

SMALL THEROPODS FROM THE LATE CRETACEOUS OF THE HATEG BASIN (WESTERN ROMANIA) - AN UNEXPECTED DIVERSITY AT THE TOP OF THE FOOD CHAIN

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Abstract : The Late Maastrichtian deposits of the Hateg Basin have yielded numerous remains of herbivorous dinosaurs (titanosaurids, ornithopods, nodosaurids); but those of theropods are scarce, represented mostly by teeth and hindlimb elements. New material allows the recognition of an unexpected diversity of these predators in the Hateg fauna. Teeth of various morphologies are reported here to represent several distinct taxa of small theropods: a velociraptorine dromaeosaurid, a "troodontid-like" small theropod, cf. *Euronychodon* and perhaps a fourth, peculiar small theropod with sharp, but unserrated carinae on the teeth. Re-examination of previously published theropod material also suggests such diversity. Femora, previously referred to *Elopteryx*, probably belong to a derived maniraptoran. A distal end of a femur seems to document a small ceratosaur, while some tibiotarsi (holotypes of *Bradycneme* and *Heptasteornis*) may represent a non-maniraptoran tetanuran theropod. Without diagnostic remains of small theropods, it is inappropriate to give the reported material generic names; consequently informal use of the published names '*Elopteryx*' and '*Bradycneme*' is recommended. Moreover, for most part of the isolated theropod remains from Hateg there are no reasons to group them under the same name; one such case may be represented, however, by some skull elements and the velociraptorine teeth.

The diversity of the small theropods in the Hateg fauna, together with the absence of a large "top" theropod, represents the first such case reported for Late Cretaceous faunas. This phenomenon is probably linked to the restricted, insular habitat of the Hateg fauna, which could not accommodate and support any larger sized predator.

Key words : Hateg Basin, Late Maastrichtian, ceratosaurs, maniraptorans, dromaeosaurids, *Euronychodon*, diversity, insular habitat.

Les petits théropodes du Crétacé terminal du Bassin du Hateg (Ouest de la Roumanie) : une diversité inattendue au sommet de la pyramide trophique

Résumé : Les dépôts d'âge Maastrichtien terminal du Bassin de Hateg ont fourni de nombreux restes de dinosaures herbivores (titanosauridés, ornithopodes, nodosauridés), mais ceux de théropodes sont rares, représentés par des dents et des fragments de membres postérieurs. Le nouveau matériel a permis de mettre en évidence une diversité inattendue de ces prédateurs dans la faune d'Hateg. Des dents de morphologies variées attestent la présence de différents taxons de petits théropodes : un dromaeosauridé, un petit théropode proche des troodontidés, cf. *Euronychodon* et peut-être un quatrième petit théropode curieux avec des dents à carènes saillantes mais sans crénelures. Un nouvel examen des restes des petits théropodes de Hateg déjà publiés confirme cette diversité. Les fémurs, rapportés à *Elopteryx*, appartiennent probablement à un maniraptorien; l'extrémité distale de fémur semble documenter un petit cératosaure, tandis que des tibiotarses (holotypes de *Bradycneme* et *Heptasteornis*) pourraient représenter un théropode tetanurane primitif.

En l'absence de restes diagnostiques des petits théropodes, il semble prématuré de donner des noms génériques; nous recommandons par conséquent l'utilisation informelle des noms publiés '*Elopteryx*' et '*Bradycneme*'. De plus, il n'y a pas lieu de regrouper des restes isolés sous le même nom générique; le seul cas où l'on peut se permettre de le faire concerne quelques restes de crânes publiés auparavant et les dents de dromaeosauridés.

La diversité des petits théropodes dans la faune d'Hateg, ainsi que l'absence de grands théropodes, est un cas unique dans les faunes du Crétacé terminal. Ce phénomène est probablement lié à un habitat insulaire qui n'a pas permis la colonisation par un grand prédateur.

Mots clés : Bassin du Hateg, Maastrichtien terminal, Ceratosauria, Maniraptora, Dromaeosauridae, *Euronychodon*, diversité, habitat insulaire.

INTRODUCTION

The vertebrate fauna of the Hateg Basin (Late Cretaceous : Latest Maastrichtian; Antonescu *et al.*, 1983) was discovered in 1895 and first described in 1900 by Nopcsa. The fauna comes mostly from the fluvial, continental deposits of the Densus-Ciula and Sinpetru formations, cropping out in the north-western and central parts of the basin respectively (Grigorescu, 1992 : fig. 1). Isolated or associated remains of herbivorous dinosaurs (the titanosaurid sauropod *Magyarosaurus dacus*, the ornithomimid of uncertain affinities *Rhabdodon robustus*, the basal hadrosaurid *Telmatosaurus transsylvanicus* and the nodosaurid *Struthiosaurus transilvanicus*) are widespread, along with those of turtles and crocodylians. In contrast, the remains of the top predators (theropod dinosaurs) are very scarce, despite the intensive collecting effort conducted over two periods: the first two decades of the century by F. Nopcsa and in the last two decades by teams from the Faculty of Geology and Geophysics of the Bucharest University (FGGUB) led by D. Grigorescu and those of the Muzeul Civilizatiei Dacice si Romane, Deva (MCDRD; formerly Deva County Museum); in the last four years fieldwork was done jointly with D. Weishampel from the Johns Hopkins University in Baltimore, USA.

PREVIOUS REPORTS ON LATE CRETACEOUS THEROPOD DINOSAURS FROM TRANSYLVANIA

1- *Megalosaurus hungaricus* - a problematic and misinterpreted theropod from Transylvania

Nopcsa (1901, cited by Le Lœuff & Buffetaut, 1991) erected *Megalosaurus hungaricus* on the basis of two (cf. Nopcsa, 1915; contra Le Lœuff & Buffetaut, 1991) small, isolated teeth (MAFI Ob. 3106, not found in 1982; Weishampel, pers. comm.). *Megalosaurus hungaricus* is currently regarded by most authors (Le Lœuff & Buffetaut, 1991; Le Lœuff, 1992) as an indeterminate theropod of (?) Late Campanian - Maastrichtian age. However, as Nopcsa (1915) noted, the teeth were found at Nagybáród (today Borod, Bihor County, Romania); according to the label once accompanying the teeth, they came from the "Gosau coal outcrops near Nagybáród locality".

In the Borod basin, the Upper Cretaceous outcropping rocks are represented by mostly detritic deposits: sandstones and marls with interbedded microconglomerates and charophyte-bearing lacustrine limestones, followed by a sandstone - conglomerate unit with rudist bivalve-bearing limestones and rudist reefs, a thin, discontinuous sandstone-siltstone unit with tuffites and rhyolitic tuffs; the Upper Cretaceous sequence ends with a marly unit with *Inoceramus* (Mutihac & Ionesi, 1974). In the eastern part of the outcropping area, the lower part of these deposits laterally grade into a typical coal-bearing "Gosau facies" (Ianovici *et al.*, 1976; Mutihac, 1990). The whole sequence can be characterized as a transgressive unit overlaying older deposits and the crystalline basement of the Plopiș Mts. (to the north); the deposition reflects changing paleoenvironmental conditions from nearshore continental-lacustrine and litoral environments to inner shelf ones. The deposits are highly fossiliferous. The basal, terrigenous deposits contain a fauna with *Corbula striatula*, *Cardium subdinense*, *Turritella dupiniana*, *Melanopsis dubia* and are considered of a Coniacian-early Santonian age (Ianovici *et al.*, 1976). The overlying calcareous deposits yielded a rich association dominated by *Hippurites praecursor*, *Vaccinites gosaviensis*, *V. oppeli santonianus* in the lower part (indicating a late Santonian age) and *Vaccinites oppeli*, *V. archiaci*, *V.*

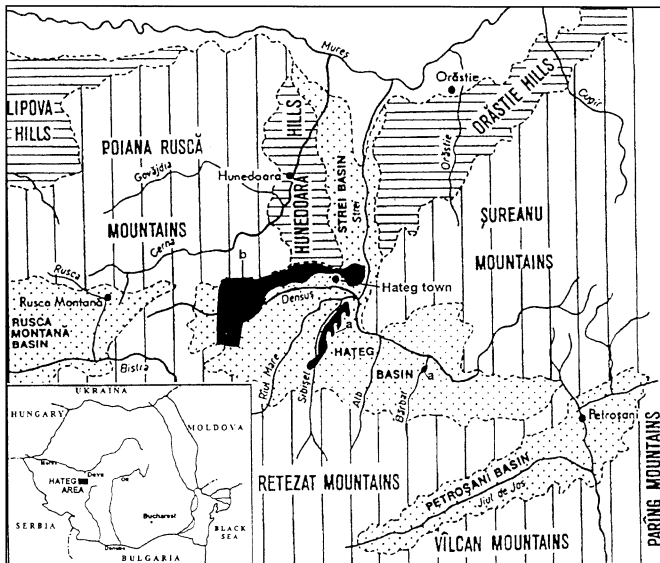


FIGURE 1 - The geographical setting of the Hateg Basin and surrounding regions.

