LATE MIOCENE RHINOCEROTIDS (MAMMALIA) FROM YULAFLI (ÇORLU-THRACE/TURKEY)

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ABSTRACT - New Rhinocerotidae remains from the Upper Miocene in Yulafli (Çorlu-Thrace/Turkey) include *Aceratherium incisivum* KAUP, 1832, *Acerorhinus zernowi* (BORISSIAK, 1914) and *Dihoplus schleiermacheri* (KAUP, 1832). *A. incisivum* and *D. schleiermacheri* are first documented in Turkey. *A. zernowi* is already known in Turkey but is first described from Yulafli. This faunal assemblage indicates a Turolian (MN 11-MN 12) age. *A. incisivum* and *D. schleiermacheri* are consistent with a European paleobiogeography. The presence of *A. zernowi* in Thrace indicates a paleobiogeographical crossroad from Anatolia to Europe. © 2001 Éditions scientifiques et médicales Elsevier SAS

KEYWORDS: RHINOCEROTIDAE, LATE MIOCENE, THRACE, TURKEY.

RÉSUMÉ - Les restes de Rhinocerotidae nouvellement trouvés dans la faune de Yulafli (Çorlu-Thrace/Turquie) sont *Aceratherium incisivum* KAUP, 1832, *Acerorhinus zernowi* (BORISSIAK, 1914) et *Dihoplus schleiermacheri* (KAUP, 1832). Les espèces *A. incisivum* et *Dihoplus schleiermacheri* sont trouvées pour la première fois en Turquie. Alors que *A. zernowi* est une espèce déjà connue en Turquie, elle est nouvelle pour Yulafli. Toutes ces espèces prouvent que la faune de Yulafli date du Turolien (MN 11- MN 12). *A. incisivum* et *D. schleiermacheri* sont des espèces d'origine européenne. La présence d'*A. zernowi* démontrée en Thrace indique l'existence d'un passage entre l'Anatolie et l'Europe. © 2001 Éditions scientifiques et médicales Elsevier SAS

MOTS-CLÉS: RHINOCEROTIDAE, MIOCÈNE SUPÉRIEUR, THRACE, TURQUIE.

INTRODUCTION

The Anatolian rhinoceroses are studied by Sen (1970), Heissig (1974, 1975, 1976), Fortelius (1990), Saraç (1987, 1994), Geraads (1994) and Kaya (1993, 1994). The Yulafli fauna (Çorlu - Thrace/Turkey) (Fig. 1) was first described by Saraç (1987) to be characterised by *Hipparion* sp., *Chilotherium* sp. (isolated P3, P4, and M1) and *Palaeotragus* sp. (astragalus).

New mammalian fossils in large amounts and with good preservation quality were collected from the Yulafli sand quarry in 1998. The fauna includes *Ursavus* sp. (lower mandible), *Hipparion* sp. (isolated teeth and limb bones), *Aceratherium incisivum* KAUP, 1832, *Acerorhinus zernowi* (BORISSIAK, 1914), *Dihoplus schleiermacheri* (KAUP, 1832), *Deinotherium gigantissimum* STEFANESCU, 1892 (lower mandible, isolated upper teeth P3-4, M1-2, tusks and limb bones), *Tetralophodon longirostris* (KAUP, 1832) (isolated teeth and lower mandible), *Microstonyx erymanthius* (ROTH & WAGNER, 1854) (symphsis region) and *Palaeotragus* sp. (4 Mc-III, radius, ulna, calcaneum, tibia and Mt-III). The rhinocerotid remains are the objective of this study.

The Yulafli fauna is comprised by the Middle to Late Miocene (Saraç 1987) Ergene formation (Fig. 2). This formation consists primarily of yellowish gray, sandy to muddy fluvial deposits, and rests unconformably on the Sarmatian (Rückert-Ülkümen 1990) Danisment formation. The mammalian fossils occur in a channel-filling sand horizon of the Ergene formation.

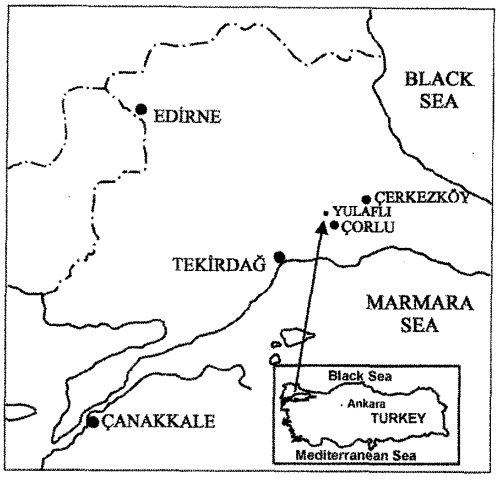

FIGURE 1 - Location map. *Carte de localisation.*

Terminology and taxonomy follow Heissig (1972, 1989). Dental measurements are according to Heis-

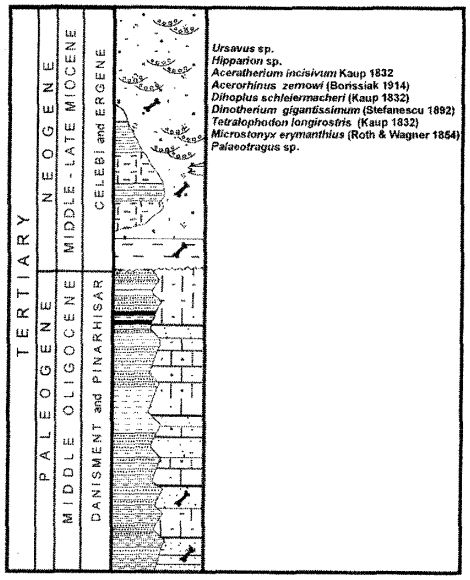

FIGURE 2 - Generalized stratigraphic section after Saraç (1987). *Colonne stratigraphique généralisée d'apres Saraç (1987).*

sig (1975) and Fortelius (1990). Measurements are given in mm. The material is deposited in the Natural History Museum (Ege University-Izmir/Turkey).

Abbreviations: NHM, Natural History Museum-Izmir/Turkey; ÇY Çorlu-Yulafli; BL buccal length; LL lingual length; MB mesial breadth; DB distal breadth; BH buccal height; W dia diagonal width; P/p, M/m, D/d, I/i for upper and lower teeth.

