascribed to *Helladotherium*, presents a large synovial fossa, which opens widely towards the caudal face. This character strongly recalls *Helladotherium* from Pikermi but also *Samotherium sinense* (Bohlin 1926: fig. 103), while the immaturity of the individual may influence the fossa pattern (Geraads pers. comm. 2004). Regarding the absolute dimensions, this young individual falls, however, within the range of large samotheres, indicating probably an even larger and stouter adult animal, hence, closer to those of *Helladotherium*.

The rectangular epiphyses of the complete radius AK7-64 are not significantly wider than the shaft (Fig. 3A), the lateral tuberosity is weak, the radial tuberosity is placed below the medial proximal articular surface, the antero-lateral corner of the proximal part forms an almost right angle, the radial styloid process is more projected downwards than the ulnar one, the shallow groove of the *extensor capri rarialis* muscle is defined by two blunt crests of more or less equal length and it is symmetrically located above the medial ulnar ridge, the groove of the *abductor digiti I longus* muscle is shallow and located rather anteriorly than medially, the anterior margins of the distal articular facets are low, the anterior part of the scaphoid facet is rather quadrangular with flat anterior border bended medially, the anterior part of the lunar facet is spindle-shaped with clear posterior margin, the lateral crest of the lunar is shorter, less prominent and more oblique than the medial one, the articular surface for the cuneiform is rather narrow and the transverse crest of the posterior face is weakly developed (Fig. 4).

The tibia (AK7-129, Fig. 3B) is relatively long and moderately robust ($DTdiaph \times 100/L = 13.5$). The tibial crest is relatively short, laterally located, not very prominent and with wide-shallow tuberosity. Consequently, in the upper part of the anterior face the restricted tibial sulcus is oval-shaped and not very deep. The tibial spine is relatively high. A small facet for the fibula is present at the lateral side. The muscle imprint at the posterior side of the bone is located in the medial part of the diaphysis. The antero-lateral tuberosity of the distal part is weakly developed. Both the medial malleolus and the lateral malleolar facets of the distal epiphysis are strong.

The dorsal and plantar edges of the calcaneus are rectangular. The large talus has strongly assymetrical proximal trochlea, the scar for the external tendon of the cubonavicular is missing and the limit between the articular facets for the calcaneum and the cubonavicular is well marked. The cubonavicular is almost square with extremely developed caudal tuberosity, coating the proximal articular surface. The posterior metatarsal facet is present. The first phalanx is large and robust.

This set of postcranial morphological characters rules out the association with *Samotherium* and place the Akkaşdağı form closer to *Helladotherium* (Bohlin 1926; Geraads 1974; Iliopoulos 2003; Iliopoulos pers. comm. 2004; pers. data). Nonetheless, the observed morphological features are not fully identical to those of the Pikermian form (BMNH sample), suggesting either a larger intraspecific variability for Gaudry's species or – less possibly – a distinction at a higher taxonomic level.

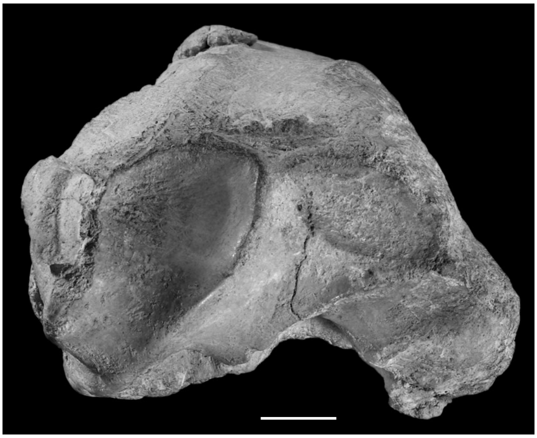

FIG. 4. — *Helladotherium* sp., Akkaşdağı, Turkey, distal articulation of radius AK7-64. Scale bar: 2 cm.

In the absence of adequate data we refer at the moment this form to *Helladotherium* sp.

Subfamily PALAEOTRAGINAE Pilgrim, 1911

Genus *Palaeotragus* Gaudry, 1861

TYPE SPECIES. — *Palaeotragus rouenii* Gaudry, 1861. Type locality: Pikermi, Greece.