- a - outcrop area of the Sinpetru Formation;
- b - outcrop area of the Densus-Ciula Formation

inequicostatus in the upper part (indicating an early Campanian age; Ianovici *et al.*, 1976).

The Borod Senonian sequence is diachronous in its terminal part. In the eastern part of the outcrop area, the uppermost limestone deposits yielded *Lepidorbitoides mamillata*, *L. minor*, *Orbitoides genseanicus*, an assemblage of late Campanian - Maastrichtian age (*op.cit.*), while in the northern part the overlying marls yielded clams (*Inoceramus balticus*) and a micropaleontological association with *Globotruncana lapparenti lapparenti*, *G. lapparenti bulloides*, *G. elevata elevata*, *G. bulloides*, indicating an early Campanian age (Th. Neagu, pers. comm.). As *M. hungaricus* came from the "Gosau coal" (i.e. the lower, terrigenous part of the Senonian sequence), although it may represent a (dwarf, cf. Nopcsa, 1915) theropod, it is more probably member of a stratigraphically older and also ecologically distinct - yet still unknown - assemblage, different from that from the Hateg Basin.

2- Theropod dinosaurs reported from the Hateg basin

The first top predator identified from the Hateg Basin was called "*Megalosaurus sp.*" by Nopcsa (1915) who considered it as an indeterminate carnivorous, possibly a close relative of *M. pannoniensis* or *M. hungaricus* from the Late Cretaceous of Europe. Both of these later taxa, based solely on isolated teeth, are listed as Carnosauria *nomina dubia* by Molnar *et al.* (1990).

Nopcsa's "carnosaur" material is very poor, consisting of two caudal vertebral centra (Nopcsa, 1915: pl. III, figs. 6,7). These, which came from Kadic's excavations at Valioara (Densus-Ciula Formation), are very similar to titanosaurid mid-posterior caudal vertebrae and are here tentatively referred to *Magyarosaurus dacus*, the only titanosaurid taxon known from Hateg (Le Lœuff, 1993).

Paradoxically, misidentified theropod remains were unearthed and described before those of "*Megalosaurus sp.*". Fragmentary limb bones from the Sinpetru Formation deposits cropping out in the Sibisel Valley were described by Andrews (1913) as the peleciform bird *Elopteryx nopcsai* (the material is currently in the British Museum of Natural History, BMNH). The type material is represented by a proximal femoral fragment (BMNH A.1234) and the distal

part of a left tibiotarsus (BMNH A.4358, formerly under the same specimen number as the femur); referred material includes another proximal femur (BMNH A.1235) and two more distal tibiotarsi (BMNH A.1588, A.1528). All the referred material comes from the Sibisel Valley (Weishampel, pers. comm.), but no further details are known about their precise locality or possible co-occurrence.

Subsequently, Harrison and Walker (1975) separated the tibiotarsi and erected for them the new strigiform bird genera *Bradycneme draculae* (A. 1588) and *Heptasteornis andrewsi* (A. 1528, A.4358). The avian nature of all these remains were questioned by numerous authors, who noted their reptilian (and more exactly dinosaurian) affinity (ex. Elzanowski, 1983; Grigorescu, 1984a as "coelurosaurians"). Further suggestions were made on their relationships by Norman (1985) and Osmolska (1987; *Bradycneme* and *Heptasteornis* were listed as possibly troodontids), Paul (1988; as the possible troodontids *Bradycneme draculae* and *Troodon? andrewsi*), Osmolska & Barsbold (1990; all three taxa as Troodontidae *nomina dubia*), Le Lœuff (1992) and Le Lœuff and Buffetaut (1991; as representing the elopterygine dromaeosaurid *Elopteryx nopcsai* with *Heptasteornis* and *Bradycneme* as junior synonyms) and Howse and Milner (1993, as the troodontid *Heptasteornis*). No appropriate arguments were presented to support these assertions, with the exception of Le Lœuff's papers.

Similarly early discovered small theropod remains come from the Densus-Ciula Formation at Valioara, from where two possible theropod teeth were mixed with and considered to be crocodylian teeth (in the depository of the Hungarian Geological Survey, catalogued as MAFI V.12685 partim.). The nature of these teeth were recognized in 1994, during a short visit to the MAFI collection; their laterally compressed, pointed, distally recurved shape and serrated carinae suggest they may indeed belong to small maniraptoran theropods. Also from Valioara, Kadic collected two paired frontals that Nopcsa misidentified as *Telmatosaurus* (MAFI v.1 3528); recently, Jianu and Weishampel (1997) suggested that they could in fact belong to an arctometatarsalian theropod of uncertain affinities.

No new material assigned to small theropods was found until the late seventies; at that time, several

teeth of “coelurosaurian” dinosaurs were reported from different localities within the Sinpetru Formation (Grigorescu, 1984a,b; Grigorescu *et al.*, 1985). Finally, the Sibisel Valley yielded in 1992 a small, partial skull roof (Weishampel & Jianu, 1996) representing a dromaeosaurid dinosaur apparently closely related to *Saurornitholestes langstoni* from the Late Cretaceous Judith River Formation of North America. The same authors report on further cranial and teeth material from the same locality to be published in the future.

The excavations carried out after 1978 at several fossil sites from both the Densus-Ciula and the Sinpetru Formations led to the recovery of a large number of small theropod remains (mostly teeth) that unravel an unexpected diversity of these dinosaurs in the Hateg paleocommunity.

DESCRIPTION AND COMMENTS

Several small theropod teeth were recovered between 1979 and 1996 from different localities spread all over the outcropping surface of the Densus-Ciula (Valioara, Tustea) and Sinpetru (Sibisel Valley, Pui) formations (fig. 2). These were found mostly by wet-screening techniques and came from either channel lag-type, poly-taxic bonebed-type or microvertebrate accumulation-type taphocoenoses (Csiki, 1995). The isolated, rootless crowns are considered to be shed teeth. Their state of preservation varies from well-preserved, complete, unworn crowns to enamel-less, worn fragments, but their integrated study permits the recognition of four major types of teeth on the basis of their (Currie *et al.*, 1990; Rauhut & Werner, 1995)

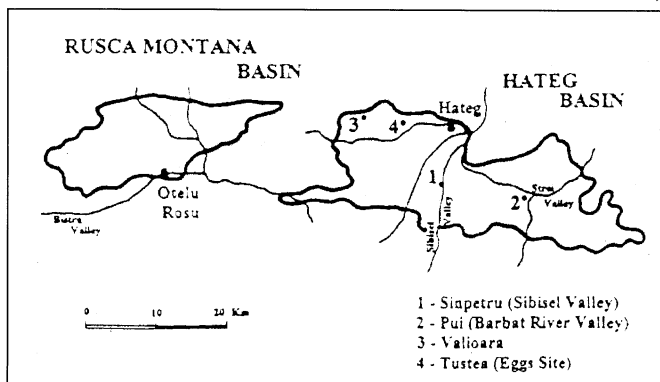


FIGURE 2 - Fossiliferous localities in the Hateg Basin that yielded small theropod remains

general shapes; cross-sections; positions of the anterior and posterior carinae; morphology of the denticles; maximum number of denticles per 1 mm; fore-aft basal lengths (FABL, with which all the other measurements could be compared; it is proportional with the total length), basal widths (BW); lateral compression indices ($LCI = FABL/BW$), denticle size difference indices ($DSDI = \text{ratio between the number of denticles on the anterior and distal carina on 1mm}$). (All specimen numbers, where not specified, are FGGUB).

1- Velociraptorine dromaeosaurids

(figs. 3a, b, c, d; 4b)

Material: R.1271, R.1321, R.1322, R.1428, R.1430, R.1580, R.1582 (for measurements and other details see table 1).