SYSTEMATIC PALEONTOLOGY

Order PERISSODACTYLA Owen, 1848
Family RHINOCEROTIDAE Gill, 1872
Subfamily ACERATHERINAE Dollo, 1885
Tribe ACERATHERINI Dollo, 1885
Genus ***Aceratherium*** KAUP, 1832

Aceratherium incisivum KAUP, 1832
Figs 3.1-3; 4.1-3

Material - Skull with right and left P1-M3 (1988-ÇY/1); left juvenile maxilla with DP2-DP4, erupting M1 (1988-ÇY/2); right juvenile mandible with dp2-dp4 (1988-ÇY/4); proximal part of left radius (1988-ÇY/10).

Description

The skull - The skull (1988-ÇY/1) is slightly distorted along the midline. The top of the skull is shifted towards the right, and the right toothrow towards the left. The right toothrow has a lower level than the left toothrow, to be related to distortion. An adult individual is apparent. There is no indication of a frontal or nasal horn on the skull. A part of the right maxilla and both premaxillae are broken away. In lateral view, the profile of the skull is flat. It becomes gradually higher from the front to the rear. In dorsal view, the roof of the skull is lozenge-shaped, and narrows backward. The parietal crests are separated by the sagittal plane.

The nasals are moderately long and flat. They extend backwards above the front of the first premolars. The nasals become narrower from the back to the front, and taper at the end. The tip of the nasals is in a somewhat high position. The lateral sides of the nasals are transversally convex. On the dorsal surface the suture between the nasals is distinct. The lower surface of the nasals is convex along the median valley. In lateral view, the nasal notch is deep and quadrate-shaped. Its posterior border is situated above the boundary between P4 and M1. There are two infraorbital foramina. The larger one is situated behind the nasal notch, and above P4. The smaller infraorbital foramen is located below the larger one. The anteorbital area is smooth, and no facial crest can be distinguished. The zygomatic arches are strongly structured and deep.

The frontal is flat and slightly concave, and narrows backwards. It is broadest at the supraorbital processes. The suture between the nasals and the frontals consists of two composite anteriorly concave lines. The orbits are in a moderately high position, just below the frontal. The anterior border of the orbit is above the anterior part of M2. The supraorbital processes are well developed.

The occipital region is broken away. The postglenoid processes are moderately long, and curve anteriorly and inwards. The joint surfaces with the mandible are flat and oval-shaped. The tip of the posttympanic process is broken. However, it is clearly in contact with the postglenoid process. The condyles are oval-shaped and oblique in orientation.

Upper Teeth - All the teeth are covered with cement on the labial surface. The length of premolars is equal in size to that of molars (Tab. 1).

	P1	P2	P3	P4	M1	M2	M3
BL	19.0	28.5	32.0	34.0	40.5	43.5	49.0
LL	18.0	27.0	31.5	30.0	37.0	38.5	49.0
MB	13.5	41.0	50.0	53.5	54.8	54.2	47.0
DB	17.5	41.6	51.0	51.0	49.6	49.9	34.0
BH	7.0	17.0	16.0	19.0	19.0	23.0	24.0
W (dia)							49.0

Length of the toothrow excl. P1	220
Length of the toothrow incl. P1	235
Length of M1-M3	124
Length of P2-P4	101
Length from occiput to tip of nasals	(485)
Distance from nasal notch to the front of the orbit	73
Least distance between parietal crests	41
Width over the postorbital processes of the frontal	18
Height of the zygomatic arch at the middle	71
Zygomatic width of the skull	290
Zygomatic depth of the skull	252
Height of the skull (Guérin 1980, 25)	140
Distance between left P2- right P2	(64)
Distance between left M3-right M3	86
Interior distance of the condyli	38
External width over the condyli	111
Basal width of nasals (at the nasal notch)	92
Nasal length	148

TABLE 1 - Measurements of skull and teeth of *A. incisivum* (1988-ÇY/1). *Mesures du crâne et de la denture supérieure d'*A. incisivum.