Palaeotragus rouenii Gaudry, 1861

MATERIAL EXAMINED AND MEASUREMENTS (in mm). — Upper toothrow (AK3-298): LP2-M3 = 123.0, LP2-P4 = 53.0, LM1-M3 = 72.7, LP2 = 15.5, WP2 = 15.3, LP3 = 15.8, WP3 = 18, LP4 = 17.1, WP4 = 17.1, LM1 = 23.1, WM1 = 22.5, LM2 = 24.8, WM2 = 26, LM3 = 26.5, WM3 = 25.8; lower toothrow (AK12-78): Lp2-m3 ≈ 129.0, Lp2-p4 ≈ 49.0, Lm1-m3 = 77.0, Lp3 = 17.0, Wp3 = 10.1, Lp4 = 18.5, Wp4 = 12.2, Lm1 = 22.5, Wm1 = 15.4, Lm2 = 24.5, Wm2 = 16.4, Lm3 = 30.5, Wm3 = 15.3; proximal part of radius (AK5-392): $DT_{prox} = 88.2$, $DAP_{prox} = 50.0$; part of metacarpal III+IV (AK6-86): $DT_{prox} = 65.0$, $DAP_{prox} = 48.0$, $DT_{diaph} = 34.4$, $DAP_{diaph} = 41.0$; (AK6-87): $DT_{prox} = 56.6$, $DAP_{prox} = 38.4$; tibia (AK4-236): $DT_{dist} = 67.5$, $DAP_{dist} = 51.7$; talus (AK3-197): $L_{lat} = 76.2$, $L_{med} = 69.0$, $DT_{dist} = 50.0$; (AK5-184): $L_{lat} = 80.0$, $L_{med} = 72.0$, $DT_{dist} = 49.5$.

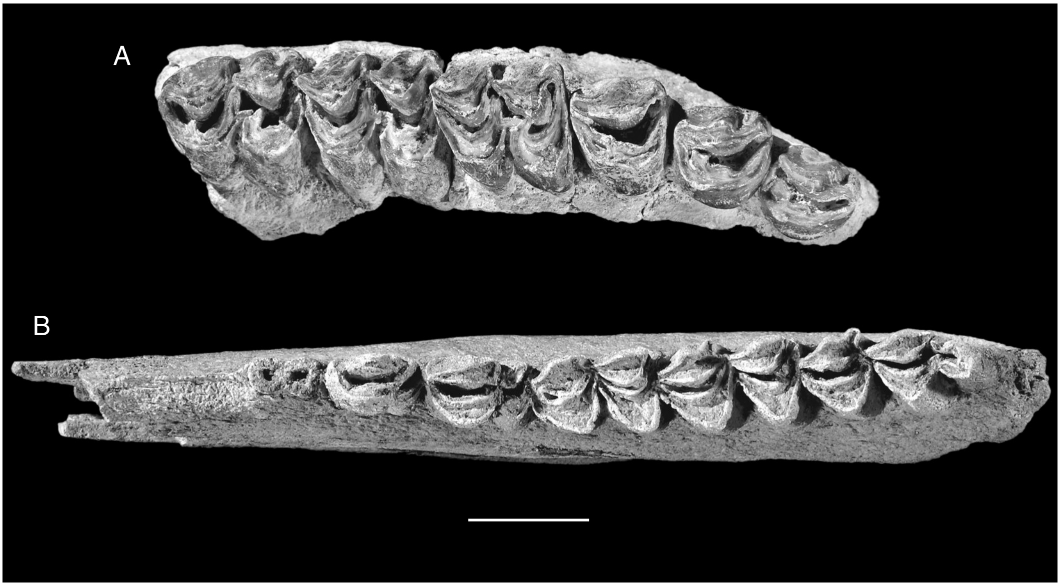

FIG. 5. — *Palaeotragus rouenii* from Akkaşdağı, Turkey, occlusal view; **A**, upper dentition; **B**, lower dentition. Scale bar: 2 cm.

DESCRIPTION (FIGS 5; 6)

The teeth are small, brachyodont and with finely rippled enamel (Fig. 5). The upper premolar row represents 72.9% of the molars, while the same ratio is estimated about 63-65 for the lower dentition.