The tooth crown is laterally compressed ($LCI < 0.55$), pointed and sharply recurved. Both the anterior and posterior edges are strongly curved so that the tip extends behind the base of the crown, giving it a strong backward arch. The labial and lingual sides are convex; the degree of the lingual convexity varies from slight (giving an asymmetrical cross-section; R.1321, R.1430, R.1580) to highly rounded (symmetrical cross-section, R.1271, R.1322, R.1428, R.1582). The anterior carina is serrated only in its distal half (at most); below this serrated portion it continues as a low, rounded although visible ridge. The posterior carina is serrated from the tip to the base. As a general rule, the posterior denticles are wider at their base than the anterior ones ($DSDI > 1.3$); moreover, they are twice as tall. In the crowns with asymmetrical cross-sections (identified here as premaxillary, anteriormost maxillary or dentary teeth; Ostrom, 1969, Sues, 1977, Currie *et al.*, 1990) both the anterior and posterior denticles (5.5-6 denticles per mm and 4-6 denticles per mm, respectively) are relatively larger than in the more posterior teeth (9.5-10.5 denticles per mm and 7 denticles per mm, respectively); the denticles also decrease in size at the ends of the serrated portions. The denticles (where well-preserved, unworn) are straight, taller than wide at the base, and perpendicular to the tooth axis (sometimes slightly oblique near the tip, also noted in *Velociraptor*, Sues, 1977, but considered subject of individual and/or ontogenetic variation in *Deinonychus*, Ostrom, 1969).

Taxon	Spec. nr.	Locality data	Length (L)	FABL	BW	L/FABL	LCI	ant. serrat. per mm	post. serrat. per mm	DSDI
velociraptorine	FGGUB R.1428	Sinpetru, 1995 "La Carare"	7* (9.5)	4.6	2.1	2.06	0.46	10.5	7	1.5
velociraptorine	FGGUB R.1271	Sinpetru, 1994	7.3	3.2	-	-	-	-	9	-
velociraptorine	FGGUB R.1321	Sinpetru, 1983	11	5	2.5	2.2	0.5	5.5	4	1.38
velociraptorine	FGGUB R.1322	Sinpetru, 1983	6*	3.5	1.9	1.71	0.54	9.5	7	1.36
velociraptorine	FGGUB R.1430	Sinpetru, 1995 "La Carare"	4.1* (6.5)	3.3	1.6	1.97	0.48	-	9	-
velociraptorine	FGGUB R.1580	Tustea, 1994	5.2*	3.5	-	-	-	6	6	1?
velociraptorine	FGGUB R.1582	Valioara, 1995	1.8	0.9	0.4	2	0.44	-	-	-
troodontid-like	FGGUB R.1318	Sinpetru, 1982	12.5	8	5.3	1.56	0.66	5	5	1
troodontid-like (?)	FGGUB R.1319	Sinpetru, 1981	11	8	5	1.38	0.63	-	-	-
troodontid-like	FGGUB R.1320	Sinpetru, 1992	5.3	2.9	-	1.82	-	-	-	-
troodontid-like	MAFI v.12685a	Valioara, ? (Kadic coll.)	11.2	5.8	4.1	1.9	0.71	5	5	1
troodontid-like	MAFI v.12685b	Valioara, ? (Kadic coll.)	8	3.9	2.3	2.05	0.6	5	5-6	0.91
cf. <i>Euronychodon</i>	FGGUB R.1431	Sinpetru, 1995 "La Carare"	5.1	1.8	1	2.83	0.55	-	-	-
indet. theropod (?)	FGGUB R.1583	Valioara, 1995 Fantanele	1.5*	1	-	2	-	-	-	-

Table 1. Measurements of theropod teeth from the Hateg Basin. All measurements are given in mm
 Abbreviations: FABL - fore-aft basal length (Currie *et al.*, 1990); BW - basal width (Currie *et al.*, 1990);
 LCI - lateral compression index (Grigorescu, 1984b); DSDI - denticle size difference index (Rauhut & Werner, 1995).
 * - incomplete tooth, with (...) approximated length.

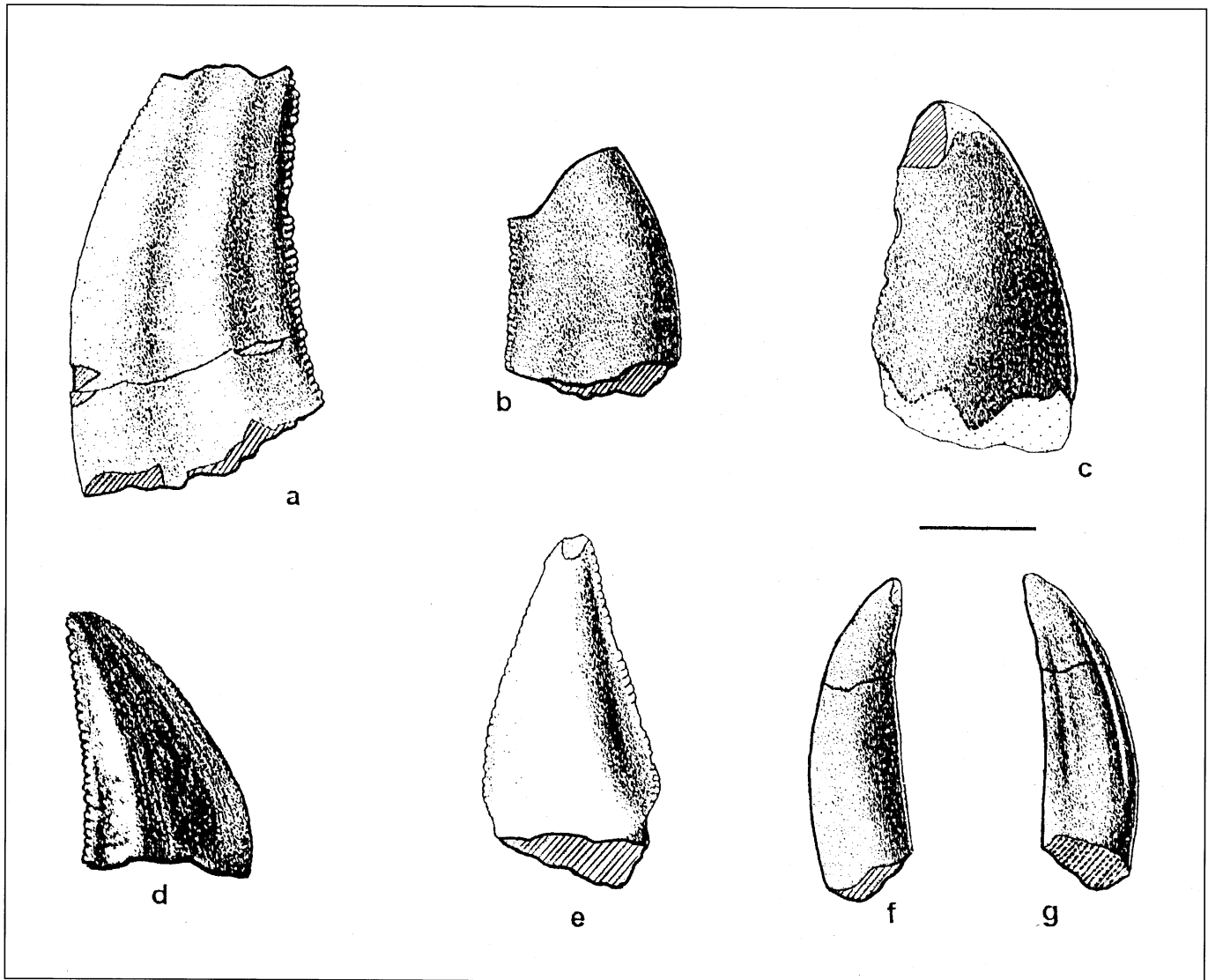


FIGURE 3. Small theropod teeth from the Hateg Basin. Velociraptorine dromaeosaurid : a - FGGUB R.1428; b - FGGUB R.1430; c - FGGUB R.1322 and d - FGGUB R.1580 (all in labial view). "Troodontid-like" small theropod: e - FGGUB R.1320 (?anterior dentary tooth). cf. *Euronychodon* (FGGUB R.1431) in: f - labial ; g - lingual view. Scale bar = 3 mm.

Distally they are rounded and slightly apically pointed. The labial and lingual sides are convex or present a slightly depressed median longitudinal groove bordered by more inflated anterior and posterior parts; this depression becomes shallow upward and ends before reaching the tip. The teeth may present small wear facets, developed especially near the tip and extending sometimes onto the anterior edge.