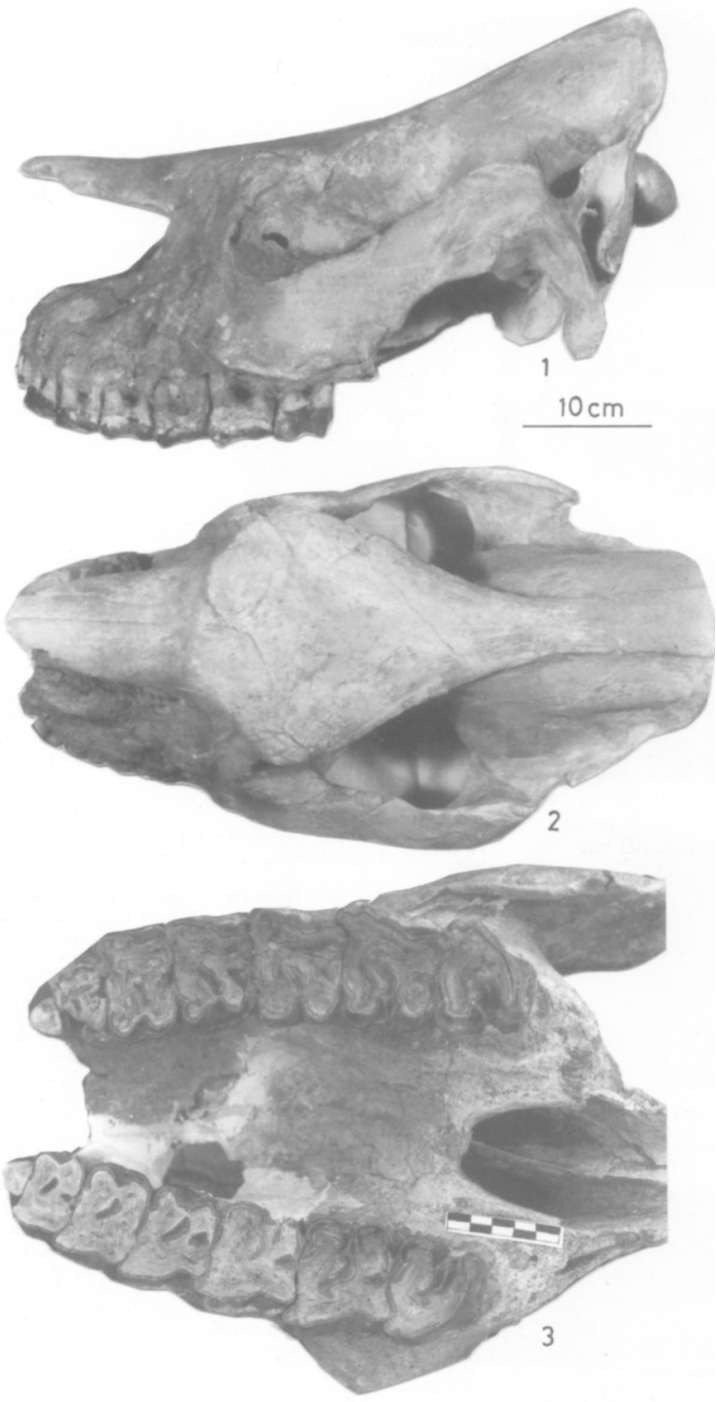

FIGURE 3 - **1-3.** *Aceratherium incisivum* KAUP, 1832. **1**. Skull, with right and left P1-M3 (1988-ÇY/1), lateral view. **2.** Same specimen, dorsal view. **3**. Same specimen, occlusal view. ***1-3***. Aceratherium incisivum *KAUP, 1832 , crâne muni de P1-M3 droite et gauche (1988-ÇY/1). **1**. Vue latérale. **2**. Vue supérieure. **3**. Vue occlusale.*

Premolars - P1 is small and triangular-shaped. The occlusal surface shows no more pattern due to strong wear. P2-P4 are quadrate-shaped, large and structurally similar to each other. The posterior premolars are semimolariform. The labial wall of the teeth is slightly convex, and is devoid of prominent styles. Anterior and posterior protocone valleys are developed only on P4. The parastyle valley is shallow and short. The medisinus is sigmoidally curved. Protoloph and metaloph are united with the lingual bridge, and their breadths are equal in size. The lingual bridge is higher than the lingual

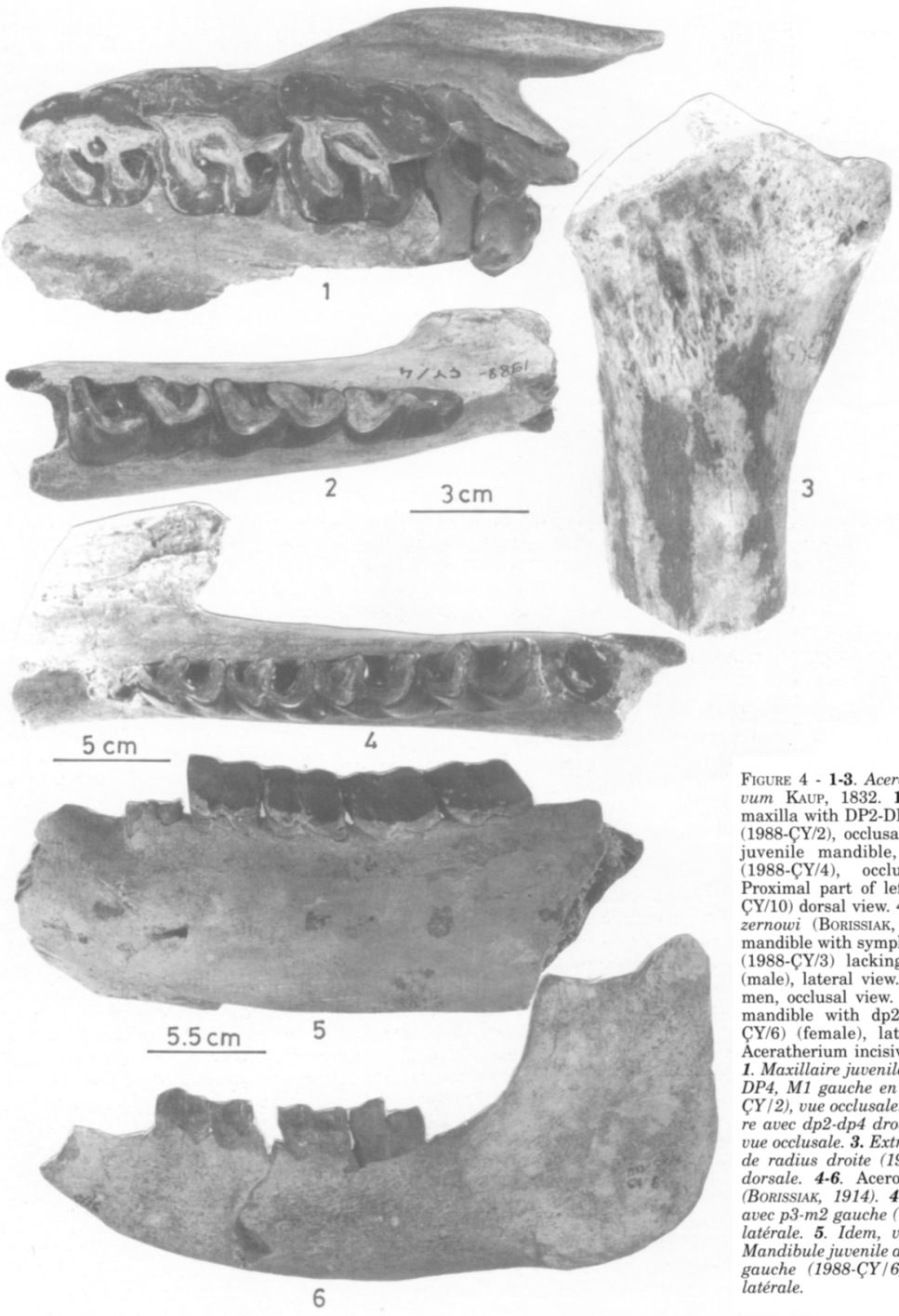

FIGURE 4 - **1-3**. *Aceratherium incisivum* KAUP, 1832. **1**. Left juvenile maxilla with DP2-DP4, M1 erupting (1988-ÇY/2), occlusal view. **2**. Right juvenile mandible, with dp2-dp4 (1988-ÇY/4), occlusal view. **3.** Proximal part of left radius (1988-ÇY/10) dorsal view. **4-6**. *Acerorhinus zernowi* (BORISSIAK, 1914). **4**. Left mandible with symphysis and p3-m2 (1988-ÇY/3) lacking anterior part (male), lateral view. **5**. Same specimen, occlusal view. **6.** Left juvenile mandible with dp2-p4, m1 (1988-ÇY/6) (female), lateral view. ***1-3***. Aceratherium incisivum *KAUP, 1832. **1**. Maxillaire juvenile munie de DP2-DP4, M1 gauche en eruption (1988-ÇY/2), vue occlusale.* **2**. *Série dentaire avec dp2-dp4 droite (1988-ÇY/4), vue occlusale.* **3.** *Extrémité proximale de radius droite (1988-ÇY/10), vue dorsale.* ***4-6***. Acerorhinus zernowi *(BORISSIAK, 1914).* **4**. *Série dentaire avec p3-m2 gauche (1988-ÇY/3), vue latérale.* **5**. *Idem, vue occlusale.* **6**. *Mandibule juvenile avec dp2-dp4, m1 gauche (1988-ÇY/6) (femelle), vue latérale.*

cingulum and narrower on P4 than on P3. The lingual surfaces of the lophs are rounded.