Upper toothrow (Fig. 5A)

P2 is simple with a rudimentary hypoconal spur, directed strongly backwards. The parastyle is well developed. The paracone rib is strong and is placed anteriorly. A weak cingulum is present anterolingually (Fig. 5A). P3 is morphologically similar to P2, but with stronger hypoconal spur, tending to form a hypoconal islet. The parastyle and the lingual cingulum are also stronger than in P2. P4 is more symmetrical than P2 and P3. In occlusal view there is a well formed hypoconal islet (Fig. 5A). The paracone rib is strong and situated centrally on the labial wall, while both the parastyle and the metastyle are less developed. A weak cingulum appears along the lingual surface. All the molars have moderate to well developed styles and ribs. The posterior flange of the paracone does not confine with the mesostyle. The protocone of M1, 2 is angular and slightly constricted lingually (Fig. 5A). A strong hypoconal spur is present in all upper molars and especially in M3, which also bears a weak protoconal fold. The cingulum is weakly developed both on the lingual and labial faces. A very short basal pillar is also present.

Lower toothrow (Fig. 5B)

p3 is highly molarized with strongly elongated metaconid, parallel to the anteroposterior axis of the tooth and extremely shortened talonid. The elongated endoconid is independent from the metaconid in early wear. The reduced endostylid is obliquely settled. Labially, a well developed furrow separates the bulgy hypoconid from the strong protoconid. The parastylid is well defined (Fig. 5B). p4 is also molariform (Fig. 5B). Its metaconid is long and the parastylid thinner than in p3. The endoconid is well distinct and oblique. The endostylid is longer than in p3 and placed lingually. On the labial wall, the trigonid is distinguished from the bulgy talonid by a deep furrow. The first molar shows a weak anterior fold. A rudimentary basal pillar, a well developed metaconid and a strong metastylid (especially on the m2, 3) are present in all molars. The third lobe of m3 is relatively small, elliptical and bicuspid (Fig. 5B).

Postcranials

The poor postcranial material ascribed to this form does not allow major observations. The preserved part of the metacarpal clearly shows dolichopodial morphology. The external articular groove of the distal trochlea of the tibia is shorter than the internal one. The plantar face of the talus lacks the depression for the external tendon of the cubonavicular and its external face is quite flat.

DISCUSSION

Palaeotragus is a well known genus from the so-called Greco-Iranian province and Eurasia in general, while its distribution area extends also to Africa. Nonetheless, the phylogenetic relationships among the referred late Miocene species are not always clear and the species synonymy appears sometimes to be confused (see Bohlin 1926; Bosscha-Erdbrink 1977; Hamilton 1978; Geraads 1986, 1994; Gentry *et al.* 1999). Overlooking the palpable nomenclature problems, it is evident that most of the Turolian *Palaeotragus* could be grouped in two size categories:

– a group of small-sized and slender-limbed forms, represented mainly by the type species of the genus *P. rouenii* Gaudry, 1861 from Pikermi (Greece) and its allies; and

– a group of larger and stouter forms, principally represented by *P. coelophrys* (Rodler & Weithofer, 1890), originally described from Maragha (Iran).

The contemporaneous *Palaeotragus microdon* (Koken, 1885) from China (mainly from Loc. 116 of Kansu; Bohlin 1926) is considered to be very similar to *P. rouenii* (Bohlin 1926; Bosscha-Erdbrink 1977; Geraads 1986). Nevertheless, *P. microdon* presents ossicones in both sexes while *P. rouenii* females appear to be "hornless" (Bohlin 1926; Geraads 1974). Moreover, the lower dentition of *P. microdon* presents a comparatively shorter premolar row than that of *P. rouenii* (the index [premolar/molar row length]% ranges between 57-62 [n = 7] in the first species and between 63-73 [n = 5] in the second one; Fig. 6) and its limb proportions are slightly different (more slender limb bones, stouter tali, etc.). Therefore, we regard *P. microdon* as a distinct species.