As noted by Ostrom (1969 : p. 157), the "tooth form among theropods is perhaps even less reliable than is dental formula, as a taxonomic criteria. The dromaeosaurids, however, may be the exception. All

dromaeosaurid teeth appear to be laterally compressed, acutely tapered, recurved, serrated both fore and aft ... with disparity between the mesial (anterior) and distal (posterior) serrations"; the same features are present also in the teeth from the Hateg Basin. Characters such as strongly laterally compressed teeth bearing both anterior and posterior serrations with obvious size differences between them (the anterior ones being half as large as the posterior ones) are listed by Ostrom (1990) as derived features (synapomorphies) of Dromaeosauridae. Among them, velociraptorines (including *Deinonychus*,

Saurornitholestes and *Velociraptor*) are diagnosed by more elongated, more pointed denticles, slightly apically hooked at their tips (Currie *et al.*, 1990). The following features seen in the teeth from the Hateg Basin are shared with velociraptorines (or dromaeosaurids): strong lateral compression (LCI < 0.55; Carpenter, 1982; Buffetaut *et al.*, 1986; Rauhut & Zinke, 1995; Rauhut & Werner, 1995); sharp distal curvature so that the tip extends well behind the base (see Ostrom, 1969 on *Deinonychus* ; Osborn, 1924 and Sues, 1977 on *Velociraptor* ; Currie *et al.*, 1990 on *Saurornitholestes*); anterior carina that does not twist onto the lingual side and bears (usually smaller) serrations only on its distal part (Ostrom, 1969 on *Deinonychus* ; Osborn, 1924 on *Velociraptor* ; Currie *et al.*, 1990 on *Saurornitholestes*; Carpenter, 1982; Buffetaut *et al.*, 1986); a posterior carina that is serrated over its entire length with denticles at least twice as large as those from the anterior carina (Ostrom, 1969 on *Deinonychus* ; Osborn, 1924 on *Velociraptor* ; Sues, 1978, Currie *et al.*, 1990 on *Saurornitholestes* ; Carpenter, 1979, 1982; Buffetaut *et al.*, 1986; Rauhut & Zinke, 1995; Rauhut & Werner, 1995); a shallow sulcus on both sides that does not extend to the tip (Carpenter, 1982), straight, distally slightly hooked denticles (Currie *et al.*, 1990; Rauhut & Werner, 1995) and wear facets usually developed only near the tip (Ostrom, 1969 on *Deinonychus* ; Carpenter, 1982).

It is worth mentioning that R.1321 and R.1322 were previously identified as velociraptorines, possibly related to *Saurornitholestes* (Currie, 1991, pers. comm.).

The teeth differ from those of troodontids by having differently shaped and relatively smaller denticles and by the absence of the “blood pits” (Currie, 1987) and a basal constriction. They also differ from those of *Richardoestesia* by their non-lanceolate shape and apically pointed, relatively larger denticles and from those of “paronychodons-euronychodons” in their biconvex cross-section and serrated carinae. As already mentioned, both premaxillary/anterior maxillary/anterior dentary teeth and more posterior (“cheek”) teeth were identified, based mainly on their cross-section. Even a so-called “digested tooth” was recognized, too (R.1582); this unserrated, chalky gray-colored tooth with enamel-less surface is similar to those described by Currie *et al.* (1990) as shed

teeth swallowed during feeding; its general morphology supports the assignment of R.1582 as a velociraptorine.

2- “Troodontid-like” small theropods (figs. 3e, 4a)
Material: R.1318, (?)R.1319, R.1320, MAFI v.12685a,b (see table 1.).

The tooth crown is conical, laterally compressed (but less so than the teeth here referred to as “velociraptorine” or “euronychodont”; LCI > 0.6), and only slightly recurved distally (the tip only reaches the level of the posterior end of the tooth base). Some teeth also show a moderate lingual curvature at the tip (R.1318, MAFI v.12685a). The anterior edge is slightly curved, while the posterior one is almost straight, very slightly concave only near the tip; the resulting general shape is that of an almost isosceles triangle. Both labial and lingual sides are convex and the anterior and posterior carinae lay in the midline; these carinae are strong and keel-like (especially so in the larger specimens). Both carinae show serrations; when well preserved, they extend from the base to the tip anteriorly as well as posteriorly.

The denticles on the carinae are relatively wider at their bases than in the purported velociraptorine teeth and are sub-equal on the anterior and posterior carinae (~ 5 denticles per mm; DSDI = 0.91-1). However, the height of each denticle is usually less than their basal width (it equals 50% of the basal width on the posterior, but only 35% on the anterior carina in R.1318 and 90% posteriorly in MAFI v.12685a,b). The denticles decrease in size near the tip or the base; they are rectangular, perpendicular to the tooth axis and distally very slightly rounded, almost straight. The blood groove between denticles tends to expand into a “blood pit” without attaining the development seen in troodontids (Currie, 1987).

The sides of the teeth are smoothly convex; only some teeth (ex. R.1319) are slightly folded at their base, the folds continuing for a very short distance up the crown. There is a constriction at the base of the crown, emphasized by the strong carinae. R.1318 shows a large wear facet on the antero-terminal part of the (?)labial side, extending down the crown for almost half of its length (Fig. 4a); this deep, oval, obliquely anteriorly dipping facet extends onto the anterior carina as well.

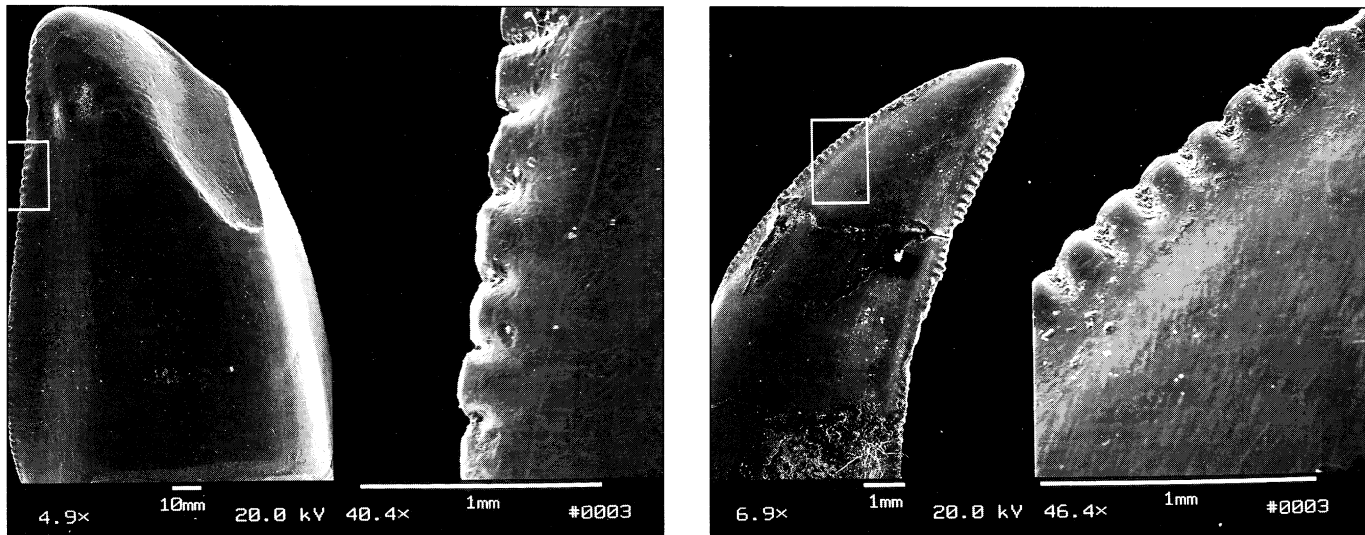


FIGURE 4. SEM photographs of small theropod teeth from the Hateg Basin :
 a - "troodontid-like" small theropod tooth (FGGUB R.1218); b - velociraptorine dromaeosaurid tooth (FGGUB R.1321).
 Enlargements of the boxed areas show the morphological distinctness of the denticles in the two taxa.

When compared to the dentition seen in other Cretaceous small theropod taxa (dromaeosaurids, troodontids, *Richardoestesia*, "paronychodons", "euronychodons") the above-described teeth compare closer to those of the troodontids. They share the following characters: constriction at the base of the crown (considered as a troodontid synapomorphy by Currie, 1987); relatively large, subequal denticles on the carinae; blood pits developed at the base of the denticles (although at a lesser degree than in Troodontidae); these character association is also shared with the "paronychodons" (sensu Zinke & Rauhut, 1994). Moreover, the only slightly-recurved shape of the tooth and the shape and position of the wear facet compare closely to that seen in *Troodon formosus* (see for ex. R.1318, fig. 4a comparative to Currie *et al.*, 1990 : fig. 8.3.c - a maxillary tooth; Currie, 1987 : figs. 4e, 5k, 5r, 5u - premaxillary, maxillary, anterior and posterior dentary teeth, respectively). Among troodontids, the teeth from Hateg are more similar to those of *Troodon formosus* (Currie, 1987) than to any of the Asian taxa with known dentitions (unnamed troodontid from the Early Cretaceous of Mongolia, Barsbold *et al.*, 1987; *Saurornithoides mongoliensis*, Osborn, 1924; *S. junior*, Barsbold, 1974; *Sinornithoides youngi*, Russell & Dong, 1993) in that the anterior carina is serrated to the tip. It is worth mentioning that Currie identified one of these teeth (R.1318) as troodontid (1991, pers. comm.).