The lingual cingulum forms a continuous shelf-like wall, high above the base of the teeth. The labial cingulum is weak between the paracone and metacone.

Molars - The labial wall of the teeth is convex at the front and concave at the rear. The lingual side of the protocone is flattened. Its lateral sides are rounded. The protocone is quite broad. Its anterior and posterior valleys are well developed. The paracone is weak. The metacone forms a bulge at the

base. The crochet is present. There is no crista. The antecrochet is strongly developed in the molars. The parastyle valley is shallow and short. The anterior valley of the hypocone is present. The entrance of the medisinus is open. The M3 is triangular-shaped. The labial wall of the ectometaloph is convex, and extends to the lingual side. The ectometaloph angle is obtuse.

The antero-lingual cingulum forms a shelf-like wall, and extends to the entrance of the medisinus. The labial cingulum is slightly developed, and bow-shaped at the base of the teeth. The talon of the M3 forms a low and vertical prominence. The postero-labial cingulum is well developed.

Upper Milk Teeth - The teeth are low-crowned (Tab. 2). The DP2 is triangular-shaped in outline and long anteriorly. The labial wall of DP2 is slightly convex. It has two depressions, and poor indications of the paracone and metacone. The parastyle valley is shallow, and extends to the base of the tooth. The base of the metacone is flat and slightly concave on DP4. The anterior hypocone valley is located within the medisinus. A cingular cusp is situated in the entrance of the widely open medisinus. The crochet is long and united to the ectoloph on DP2, but not on DP3-4. The crista is not united to the crochet on DP2. The medifossette is closed on DP2. The postfossette is triangular-shaped, and enlarges to the top.

The anterior cingulum extends along the protoloph. It forms a high and wavy structure at the base of the tooth. There is a sharp break in the cingulum at the entrance of the medisinus. The posterior cingulum surrounds the postfossette. The labial cingulum is faintly developed, and surrounds continuously the base of the tooth.

Juvenile mandible - The symphysis region is broken. The symphysis reaches posteriorly beside the talonid valley of dp2. The big foramen mentale is located below the protoconid of dp2. The small foramen mentale is situated below a short diastema. The corpus mandibulae is low. The lower border of the mandible is convex, and curves slightly upwards in the anterior part. The lateral face of the alveolus of I2 is angled.

Lower milk teeth - There is no dp1. The teeth are low-crowned (Tab. 3). The dp2 is triangular-shaped in outline and long. The protoconid forms an occlusally high point. The paralophid is long, and extends anteriorly. The hypoconid is recurved. The trigonid basin is quite shallow. The talonid basin is narrow and v-shaped. The anterior labial valley is narrow and shallow. The labial valley (ectoflexid) is narrow, deep and vertically orientated on dp2, and large and oblique on dp3-4. There is a strong protoconid pli along the anterior part of the labial valley. The talonid is larger than the trigonid, particularly on dp3-4.

There is a small lingual cingulum at the anterior part of the trigonid valley. The labial cingulum is poorly developed. The labial and lingual enamel surfaces show fine growth lines.

Radius - The proximal facet for the humerus consists of two concave parts. The medial part is larger than the lateral one. The tuberositas radii is smooth. The lateral tuberosity is slightly developed. The ulna facets are separated but near to each other. The lateral facet is large. The medial one is band-shaped. Below these facets a long and roughened attachment surface serves for the proximal ligamentum interosseum. The cross section of diaphysis is triangular.

	DP2	DP3	DP4
BL	32.7	33.4	37.8
LL	30.4	28.5	36.0
MB	28.5	36.1	38.5
DB	31.4	33.8	37.6
BH	20.5	21.7	32.2

TABLE 2 - Measurements of upper milk teeth of *A. incisivum* (1988-ÇY/2). *Mesures des dents de lait supérieures d'*A. incisivum.

	dp2	dp3	dp4
BL	31.5	35.4	36.2
LL	30.8	35.0	36.0
MB	12.9	16.7	20.0
DB	14.9	19.5	21.6
BH	19.0	16.0	21.8
Height of the corpus mandibulae (between dp2-dp3)			52.5
Diameter of the corpus mandibulae (between dp4-m1)			34.0

TABLE 3 - Measurements of the juvenile mandibulae and teeth of *A. incisivum* (1988-ÇY/4). *Mesures de la mandibule juvénile et de la denture d'*A. incisivum.

Comparison

The skull from Yulafli resembles *Aceratherium incisivum* KAUP from Eppelsheim (Kaup 1832: Pl. 10, Figs 2, 2b, Pl. 14, fig. 5) with respect to the general morphology and teeth. These include the moderately long nasals with slightly upward trend and a strong supraorbital process. The teeth are characterized by large premolars, an equal breadth for the lophs on P2 and P3, the flat lingual side of the protocone, and the broad protocone on the molars. Differences exist between the Yulafli skull and *A. incisivum* from Eppelsheim. In the latter case, lingual cingulum is weak on the premolars, the lingual bridge is narrow, and the foramen infraorbitale is located above P3. The general characteristics of the Yulafli skull is also coincident with *A. incisivum* KAUP from Tchobroutchi (Pavlow 1914: Pl. 5, Figs 1,1a, 1b, 3) and from Höwenegg (Hünermann 1989: Figs. 4, 9). *'A. incisivum'* from Tchobroutchi is, however, removed from the genus *Acerorhinus*, and described to be closer to *Chilotherium* (Cerdeño 1996). The Tchobroutchi material differs from that of Yulafli by having a quite flat, long skull and narrow nasals. In the case of Höwenegg, the parastyle valley is deep on the molars, the cingulum is absent on the molars, and the foramen infra orbitale is small and located above M1. *A. incisivum* from Montredon (Guérin 1980: Pl. 8, Fig. A) is coincident with the skull from Yulafli with respect to the general shape of the teeth, but differs in having a longer P1, a narrower

protocone in the molars, and an anteriorly placed posterior edge of the nasal notch.