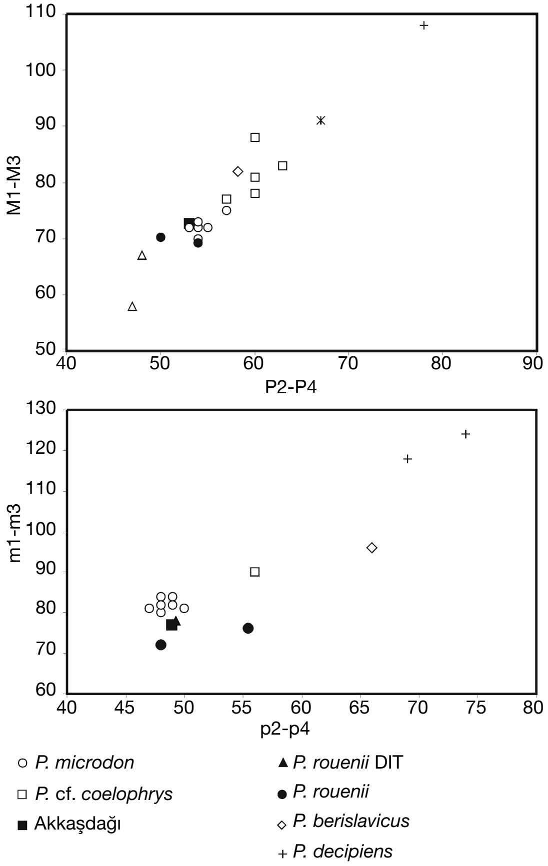

FIG. 6. — Scatter diagram "Length P2-P4 against Length M1-M3 (p2-p4/m1-m3)" of *Palaeotragus rouenii*, Akkaşdağı, Turkey (■) in comparison with other late Miocene *Palaeotragus* species (data from Bohlin 1926; Geraads 1974, 1978; and pers. data). Abbreviation: **DIT**, Dytiko 3, Axios valley, Greece.

Except for the ossicone and skull morphology (which anyway are not available in the Akkaşdağı collection) *P. coelophrys* differs from *P. rouenii* in its larger size and dental dimensions (Fig. 6), simpler dental morphology, more robust and less dolichopodial limbs (Bohlin 1926; Geraads 1974, 1978). Moreover, the p3 of *P. coelophrys*

FIG. 7. — *Samotherium* cf. *major*, Akkaşdağı, Turkey, right talus AK7-28, posterior view. Scale bar: 4 cm.

has an independent metaconid, while the p3 of *P. rouenii* presents a strong molarization on the lingual wall.

The small size, the molarized p3 and p4, the bi-cuspid talonid of m3, the weakly developed cingula and basal pillars on the molars and the slender limbs of the Akkaşdağı form rule out the association with *P. coelophrys* and related forms, and match *P. rouenii* and *P. microdon*. Moreover, the "premolar/molar ratio" values for the Akkaşdağı specimens are larger than those of *P. microdon* and within the known range of *P. rouenii*.

The original comparison with *P. rouenii* from RPl, NKT, DIT (Greece; LGPUT), PIK (Greece; MNHN, BMNH), Samos (Greece; MGL, BMNH, AeMNH) and KTD (Turkey; MNHN), does not exhibit important morphological or metrical differences (Fig. 6). Nevertheless, the accessory features of the dentition (labial and lingual cingula, basal pillars, spurs, etc.) seem to become less significant in the younger samples of the species. Although the value of this "smoothening" cannot be systematically or chronologically appreciated because of the insufficient data, the Akkaşdağı *P. rouenii* seems to be closer to the later Turolian forms than to the early ones.

Genus *Samotherium* Forsyth-Major, 1888

TYPE SPECIES. — *Samotherium boissieri* Forsyth-Major, 1888. Type locality: Samos, Greece.

Samotherium cf. ***major*** Bohlin, 1926

MATERIAL EXAMINED AND MEASUREMENTS (in mm). — Distal part of tibia (AK2-506): DT_{dist} = 106.6, DAP_{dist} = 76.0; part of tibia (AK4-203): DT_{diaph} = 70.0, DAP_{diaph} = 52.5; talus (AK7-28): L_{lat} = 109.5, DT_{dist} = 74.0; (GOK-198): L_{lat} = 105.2, L_{med} = 92.0, DT_{dist} = 68.6; cubonavicular (AK11-65a): DT_{max} = 88.7, DAP_{max} = 77.0.