In all these respects, the above described teeth differ from those of either dromaeosaurids, *Richardoestesia* or "euronychodons"; they differ, however, from those of the troodontids and "paronychodons" as well in the relatively smaller denticles (5 denticles per mm vs. 1.5-3 denticles per mm) which are of different shape (straight, low, rounded versus strongly apically hooked). The teeth also show clear-cut distinction from any other small theropod teeth known from Hateg and they conceivably represent another taxon, here informally called "troodontid-like" and probably more closely related to troodontids (?and "paronychodons") than to other small theropods (but, as Zinke & Rauhut, 1994, cautioned, there are severe difficulties in assigning isolated teeth to certain taxa in less well-known faunas, such as from Hateg, and one cannot consider isolated teeth as "troodontids" based solely on characters on the basis of a "constricted base" - although this may well be a tempting assumption).

3- cf. *Euronychodon* (fig. 3f, g)

Material: R.1431 (see table 1).

R.1431 is a small, elongated, strongly recurved and pointed tooth. The crown is strongly convex on the labial side, and flat on the lingual side. Both the anterior and the posterior carinae are positioned on the lingual side and are unserrated; they originate at the tip (although some uncertainty remains as the tooth is rather worn), but end before reaching the

base. The same lingual side shows two longitudinal grooves just near the carinae, separated by a median ridge; the anterior groove is narrower and deeper, while the posterior one is wide but shallow.

Teeth with the same character complex are known from several localities ranging from the Early Cretaceous (Barremian of Uña, Spain; Rauhut & Zinke, 1995) to the Late Cretaceous (Campanian of Champ-Garimond, France, Sigé *et al.*, 1997; Early Maastrichtian of Taveiro, Portugal, Antunes & Sigogneau-Russell, 1991; Laño, Spain, Le Lœuff, 1992 and Quintanilla del Coco, Spain, Pol *et al.*, 1992, respectively; Maastrichtian of North America, Currie *et al.*, 1990). The North American teeth, previously referred by Cope (1867, cf. Currie *et al.*, 1990) to *Paronychodon lacustris*, a taxon widely distributed in the Campanian-Maastrichtian of North America, were recently discussed by Currie *et al.* (1990); these authors restrict the name *Paronychodon* only to the teeth with unserrated carinae coming mostly from Maastrichtian beds. Defined as such, *P. lacustris* differs from R.1431, however, in having a larger number of longitudinal ridges (but it should be noted that no author figured any “true” *Paronychodon* teeth, so that no direct comparisons can be made here).

Closely comparable teeth from the Cretaceous of Europe were described as *Euronychodon portucalensis* (Antunes & Sigogneau-Russell, 1991) and cf. *Euronychodon* (Rauhut & Zinke, 1995); these are more similar (indeed, almost identical; compare fig. 3f, g to Rauhut & Zinke, 1995 : fig. 1b) to R.1431. However, it should be noted that the teeth reported as cf. *Paronychodon* by Pol *et al.* (1992 : fig. 5a) and Sigé *et al.* (1997 : fig. 13) differ from R.1431 in having a convex (largely convex in the Quantanilla del Coco specimens) lingual side, being serrated distally (Quantanilla del Coco) or missing anterior and posterior carinae at all (Champ-Garimond).

Norman (1990) and Le Lœuff (1992) listed *Euronychodon* as *Coelurosauria nomina dubia* and *Theropoda nomina dubia*, respectively. Le Lœuff (*op. cit.*) considered the referred teeth as “growth anomalies”, following Currie *et al.* (1990), although even these authors did not reject the name *Paronychodon* on the same ground, noting that: “the name *Paronychodon lacustris* should be restricted to non-serrated forms. These tend to be more common in

Maastrichtian beds and conceivably may represent a distinct taxon of theropods” (*ibid.*, p. 117). Sigé *et al.* (1997) consider *Euronychodon* morphologically identical to *Paronychodon*, taxon showing then a wide range of variability; however, their figure and the tentative comparison with *Richardoestesia* (a North American taxon with teeth of distinct morphology including serrated anterior and posterior carinae, clearly different from R.1431; Currie *et al.*, 1990) cast doubts on the correctness of their conclusion.

Rauhut & Zinke (1995) also consider their cf. *Euronychodon* as a valid taxon, possibly related to the primitive ornithomimosaur *Pelecanimimus polyodon* from the Barremian of Las Hoyas, Spain (Perez-Moreno *et al.*, 1994).

The occurrence of cf. *Euronychodon* teeth in the Late Cretaceous of Hateg along with those in Portugal and Spain, may provide evidence of the existence of a peculiar, small theropod, widely distributed in the south European archipelago.

4- Theropoda indet

Material: R.1583. (Note added in correction: more, uncatalogued referred specimens were recently recovered from the same site - the Fantanele microvertebrate site at Valioara).

Only the tip and distal part of the crown are preserved. The crown is laterally compressed, pointed, curved distally and slightly lingually. The labial side is largely rounded transversely, but with a small, longitudinally depressed area near the anterior edge, an area that ends at some distance from the tip. The lingual side is more flattened (but still convex) with a similar, wider depression presenting two low longitudinal ridges. The most peculiar feature of the crown is represented by the two non-serrated, but sharp, thin carinae on the anterior and posterior edges. As the specimen is well preserved and unworn at its tip, clearly its edges would have also been smooth in life.

This laterally compressed, pointed tooth most probably belongs to a small theropod dinosaur. However, the unserrated condition of both the anterior and posterior carinae is uncommon among theropods; it is present in the purported primitive maniraptoran *Lisboasaurus estesi* from the Kimmeridgian of Guimarota, Portugal (but see Buscalioni *et al.*, 1996, who regard *L. estesi* as a crocodylomorph), in

Spinosaurus from the early Late Cretaceous of northern Africa (Elzanowski & Wellnhofer, 1992), in the primitive ornithomimosaur *Pelecanimimus* (Perez-Moreno *et al.*, 1994) and in the basal metornithine *Mononykus olecranus* (Perle *et al.*, 1993).

Among these taxa the only one that might be positively compared to R.1583 is *Pelecanimimus*, whose teeth are more blade-like, but still with unerrated carinae distally in the jaws (*Mononykus* has leaf-shaped, spatulate, straight teeth, *Spinosaurus* teeth are conical, while those of *Lisboasaurus* are lingually flat and unrecurved). In this case, and if Rauhut and Zinke (1995) correctly pointed out a possible *Euronychodon* - *Pelecanimimus* relationship, then R.1583 could belong to the same taxon as the tooth referred to above as cf. *Euronychodon*. It should be noted, however, that no skeletal material referable to any primitive ornithomimosaur has been reported until now from Hateg.

Alternatively, the tooth may represent juvenile (neonate) velociraptorine dinosaurs as those described by Norell *et al.* (1994). The outline of R. 1583 (as well as that of the newly recovered, still uncatalogued specimens) conforms to that of the teeth figured by these authors (Norell *et al.*, 1994, fig. 2.), and their generally small dimensions (tooth height rarely exceeds 1,5 mm, and usually falls in the 0.5-1 mm interval) are also suggestive of their juvenile origin. They seem, however, to be more labio-lingually compressed than the velociraptorine teeth from Ukhaa Tolgod. As a more remote possibility, the teeth might come from another, non-dinosaurian archosaur (crocodilian) taxon.

REASSESSMENTS OF PREVIOUSLY PUBLISHED SMALL THEROPOD REMAINS

As previously mentioned, other described small theropod material from the Hateg Basin includes proximal left femoral fragments (BMNH A.1234, 1235; in 1913 Andrews described them as *Elopteryx nopcsai*), a distal left femoral fragment (FGGUB R.351, described as *Elopteryx nopcsai* by Grigorescu & Kessler, 1981; we do not agree with Le Lœuff, 1992 who listed R.351 as a distal tibiotarsus), distal tibiotarsi (BMNH A.1528, 1588, 4359, described as *Bradycneme draculae* and as *Heptasteornis andrewsi*

by Harrison & Walker, 1975), caudal vertebrae (FGGUB R.70, 71; Grigorescu, 1984b), proximal ulna and distal tibia (FGGUB R.72 and 73, respectively; Grigorescu, 1984b), paired frontals (MAFI v.13528; Jianu & Weishampel, 1997) and a partial skull roof (associated frontal, MCDRD 454 and parietals MCDRD 254, described as dromaeosaurid closely related to *Saurornitholestes* by Weishampel and Jianu, 1996). These remains will not be described here (for detailed descriptions, see the references) but their taxonomic assignments will be discussed (except for the MCDRD and MAFI material in whose referral we agree with Weishampel and Jianu, 1996 and Jianu and Weishampel, 1997, respectively).