The skull from Yulafli is similar to *Aceratherium depereti* BORISSIAK from the Turgai region (Borissiak 1927: Pl. 1) with respect to the large premolars, and strongly developed lingual cingulum in the premolars, and the large lingual bridge. However, there are major differences between these two species. In the case of *A. depereti*, the nasals are remarkably long and narrow, the dorsal profile of the skull is concave, and the sagittal crest and a small horn are present.

The Yulafli material is comparable with *Acerorhinus palaeosinensis* (RINGSTRÖM) from Shansi (China). Both species have a retracted nasal notch, a high occiput and a strong lingual cingulum in the premolars. However, *A. paleosinense* greatly differs by having a four-fold foramen mentale (Ringström 1924: Fig. 70; Bohlin1937: Figs 88, 163), and a narrower and shorter skull, a thinner zygomatic arch and a higher orbit.

The skull presents similarities with *Acerorhinus tsaidamensis* (BOHLIN) from Qaidam (China) (Bohlin 1937: Pl. 8, Figs 1, 2, 3). They share the retracted nasal notch, moderately long nasals, high occiput, and flattened lingual side of protoloph. On the other hand, there are several differences between these species. As for *A. tsaidamensis*, the distance between the parietal crests is lesser (10 mm), the zygomatic arch is slender, and the upper margin of the zygomatic arch is horizontal below the orbit.

The skull from Yulafli is similar to *Acerorhinus zernowi* (BORISSIAK) from Sebastopol at the Black Sea (Borissiak 1915: Pl. 2), Konya-Kayadibi (Heissig 1975: Pl. 1, fig. 2), and Ankara-Sinap (Saraç 1994). They share the strong lingual cingulum in the premolars, a strong supraorbital process, and a strong postglenoid process. *A. zernowi* differs from the Yulafli specimen in having a rounded protocone, longer nasals, a strong and vertical facial crest, and a longer and narrower P2. The suture of the Yulafli skull between the frontal and nasal also resembles that of *A. zernowi* (Borissiak 1915: Pl. 2, Fig. C). The Yulafli material greatly differs from *A. zernowi* from Tung-gur, which is synonymized with *Hoploaceratherium*, (Cerdeño 1996). The Tung-gur material is characterised by quite long nasals, a concave dorsal profile of the skull, and the presence of a sagittal crest and a shallow nasal notch.

The morphology of the Yulafli skull is similar to *Aceratherium kiliasi* GERAADS & KOUFOS from Pentalophos-1 (Geraads & Koufos 1990: Pl. 2, Figs 1, 2, Pl. 3, fig. 4). *A. kiliasi* (= *Chilotherium kiliasi*: Heissig 1999) is characterized by the absence of frontal and nasal horns, the retracted nasal notch, the strongly developed supra orbital process, and the flattened lingual side of the protoloph. It differs from the Yulafli specimen by having a v-shaped nasal notch, a quite flat skull, a weak cingulum on the premolars, a larger P1, and considerably shorter premolars.

The skull differs from *Chilotherium* RINGSRÖM, 1924. In *Chilotherium*, the facial crest forms a right angle, the orbit is high, the skull is low, long and broad, the distance between the nasal notch and orbit is large, and the premolars are short.

Proximal width	90.8
Proximal diameter	61.7
Width of the proximal facet	88.0
Diameter of the proximal facet	54.0
Width of the diaphsis	44.5
Diameter of the diaphysis	34.2
Height of the ligament attachment surface	107.0

TABLE 4 - Measurements of the radius of *A. incisivum* (1988-ÇY/10). *Mesures du radius de* A. incisivum.

The upper teeth from Yulafli are smaller than those of *A. incisivum* from Dorn-Dürkheim 1 (Germany) (Cerdeño 1997). The upper teeth from Yulafli are similar to *Acerorhinus hipparionum* (KOKEN) from Gansu (China) (Ringström 1924) with respect to the presence of the strong lingual cingulum. *A. hipparionum* differs from the Yulafli material by having more massive and hypsodont teeth and rounded hypocone on the premolars.

The upper milk teeth from Yulafli are similar to *A. zernowi* from Kayadibi (Heissig 1975: Pl. 5, figs 1, 2), with respect to the general shape of the teeth and the presence of a depression of metacone at the base. However, *A. zernowi* differs from the Yulafli material by having a split up prefossette, a strong lingual cingulum, and a hypocone valley outside the medisinus. The upper milk teeth differ from *Chilotherium* species. In *C. samium* from Çankiri-Çorakyerler (Heissig 1975: Pl. 5, fig. 4) and Samos (Weber 1905: Tab. 9, Fig. 4) the teeth are large, the labial wall of DP2 is quite convex, and the prefossette is narrow. In *C. schlosseri* from Afyon- Kınık (Heissig 1975: Pl. 5, fig. 3) the DP2 is small and triangular-shaped, and the paracone is located rather distally. The upper milk teeth from Yulafli differ from *A. paleosinense* (Ringström 1924: Pl. 11, figs 1, 2, 3) which has strong anterior and posterior protocone valleys and a strongly developed antecrochet.

The radius from Yulafli resembles *A. incisivum* from Höwenegg (Hünermann 1989: Fig. 11) and from Montredon (Guérin 1980: Fig. 33B). They match in the weakly developed tuberositas radii and the short ulna facet. However, the size of the Montredon specimen is smaller (Tab. 4) and the lateral tuberosity is stronger. *A. incisivum* differs from *A. zernowi* from Kayadibi (Heissig 1975: Figs 33a, b) which has a shorter ulna articulation surface, a deep tuberositas radii, and separate ulna facets. *A. incisivum* also differs from *C. samium* from Kayadibi (Heissig 1975: Figs 35a, b) having the deeply hollowed tuberositas radii, and the separated ulna facets.

Acerorhinus zernowi (BORISSIAK, 1914)
Figs 4.4-6; 5.1-4

Material - Left mandible with symphysis and p3-m2 (1988-ÇY/3), lacking anterior part (male); left mandible with symphysis and p2-p3 (1988-ÇY/5) (male); left mandible with m2-m3 (1988-ÇY/7); left juvenile mandible with dp2-p4, M1 (1988-ÇY/6).