DESCRIPTION AND DISCUSSION (FIG. 7)

The presence of a second large giraffid in Akkaşdağı is poorly but certainly documented by a few postcranial elements. Although the absolute dimensions of the available specimens are slightly smaller than those of *Helladotherium*, their proportions and some morphological characters clearly separate them from this genus: the lateral malleolus surface of the distal tibia is reduced (large in *Helladotherium*); the proximal trochlea of the talus (Fig. 8) is moderately unequal (clearly asymmetrical in *Helladotherium*); the proximolateral tuberosity of the calcanear facet is weak (usually strong in *Helladotherium*); the medial ridge of the plantar trochlea is continuous (presence of notch in *Helladotherium*) and presents a large, shallow and round imprint at its lateral base (absent in *Helladotherium*) (Fig. 7); the cubonavicular is longer transversally than anteroposteriorly (squarish in *Helladotherium*). This set of morphological features is indicative of *Samotherium* (Bohlin 1926; Geraads 1974; pers. data). The type species *Samotherium boissieri* Forsyth-Major, 1888 (Geraads 1994), originally known from the late Miocene deposits of Samos island (Greece), appears to present a great size variability. Based on the works of Bohlin (1926) and Şenyürek (1954), Geraads (1994) refined the specific status of *Samotherium* from Samos, recognizing two species, *S. boissieri* Forsyth-Major, 1888 and *S. major* Bohlin, 1926, the latter one considered as a successor of the former. We also consider the classical *Samotherium* stock from Samos as certainly bi-specific. Study of the Forsyth-Major collections (MGL, BMNH), as well as of the new material collected during the last years (Koufos *et al.* 1997; and pers. data) allow us to recognize two forms of certainly different stratigraphic origin, similar but not identical in cranial morphology and different in size. According to the new available magnetostratigraphic data (Kostopoulos *et al.* 2003), the fossiliferous levels yielding *S. boissieri* ("Stefano", Qx, Q4) are certainly older than those with *S. major* ("Andriano", Q1).

In comparison to the known *Samotherium* species, the Akkaşdağı form appears dimensionally closer to the large samotheres referred to *S. major* (Fig. 8) from the upper horizons of Samos, VAT, and KTA,B (Geraads 1978, 1994) and it could be referred to as *Samotherium* cf. *major*.

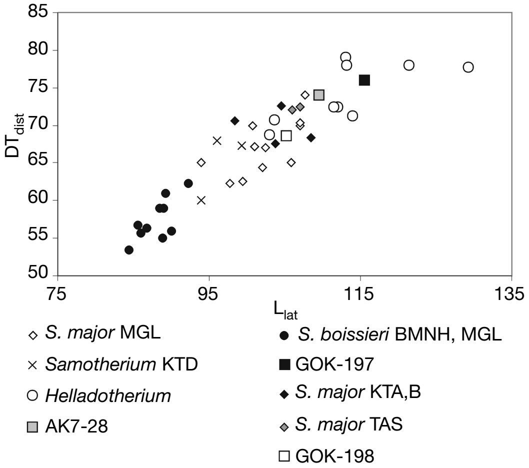

FIG. 8. — Scatter diagram "L_{lat} against DT_{dist}" of talus of *Helladotherium* sp., Akkaşdağı, Turkey (GOK-197) and *Samotherium* cf. *major*, Akkaşdağı, Turkey (AK7-28, GOK-198) in comparison with *Helladotherium* from several sites, *Samotherium major* from Samos (MGL collection), Kemiklitepe A,B (KTA,B), Taşkınpaşa (TAS), *Samotherium* sp. from Kemiklitepe D (KTD) and *Samotherium boissieri* from Samos (BMNH and MGL collections) (data from Şenyürek 1954; and pers. data).