We prefer to treat the remains as separate items (contra Le Lœuff, 1992, who assigned all the Hateg small theropod material to the dromaeosaurid *Elopteryx nopcsai*).

The proximal femoral fragments ('*Elopteryx nopcsai*', figs. 5a-e) show several features that point to their affinity with maniraptorans. First of all, '*Elopteryx*' is member of the Tetanurae, sharing with them the following synapomorphies :

- mediodorsally inclined femoral head (Perez-Moreno *et al.*, 1993);
- lesser trochanter laterally displaced, adjacent and cranial to the greater trochanter and projecting above the proximal margin of femoral head (Rowe & Gauthier, 1990; Perez-Moreno *et al.*, 1993);
- absence of a trochanteric shelf (Perez-Moreno *et al.*, 1993).

It is also member of Coelurosauria, sharing the following characters :

- tip of lesser trochanter level with the greater trochanter proximally;
- fourth trochanter weak or absent (Perez-Moreno *et al.*, 1993; Sereno *et al.*, 1996).

Among coelurosaurs, '*Elopteryx*' can be characterized by :

- confluence of the lesser trochanter with the greater trochanter (Benton, 1990), condition shared with the troodontids *Saurornithoides mongoliensis* (Russell, 1969, Currie & Peng, 1993) and ? *Sinornithoides youngi* (Russell & Dong, 1993), the dromaeosaurid *Variraptor mechinorum* (Le Lœuff & Buffetaut, this volume ; see also Le Lœuff *et al.*, 1992) and the basal metornithine *Mononykus olecranon* (Perle *et al.*, 1993). However, the continuous plate of bone formed

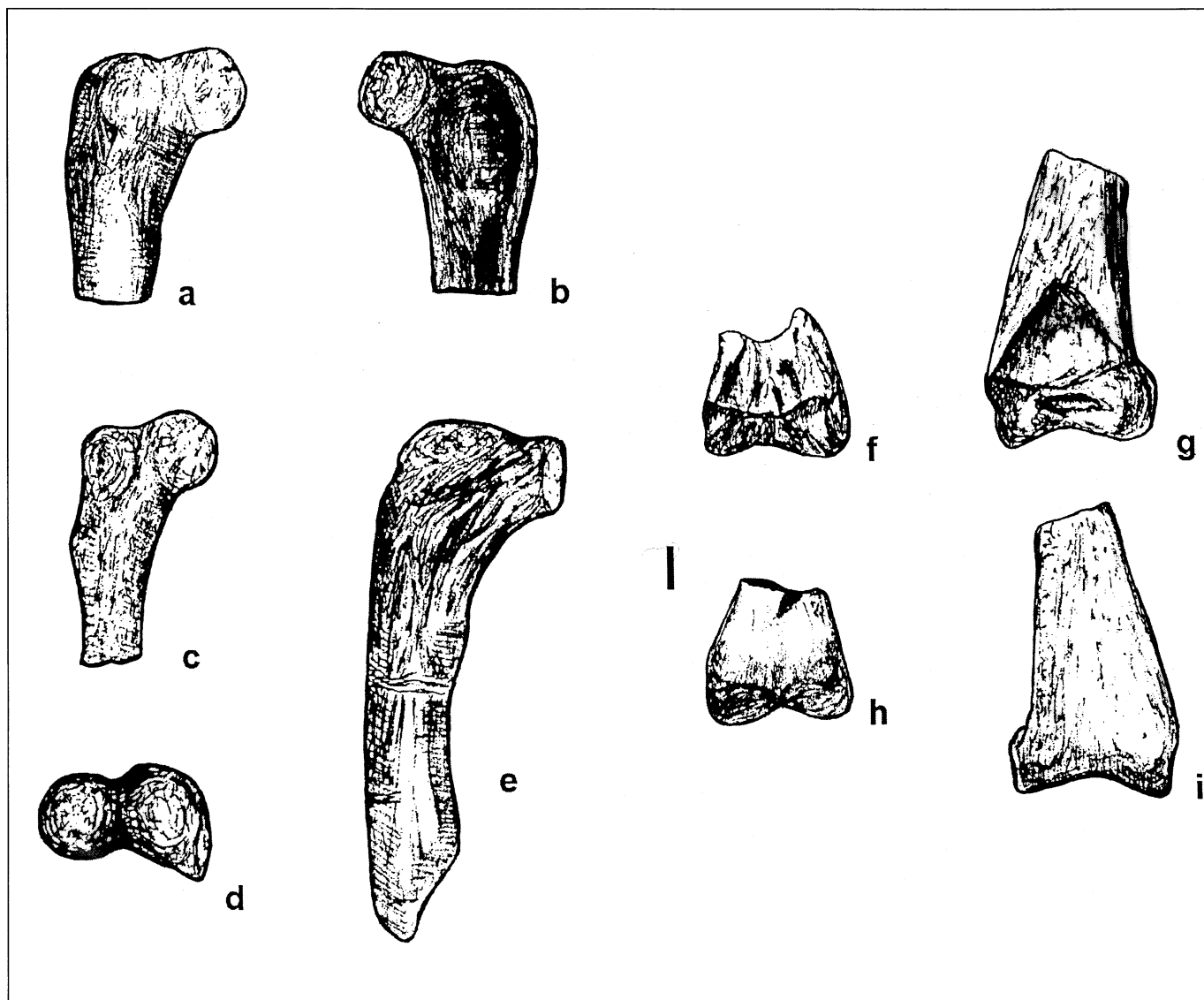


FIGURE 5. Small theropod hindlimb fragments from the Hateg Basin. *Eopteryx nopcsai*: proximal femur (BMNH R.1234) in a - cranial; b - caudal; c - mediocaudal and d - proximal view. Proximal femur (BMNH R.1235) in e - caudal view. *Bradycneme draculae*: left distal tibiotarsus (BMNH R.4359) in f - cranial and g - caudal view; right distal tibiotarsus (BMNH R.1588) in h - cranial and i - caudal view. Scale bar = 1 cm. (After Le Loeuff, 1992)

by the two trochanters are oblique as in dromaeosaurids (see fig. 5d) rather than perpendicular to the long axis of the femoral head as in troodontids (Currie & Peng, 1993);

- well-developed posterior trochanter; shared with dromaeosaurids (Ostrom, 1990), troodontids (*Troodon formosus*, Le Lœuff, 1992; *Saurornithoides mongoliensis*, Currie & Peng, 1993; *Sinornithoides youngi*, Russell & Dong, 1993), *Avimimus portentosus* (Norman, 1990), *Archaeopteryx lithographica* and enantiornithine birds (Chiappe & Calvo, 1994).

In Enantiornithes, however, the posterior trochanter is differently shaped (op. cit.: fig. 6). As the absence of the posterior trochanter is a synapomorphy of Ornithurae (Chiappe & Calvo, 1994), the avian nature of *Eopteryx* is seriously doubted.

- very reduced or absent fourth trochanter; shared with troodontids (*Sinornithoides*, *Saurornithoides*), dromaeosaurids (*Deinonychus*, *Variraptor*), elmsaurids (Currie, 1990), *Microvenator celer* (Norman, 1990), *Mononykus* (Perle *et al.*, 1994).