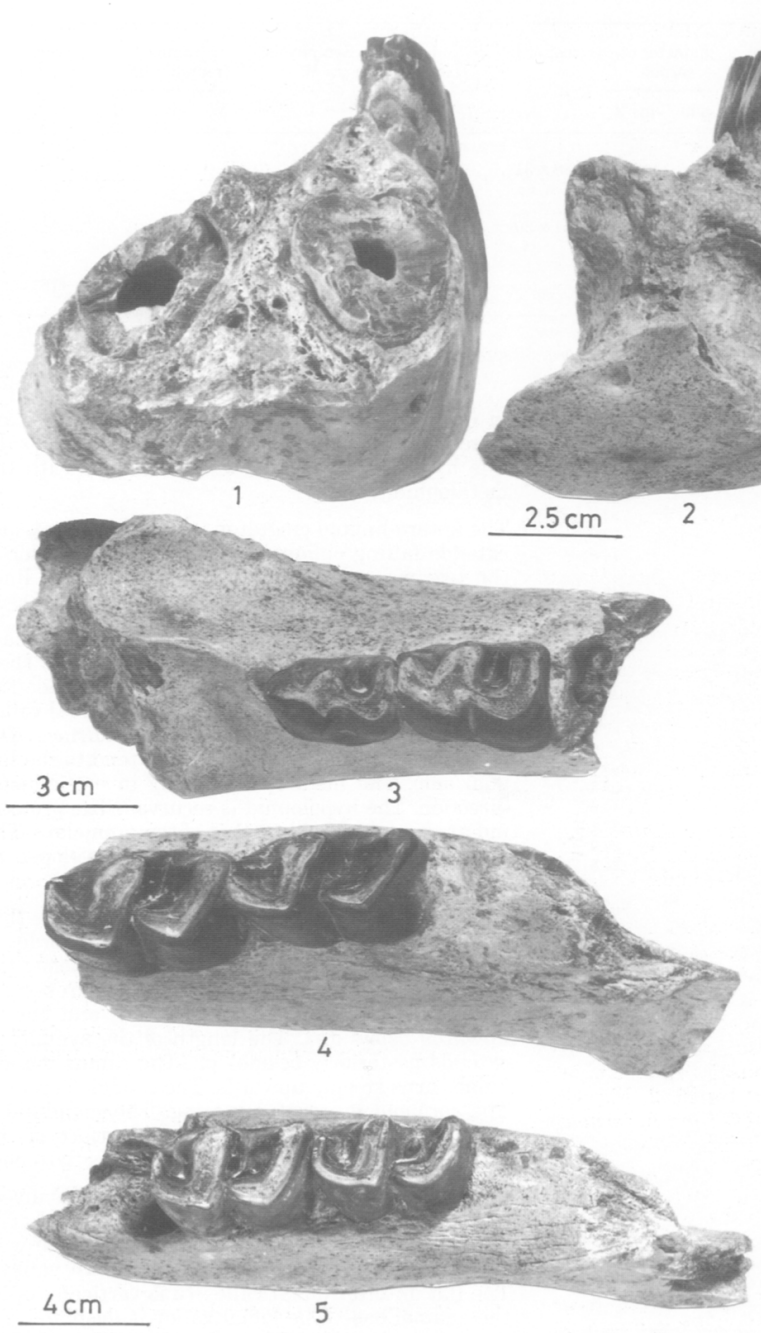

FIGURE 5 - **1-4**. *Acerorhinus zernowi* (BORISSIAK, 1914). **1**. Left mandible with symphysis and p3-m2 (1988-ÇY/3) lacking anterior part (male), anterior view. **2**. Left mandible with symphysis and p2-p3 (1988-ÇY/5) (male), anterior view. **3.** Same specimen, occlusal view (1988-ÇY/5). **4.** Left mandible with m2-m3 (1988-ÇY/7), occlusal view. **5.** *Dihoplus schleiermacheri* (KAUP, 1832), left mandible with m2-m3 (1988-ÇY/8), occlusal view. ***1-4***. Acerorhinus zernowi *(BORISSIAK, 1914). **1**. Série dentaire avec p3-m2 gauche (1988-ÇY/3), vue antérieure. **2**. Série dentaire avec p2-p3 gauche (1988-ÇY/5), vue antérieure. **3**. Idem, vue occlusale. **4**. Série dentaire avec m2-m3 gauche (1988-ÇY/7), vue occlusale.* **5**. Dihoplus schleiermacheri *(KAUP, 1832), série dentaire avec m2-m3 gauche (1988-ÇY/8), vue occlusale.*

Description

Mandible - The symphysis is robust and narrow, and begins curving upwards below p2. It extends posteriorly beside p3. The symphysis includes two divergent sheaths of the tusks. The rounded alveoli of the tusks are filled by the roots. These tusks are very close to each other (about 16 mm on ÇY/3, 14 mm on ÇY/5, Tab. 5), and curve strongly upwards. Their long axes are in an oblique position in ÇY/3, and in a more vertical direction on ÇY/5. The foramen mentale is located below p3. There is a small foramen below the diastema. The diastema is also rather short. The corpus mandibulae is deep, and displays a uniform height. Its lower border is convex on ÇY/3 and flattened on ÇY/5 and ÇY/7. The margo interalveolaris shows a distinct crest.

Premolars - The p1 is lost, but its alveolus is preserved. The teeth are high-crowned and oriented obliquely to the jaw. The p2 is triangular-shaped

Nr.	total L	height of the corpus below			diameter of corpus		root of I2	I 2 distance	Symphysis W	ramus mandibulae			coronoid process
		p2/3	p/m	m1/2	p/m	m1/2			L	W	H	H	
1988 ÇY/3		83	86	87	42.5	44.5	38 x 31	16	94				
1988 ÇY/5			67		(p3/4)	42	41 x 30	14					
1988 ÇY/6	384	73	69	76	37	38				(104)	20	174	(161)

TABLE 5 - Measurements of mandibulae and incisors of *A. zernowi*. *Mesures de la mandibule d'*A. zernowi.