BIOCHRONOLOGY AND CONCLUSIONS

Regarded as a common element of the late Miocene faunas from the Greco-Iranian province, giraffids often constitute a quite monotonous assemblage of relatively low biochronological value. Although the family is poorly documented and rather sporadically present in Turkey, all described forms had already been mentioned from several localities of late Miocene age (Şenyürek 1952; Ozansoy 1965; Sickenberg 1975; Geraads 1994).

The first appearance of *Helladotherium* is probably dated at the end of Vallesian-beginning of Turolian (NKT, NIK, RZO, Prochoma) and later on (MN12) the genus becomes more abundant, occupying a wide territory from Western Europe to India (Bohlin 1926; Bosscha-Erdbrink 1977; Gentry *et al.* 1999; NOW database 2003). Several Turkish localities of middle-late Turolian age such as Çobanpınar, Balçıklidere (= Kemiklitepe), Eski Bayırköy, Gökdere and Kavakdere exhibit the presence of *Helladotherium/Bramatherium* (Sickenberg 1975; Geraads & Güleç 1999; NOW database 2003) but as the systematic value of the genus is still under discussion and the Akkaşdağı material few for certain conclusions, the presence of the genus cannot provide a more accurate means of dating.

Palaeotragus rouenii is also widely distributed in time and space. The species or a closely related form (*P. pavlowae* Godina, 1979; *P. moldavicus* Godina, 1979) probably appeared during late Vallesian (Eşme-Akçaköy, RPl, NKT, Poksheshty) and became firmly established in the early Turolian faunas of the peri-Mediterranean region (Grebeniki, Nova Elizavetovka, RZO, KTD). Its maximum geographic extension took place during MN12 and it still exists in MN13 (DIT) (Geraads 1994; Kostopoulos *et al.* 1996; Gentry *et al.* 1999; NOW database 2003). The dental characters of the Akkaşdağı *P. rouenii* indicate closer affinities to the middle-late Turolian forms of the species, suggesting a similar age for the locality.

The common late Miocene large giraffid *Samotherium* presents a vast geographic distribution from China to the Eastern Europe. In eastern Mediterranean small-medium-sized forms appeared as early as in early Turolian (MN11; KTD, Samos, Maragha) and replaced later by larger forms, namely *S. major* (MN12; VAT, Samos, KTA,B, Taşkınpaşa, etc.). The presence of *Samotherium* in the latest Turolian-earliest Ruscinian (MN13/14) locality of Maramena (Greece; Koehler *et al.* 1995) is questioned and it seems that the genus falls into decline during late Turolian. The large samothere from Akkaşdağı shows clear metrical similarities with *Samotherium major* from Samos (upper fossiliferous levels), VAT (Greece), KTA,B and Taşkınpaşa (Turkey), indicating an MN12 age.

Although the giraffid association of *Palaeotragus*, *Samotherium* and *Helladotherium* is not unexpected, it is not so common in the faunal record. In Maragha (Iran), *Helladotherium* is associated with *Palaeotragus coelophrys*, while *Samotherium* is represented by a medium-sized form. The old collection from Samos also includes both *Samotherium* and *Helladotherium* in association with *P. rouenii* and the larger, badly known *P. quadricornis* Bohlin, 1926 but the material comes from at least four stratigraphic horizons, while *Samotherium* is represented by two distinct forms and consequently, the combination at specific level cannot be fully controlled (Bosscha-Erdbrink 1977; Solounias 1981; Geraads 1994; Kostopoulos *et al.* 2003; NOW database 2003). *P. rouenii* and *Helladotherium duvernoyi* are also present in the classic fauna of Pikermi, but the occurrence of a samothere in this locality has been not yet proved. The new collection from Samos shows that in the MN12 fauna coming from the upper fossiliferous horizons (MTLA,B; Koufos *et al.* 1997) *P. rouenii* coexists with *Helladotherium* and *Samotherium major*. A very similar condition exists in the MN12 sites of Kerassia (Greece, Iliopoulos 2003), Kemiklitepe A,B (= Balçıklıdere, Turkey, Sen pers. comm. 2004; Geraads 1994) and probably in Taraklia (NOW database 2003).

In conclusion, the giraffid assemblage of Akkaşdağı rather indicates a late middle Turolian age (MN12) which is in agreement with the radiometric dating data provided by Karadenizli *et al.* (2005).

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