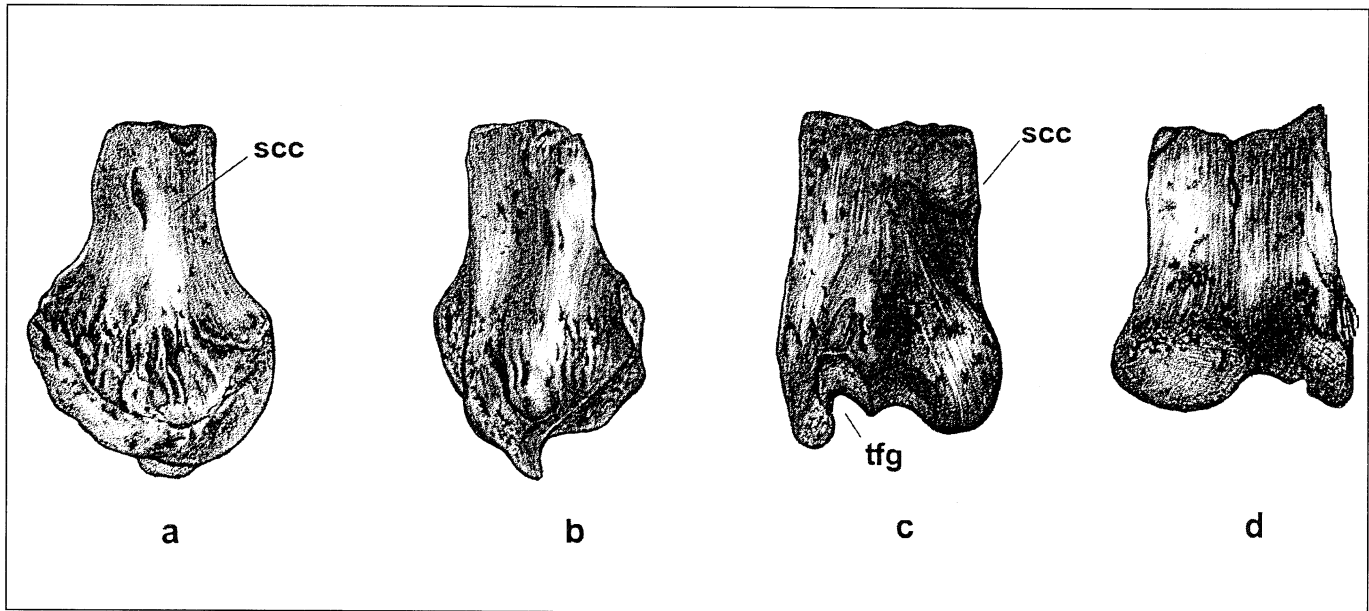


FIGURE 6. Small theropod (?abelisaurid): distal femur (FGGUB R.351) in a - medial; b - lateral; c - caudal and d - cranial view.

Abbreviations: tfg - tibiofibular groove; scc - supracondylar crest. Scale bar = 10 mm.

Moreover, as *Elopteryx* lacks certain synapomorphies of Ornithothoraces or higherbirds (absence of posterior trochanter; Chiappe & Calvo, 1994), it hardly can be positioned among the Neornithes as it was proposed by Andrews (1913).

Finally, although we cannot (and would not) definitively rule out the conclusion reached by Le Loeuff *et al.* (1992), it is still a possibility that *Elopteryx* is a troodontid or some other derived maniraptoran instead of a dromaeosaurid.

The distal femur (FGGUB R.351, fig. 6) referred to *Elopteryx* by Grigorescu & Kessler (1981) shows some peculiar features worth of noting. Its suggested avian nature can be questioned because it seems to lack several characteristic avian features (Chiappe & Calvo, 1994), as :

- femoral popliteal area bounded distally by a transverse bridge (synapomorphy of Metornithes);
- presence of a prominent patellar groove (synapomorphy of Enantiornithes + Ornithurae).

However, it still can belong to an avialian theropod, sharing the following synapomorphy with Enantiornithes + Ornithurae :

- tibiofibular crest on the lateral condyle of the distal femur.

If not avialian, R.351 shows features that could indicate a close relationship to ceratosaurs :

- absence of a well-marked cranial intercondylar groove on the distal femur. The presence of a cranial intercondylar groove is considered a synapomorphy of Tetanurae by Perez-Moreno *et al.* (1993) and Novas (1992).

This character is also shared with the derived maniraptoran *Avimimus* (Norman, 1990), dromaeosaurids (Ostrom, 1976), troodontids (Currie & Peng, 1993), ornithomimosaurs (with the possible exception of *Gallimimus*, Molnar *et al.*, 1990) and oviraptorosaurs.

- presence of a distinctively deep groove at the base of the crista tibiofibularis (Rowe & Gauthier, 1990; listed as a synapomorphy of Ceratosauria by Perez-Moreno *et al.*, 1993; Holtz, 1994).

- presence of a non-elliptical muscle scar on the craniodistal region of the femur.

This character is shared with neoceratosaurs i.e. the common ancestor of *Ceratops* and *Carnotaurus* and all its descendants, and some non-tetanuran avipods (sensu Novas, 1992) as *Pianitzkysaurus*, *Eustreptospondylus* (Perez-Moreno *et al.*, 1993).

• presence of a craniomedial crest originating above the medial (tibial) condyle, called the supracondylar crest. This crest has been described in *Carnotaurus sastrei*, a middle Cretaceous abelisaurid from Argentina and also reported to be present in the European Maastrichtian abelisaurids *Betasuchus* and "Laño theropod" (cf. *Tarascosaurus*) (Le Lœuff & Buffetaut, 1991).

A prominent craniolateral tubercle (called "apophysis for the external gastrocnemial muscle" by Grigorescu & Kessler, 1981) is also present in *Avimimus portentosus* (Norman, 1990).

Autapomorphies of R.351 include the triangle-shaped, depressed popliteal area bordered by the converging ascending ridges of the distal articular condyles and a cranially extended medial condyle. The relationships of R.351 are not easy to establish; as shown, it shares more characters with neoceratosaurs (the clade that also includes abelisaurids, otherwise known from the Late Cretaceous of France and Spain; Buffetaut & Le Lœuff, 1991) than with either dromaeosaurids, troodontids or other tetanuran theropods. Neither can it belong to '*Elopteryx nopcsai*' which represents a derived maniraptoran theropod, unless '*E. nopcsai*' is a peculiar, unknown type of theropod. However, more and better preserved material is needed to solve this question.

The tibiotarsi are here referred to as '*Bradycneme draculae*' (fig. 5f-i). We agree with Le Lœuff *et al.* (1992) who synonymize Harrison & Walker's (1975) *Bradycneme* and *Heptasteornis* (contra Paul, 1988), but disagree in that the tibiotarsi necessarily belong to '*Elopteryx*'; in fact it will be shown that they probably do not belong to a taxon of derived maniraptoran affinities.

'*Bradycneme*' has the following derived characters in common with Tetanurae (Serenó *et al.*, 1996):

- astragalar articular condyles oriented craniodistally;
- astragalar ascending process plate-like, relatively well developed;
- astragalar condyles with cranial transverse groove.

The character is listed by Sereno *et al.* (1996; character 19) as a tetanuran synapomorphy, reversed in coelurosaurians more derived than *Deltadromeus*, and by Holtz (1994; character 23) as a tetanuran synapomorphy reversed in either Coelurosauria (under ACCTTRAN option of PAUP) or the [Dromaeosauridae+Aves] + [Oviraptorosauria +

Arctometatarsalia] clade (under DELTRAN option of PAUP). BMNH A.1588 and 1528 (at least) show this transverse groove (compare Harrison & Walker, 1975 : figs. 1b, c, also fig. 5g, this paper, with the condition seen in *Sinraptor*, Currie & Zhao, 1993: figs. 23 D, J).

Among Tetanurae '*Bradycneme*' can be closely compared to troodontids, *Avimimus* and derived birds; all of these taxa show a more or less well fused tibiotarsus. The broad, cranio-caudally flattened shape of the distal tibiotarsi is similar to that seen in troodontids (see Russell, 1969 : fig. 11 - *Troodon*; Barsbold, 1974 : fig. 4 - *Saurornithoides*; Osmolska, 1987 : fig. 1 - Borogovia), showing well pronounced, cranially projected condyles separated cranially and distally by a deep intercondylar groove that becomes very narrow caudally; a calcaneum that is either fused to the astragalus (Russell & Dong, 1993) or missing (Currie & Peng, 1993); and an external fossa at the base of the ascending process.

This later character is listed as character 123 by Holtz (1994) as being present in some members of Troodontidae, Tyrannosauridae and Ornithomimosauria; from these taxa, Tyrannosauridae and Ornithomimosauria have broader distal fibular ends (than can be presumed for '*Bradycneme*') that articulate with a distinct calcaneum and condyles that are separated by broad, shallow depressions rather by grooves (Molnar *et al.*, 1990; Barsbold & Osmolska, 1990). Moreover, '*Bradycneme*' also compares with troodontids in the following features: lateral condyle extends more distally than the medial one; cranially slightly divergent condyles; lateral condyle triangle-shaped in distal view with a craniolaterally projecting "lip" (compare Russell, 1969 : fig. 11c with Harrison & Walker, 1975 : pl. 65, fig. 5) and a narrow laterocranial groove for articulation with the fibula. It differs, however, in the unusually asymmetrical, "broken" cranial view, the presence of a transverse groove on the cranial face of the articular condyles (see above) and a relatively lower, triangular rather than tall, parallel-sided astragalar ascending process (if correctly interpreted from the figures of Harrison & Walker, 1975).