Tooth/Nr	1988-ÇY/3	1988-ÇY/5	1988-ÇY/7	1988-ÇY/6, juv. dp1-4
p2				dp1
BL		29.5		33.0
LL		28.9		32.7
MB		18.9		14.9
DB		19.7		16.5
BH		31.3		18.6
p3				dp2
BL	33.5	33.8		
LL	33.1	33.1		
MB	22.8	22.2		17.2
DB	23.4	24.3		
BH	29.5	28.0		20.5
p4				dp3
BL	37.2			39.5
LL	37.8			40.0
MB	24.3			20.1
DB	26.8			20.9
BH	28.5			24.6
m1				dp4
BL	41.9			41.0
LL	39.9			41.4
MB	25.1			24.8
DB	25.8			26.9
BH	29.5			35.8
m2				
BL	42.0		42.8	
LL	42.8		42.5	
MB	27.1		28.2	
DB	25.8		27.8	
BH	28.9		29.2	
LH			19.0	
m3				
BL			42.0	
LL			41.4	
MB			25.6	
DB			24.3	
BH			28.1	
LH			18.0	

TABLE 6 - Measurements of lower teeth of *A. zernowi*. *Mesures de la dentition inférieure d'*A. zernowi.

and long. The paralophid is long, and contains a high anterior point. The anterior labial valley is shallow in p2. The premolars are large. The labial wall of the teeth is rounded in ÇY/3 and flattened in ÇY/5. The labial valley is shallow, and has a slightly oblique inclination. The protoconid angle is recognisable. The trigonid valley is shallow and v-shaped. The talonid valley is rather large, u-shaped in ÇY/3 and narrower in ÇY/5. These valleys are closed, and do not reach the base of the lingual side. The hypolophid is recurved, and united with the metalophid.

The antero-lingual cingulum is well developed, and extends falling obliquely to the anterior border of the trigonid valley. Faint horizontal growth lines occur on the labial and lingual enamel surfaces.

Molars - The molars are longer than the premolars (Tab. 6). The trigonid valley is v-shaped and shallow. The talonid valley is large and u-shaped. The labial wall of the teeth is rounded. The labial valley is remarkably oblique to the occlusal surface. The paralophid is short, and does not extend to the lingual side. The metalophid is long in mesio-distal direction. The hypolophid is recurved. The protoconid angle is weaker than that of the premolars. The anterio-lingual cingulum is strongly developed as in the premolars.

Juvenile mandible - The corpus mandibulae is thin and low and of constant height. Its lower border is convex. The foramen mentale is located below the dp2. There is no p1, but its alveolus is preserved. The symphysis is narrow and short, and curves upwards below dp2. The length of the symphysis extends posteriorly besides p2. The ramus mandibulae turns steeply upwards. The condyle is round. The coronoid process is missing. The mandibular notch is quite narrow. The lateral surface of the ramus mandibulae (fossa masseterica) is flattened.

Lower milk teeth - The dp1 is absent, but its alveolus is preserved. The teeth are low-crowned. The dp2 is triangular-shaped and long. The labial wall of the tooth is roughened, and bears two valleys. The flat anterior labial valley runs vertically up to the enamel base. The labial valley is deep and has an oblique direction. The paralophid is short. The trigonid valley is shallow. The talonid valley is narrow and u-shaped. The protoconid pli is strong, and extends parallel to the labial valley in dp2.

The antero-lingual cingulum extends along the basis of the anterior part of tooth. There is a vertical cingulum between the trigonid and talonid valleys on dp2. The antero-labial cingulum is short. There is no lingual cingulum.

Comparison

The general shape and morphology of the mandible from Yulafli bear similarities to those of *A. zernowi*

(BORISSIAK) from Kayadibi and Konya-Kayadibi-Sarisikinleri (Heissig 1975). The common features are the following: the symphysis is narrow (94 mm) and curves steeply upwards; the tusk roots are rounded; the premolars are large and long; the paralophid is short; the orientation of the toothrows is oblique. However, some differences in morphology and size are remarkable. In *A. zernowi* from Kayadibi the labial cingulum is present on the anterior lobe, the symphysis is narrower (83 mm), the teeth are broader, and the distance between the tusks is larger. The material also presents similarities with *A. zernowi* from Tung-gur (Cerdeño 1996: Fig. 3) having a small p1, large premolars, symphysis of about 92 mm width, and a great angle between the symphysis and corpus mandibulae.

The Yulafli specimens resemble the *A. kiliasi* mandible (= *Acerorhinus zernowi*: Heissig 1999) from Pentalophos-1 (Geraads & Koufos 1990: Pl. 3, figs 2, 3, 5) with respect to the narrow symphysis, the large premolars, and the ovoid-shaped and oblique alveoli of the tusks. They differ from *A. kiliasi* which has a greater distance between the tusks and a strong cingulum in p2.

Several aspects of *A. zernowi* compare with *A. palaeosinensis* from Shansi (Ringström 1924: Pl. 10, fig. 4; Bohlin 1937: Pl. 7, fig. 10). These include a narrow symphysis (respectively, 94 mm and 95 mm), a larger and triangular p2, and an oblique tusk position. In the case of *A. palaeosinensis*, the tusks are flat in the crown cross-section (Bohlin 1937: p. 70, 47 x 24 mm), there is a large distance between the tusks (Bohlin 1937: p. 70, 45 mm), and the horizontal tusks are slightly upturned.

A. tsaidamensis from Qaidam (Bohlin 1937: Figs 92, 93, 164, 165) is similar to the material from Yulafli with respect to narrow symphysis (75-95 mm), large premolars, highly upturned symphysis, and a narrow distance (Bohlin 1937: p. 70, 25 mm) between tusks. It differs in having a ventrally smooth symphysis.

The mandible from Yulafli greatly differs from *Chilotherium*. In *Chilotherium*, the symphysis is broader anteriorly and hollowed ventrally, the tusks are horizontally curved and with upturned medial flanges (Heissig 1989, 1999), and the axes of the tusks are oblique and far from each other. The premolar series are shorter than the molar series, particularly in *Ch. kowalevskii* (PAVLOW).

The Yulafli specimens resemble *A. incisivum* (Kaup 1832: Pl. 14, fig. 9) with respect to several features of the teeth and mandible. These include the convex lower border of the corpus mandibulae, the long p2, and a shallow and u-shaped trigonid valley. They differ greatly from *A. incisivum* having horizontal tusks and a ventrally smooth symphysis.

Subfamily RHINOCEROTINAE Dollo, 1885
Tribe RHINOCEROTINI Dollo,1885
Subtribe RHINOCEROTINA Dollo, 1885
Genus ***Dihoplus*** BRANDT, 1878

Dihoplus schleiermacheri (KAUP, 1832)
Fig. 5.5

	m2	m3
BL	47.6	47.5
LL	48.5	47.2
MB	32.6	29.2
DH	31.0	26.5
BH	28.3	28.7
LH	23.0	27.5
Height of the corpus mandibulae (m2-m3)		78.5
Diameter of the corpus mandibulae		51.4

TABLE 7 - Measurements of lower teeth and mandible of *D. schleiermacheri* (1988-ÇY/8). *Mesures de la mandibule et de la denture d'*D. schleiermacheri.

Material - Left mandible with m2-m3 (1988-ÇY/8).

Description

Mandible - The mandible is larger than that of the other rhinocerotid remains. In the labial side, the height of the corpus increases posteriorly, and in the lingual side, the height of the corpus is constant. The lower edge of the corpus is convex. The ramus is quite flattened laterally, and rises abruptly above the toothrow.

Teeth - The teeth are rather high-crowned (Tab. 7). The paralophid is long and narrow. The labial walls of the teeth are characterized by the deep labial valley with oblique orientation, the angled metalophid, and the slightly angled hypolophid. The protoconid fold is distinct. The trigonid valley is shallow and u-shaped. The talonid valley is large, shallow and u-shaped. In m3 there is a small tubercle in the talonid valley.

The antero-labial cingulum continues lingually along the anterior surface, and ends at the entrance of the trigonid valley. The lingual cingulum is slightly developed at the base of the lingual side of the teeth.

Comparison

Dihoplus schleiermacheri was first erected by Grooves (1983) for *Dicerorhinus schleiermacheri* (KAUP, 1832) from Eppelsheim. The Eppelsheim material was described as *Dicerorhinus schleiermacheri* (Guérin 1980), and as *Dihoplus schleiermacheri* (Geraads & Koufos 1990). Cerdeño (1995a) synonymized *'Dicerorhinus' schleiermacheri* with *Lartetotherium schleiermacheri*.

The mandible and teeth resemble in morphology and size those of *Dihoplus schleiermacheri* from Eppelsheim (Kaup 1832: Pl. 11, fig. 8) and from Soblay (Guérin 1980: Pl. 9, fig. E, tab. 49), with respect to the presence of the long paralophid, the angled metalophid and the convex lower edge of the corpus mandibulae. Some morphological differences recognized. In the Eppelsheim material include the v-shaped trigonid valley and the longer paralophid.

The lower teeth are larger than *L. schleiermacheri* from Dorm-Dürkheim 1 (Germany) described by Cerdeño (1997). *D. schleiermacheri* resembles *Lartetotherium sansaniense* (LARTET) from Sandelzhausen with respect to the long paralophid, weakly

developed anterolabial cingulum, and the deep and oblique labial valley. It differs from *L. sansaniense* from Sandelzhausen which is smaller in size and has a v-shaped trigonid valley.

PALEOECOLOGY

Deinotherium, which is the most common element of the Yulafli fauna indicates a forested habitat. The scarcity of *Hipparion* in the Yulafli fauna implies a restricted amount of steppe or savannah areas. *A. incisivum*, as a medium-sized form, has a habitat of swamp and open forest with probably patches of grassland, in a warm temperature (Guérin 1980). *D. schleiermacheri,* which is a large form, indicates a habitat of open forest intervened by some grassland and humid environment (Guérin 1980).

Ceratotherium neumayri and the *Chilotherium* species, which are grazer-like forms with semihypsodont teeth, are the common elements of the Late Miocene faunas of Anatolia. Their habitat is savannah environment with patches of bushes (Heissig 1975; Kaya 1994). They are not present in the Yulafli fauna. The paleocology of the Yulafli fauna (Thrace region) is different from that of the Anatolian localities. The faunal elements of the Yulafli fauna correlate better with those of European localities (such as, Eppelsheim, Concud), Dorn-Dürhkeim 1) (Guérin 1980; Cerdeño 1997) than with Anatolian ones.

CONCLUSIONS

The Rhinocerotidae remains from Yulafli (Çorlu) include *Aceratherium incisivum* and *Acerorhinus zernowi*, and *Dihoplus scheiermacheri*.

Aceratherium incisivum was first recorded in Turkey by Ozansoy (1965) in a faunal list regarding the Çobanpinar area, Ankara. It is known from several Late Miocene localities in Central and Western Europe, such as Eppelsheim (MN 9) (Kaup 1832), Höwenegg (MN 9) (Hünermann 1989), Montredon (MN 10) (Guérin 1980), Masia del Barbo (MN 10), La Roma 2 (MN 10), Cerro de los Batallones (MN 10), Dorn-Dürkheim 1 (MN 11), Concud (MN 12) (Cerdeño 1992, 1997; Cerdeño & Sanchez 1998), Rudabanya (MN 9) (Heissig 1996, 1999) and Tchobroutchi (Pavlow 1914). The overall stratigraphic range is MN 9 to MN 13 (Guérin 1982; Cerdeño 1998; Heissig 1999).

Acerorhinus zernowi was first defined in Sebastopol (MN 9) (Borissiak 1914). It is known from Konya-Kayadibi and Kayadibi-Sarisikinleri (both MN 11) (Heissig 1975), Ankara- Sinap (MN 9) (Saraç 1994) and Tung-gur (MN 8) (Cerdeño 1996). The stratigraphic range is MN 9 to MN 11 to Heissig (1999), and. early Vallesian for Europe and late Astaracian for Asia (Cerdeño 1998).

Dihoplus scheiermacheri is the first occurrence in Turkey. It is known from several Late Miocene localities in Europe such as Eppelsheim (MN 9), Gauweinheim (MN 9), Esselborn (MN 9), Soblay (MN 9), Luberon (MN 9) (Guérin 1980), Masia del Barbo (MN 10), La Roma 2 (MN 10), Pierra (MN 11), Dorn-Dürkheim 1 (MN 11), and Concud (MN 12) (Cerdeño 1992, 1997). Its stratigraphic range is MN 9 to MN 13 (Guérin 1982; Heissig 1999).

The coexistence of *A. incisivum* and *A. zernowi* is recognized for the first time. This is not recorded in Central or Western European localities, where *A. zernowi* is unknown. *A. incisivum* and *D. schleiermacheri* occur together in Eppelsheim, Montredon, Concud, La Roma 2, Dorn-Dürkheim 1 and Masia del Barbo (Guérin 1980; Cerdeño 1992; Cerdeño 1995b; Cerdeño 1997). The common presence of the above species points to a Turolian age (MN 11-MN 12). The other faunal elements, such as large-sized *Deinotherium gigantissimum* and *Microstonyx erymanthius* are indicative of the Turolian age.

A. incisivum and *D. schleiermacheri* are European taxa, while *A. zernowi* is an Eurasian one. The former species are widespread in Europe during the Late Miocene. *A. zernowi* is significant for a paleobiogeographical crossroad sense of Thrace to Europe.

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