Le Lœuff (1992) suggested that these tibiotarsi are similar to that of *Deinonychus*; however, we are unable to identify any specific similarity with *Deinonychus* (see Ostrom, 1969 :fig. 68) which has a

shallower intercondylar groove cranially (i.e. cranially less protruding condyles), no fossa at the base of the ascending process and no transverse groove on the articular condyles. In conclusion '*Bradycneme draculae*' is considered here as another small theropod taxon from Hateg that shares most characters with troodontids, but also has a synapomorphy that seems to exclude it from the derived coelurosaurs (see above, Holtz's character 23). Thus, the systematic position of '*B. draculae*' cannot be more precisely assessed at present. This is why we prefer to use the name '*Bradycneme*' only informally.

The other remains from Hateg that were previously assigned to small theropods do not warrant special discussion. The vertebrae, fragmentary tibia and ulna figured by Grigorescu (1984b) do not exhibit any certain theropod features and are here regarded as indeterminate dinosaurs. A small, slender tibia from Tustea locality (FGGUB R.252), labeled as "theropod" does not belong to a theropod dinosaur as it lacks a crest for the articulation of the fibula (fibular crest; Benton, 1990).

CONCLUSIONS

Reevaluation of the remains belonging to rare small theropod dinosaurs recovered from the Hateg Basin, recognized only in the last decade, reveal a previously unexpected diversity (see also Jianu & Weishampel, 1997). As no associated remains have so far been recovered, the isolated teeth, femoral fragments and distal tibiotarsi were treated separately in the present study. This approach presumably gives a greater apparent than real diversity; further discoveries of better preserved, associated material may in fact reveal the presence of fewer new small theropod taxa with unusual character associations, not yet known from elsewhere.

The study of the isolated small theropod teeth led to the identification of three (perhaps four) different taxa: a velociraptorine dromaeosaurid, a "troodontid-like" small theropod, and a *Euronychodon* - like theropod (in order of decreasing abundance). Another taxon with distally recurved, carinated but unserrated teeth may be indicated by a tooth fragment. Conversely, this tooth may belong to the same taxon as *cf. Euronychodon*, taxon with possibly close affinities

with certain primitive ornithomimosaur (such as *Pelecanimimus*).

'*Elopteryx nopcsai*' is restricted to the proximal femora of a derived maniraptoran, close to either dromaeosaurids, troodontids (or even *Avimimus*), or representing a new taxon within this clade ("elopterygines" of Le Loeuff *et al.*, 1992).

By contrast, the distal femur previously referred to *Elopteryx nopcsai* by Grigorescu & Kessler (1981) shows synapomorphies of neoceratosaurian theropods and may represent a small abelisaurid. Small-sized abelisaurids are known from the Late Cretaceous of both South America (*Noasaurus leali*; Novas, 1992) and Europe (*Tarascosaurus salluvicus*, *Betasuchus bredai*; Le Loeuff & Buffetaut, 1991, 1995), but, owing their fragmentary nature, no direct comparisons can be made.

'*Bradycneme draculae*' is informally retained to denominate the small theropod taxon represented by the distal tibiotarsi. Although the possibility, expressed by Le Loeuff *et al.* (1992), that they do belong to the same taxon as the proximal femora, cannot be ruled out, '*Bradycneme*' shows at least one clear synapomorphy (cranial transverse groove on astragalar condyles) that seems to exclude it from the maniraptoran (even coelurosaurian) Tetanurae, a clade where '*Elopteryx*' was shown to probably belong.

Without more complete, associated material, it is impossible to recognize whether such disarticulated material like that from the Hateg Basin belongs to the same taxon; moreover, as their currently recognized synapomorphies show, the hindlimb elements seem to represent taxa from different theropod clades. The only case of recognizable conspecificity may be represented by the velociraptorine teeth and the skull roof fragments described by Weishampel & Jianu (1996); but it must be pointed out that even if '*Elopteryx*' should prove to represent a dromaeosaurid, it seems to exhibit such primitive characters that exclude its conspecificity with the theropod of Weishampel and Jianu. Thus, the name '*Elopteryx*' should not be used for this latter taxon. The conspecificity of the other small theropod remains is even harder to demonstrate for the present. Norman (1990 : p. 280) stated, that: "... in ideal circumstances, taxa should be only erected and given binomial status on the basis of diagnostic characters (synapomorphies). If material is discovered which is

of considerational scientific interest by virtue of its stratigraphic or geographic position, or because it represents new evidence of hitherto unappreciated faunal association, then it would be perfectly legitimate to define the new material on general (family, ordinal status) terms rather than more specifically, thus drawing attention to important material and ideally provoking greater research." ; therefore, we choose to report on but not to name any of the Hateg small theropods until better preserved, more complete material is found. The already proposed names (*Elopteryx nopcsai*, *Bradycneme draculae* with *Heptasteornis andrewsi* as junior synonym) are retained only for informal usage.

At least three different taxa of small theropods are recognized from the Hateg Basin: a neoceratosaur (probably an abelisaurid), a (?non-coelurosaurian) tetanuran (*Bradycneme draculae*) and a derived maniraptoran (*Elopteryx nopcsai*); the presence of a velociraptorine dromaeosaurid is further substantiated. How the described teeth may relate to these different taxa is unclear for the present, but the *Euronychodon*-type teeth point to the presence of a peculiar kind of theropod known from the European Cretaceous only by its teeth (it is noteworthy that neither neoceratosaurs nor known tetanurans seem to have had such teeth). However, we caution again that further discoveries of better preserved specimens may show that some of these remains with different affinities may in fact represent a single taxon of new, peculiar small theropods.

A final remark is worth making about the paleoecological implications of the data presented here. Contemporaneous European faunas seem to have had larger theropods at the top of the food chain: abelisaurids such as *Tarascosaurus* from the Campanian and Early Maastrichtian of France and Early Maastrichtian of Spain; *Betasuchus* from the Late Maastrichtian of Netherlands (Le Lœuff & Buffetaut, 1991, 1995) or "megalosaurid"-grade theropods from the Late Maastrichtian of Portugal (Antunes & Sigogneau-Russell, 1996), along with small theropods (dromaeosaurids, euronychodons, etc.). The Hateg fauna, in turn, seems to have a more "diffuse" top of the food pyramid, with a larger number of small theropods replacing the top predator. This phenomenon seems to be related to the general body dwarfism, already noted for other Hateg dinosaurs

(Weishampel *et al.*, 1991) which, in turn, is certainly related to the insular, small-area habitat of this fauna. We are not aware of any dinosaur fauna that lacks a large top predator (usually represented by "megalosaur-grade" theropods, allosauroids or tyrannosaurids in the northern continents, and abelisaurids in Gondwana); even in the Late Cretaceous Asian faunas, with their diverse small theropod faunal component, the top predators are represented by tyrannosaurids (though of smaller size; Holtz, 1994). Even in the case of the "Djadochtan" (Jerzykiewicz & Russell, 1991) faunal assemblages from the Bayn Dzak and correlative strata, where small theropods (*Velociraptor*, *Oviraptor*, *Saurornithoides*, *Avimimus*) are outstandingly abundant and tyrannosaurid remains are rare, these remains were continuously found. The case of the Hateg fauna is singular and surely can be explained by the restrictive, insular environment these dinosaurs lived in.

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NOTE ADDED IN CORRECTION

After submitting the manuscript, we became aware of the description of a new theropod dinosaur taxon from the Late Cretaceous of Mongolia (Osmólska, 1996), *Bagaraatan osborni*. The holotype specimen of *Bagaraatan* includes among others the almost complete femur and tibiotarsus, evidently found in association.

Osmólska (1996) was rather confused when assessing the relationships of the new theropod taxon. She noted the presence of unusual character associations in *Bagaraatan*, such as the confluence of the lesser and greater trochanters and the presence of a well-developed posterior trochanter on the proximal, respectively the absence of well-marked cranial intercondylar groove and the presence of a distinctively deep groove at the base of the crista tibiofibularis on the distal femur (all these features are also found in an indetermined avimimid from the Late Cretaceous of Iren Nor; Osmólska, 1996 : p. 31). On the crus there are also worth noting the fusion between the tibia and the proximal tarsals and the presence of a horizontal groove on the cranial face of the astragalus. *Bagaraatan* also shares with the Hateg theropod(s?) the presence of a lateral tubercle (ectepicondyle of Osmólska, 1996, fig. 11) on the lateral articular condyle of the femur (also present in the Iren Nor avimimid), a narrow popliteal area and head of femur raised slightly above the level of the proximal end of the greater and lesser trochanters (at the same level in *Deinonychus*). Finally, the author notes the features shared by *Bagaraatan* with the ceratosaurs (including those of the hindlimb; also present in R. 351 or '*Bradycneme*'), although considers them homoplastic rather than suggesting real phylogenetic relationships. Consequently, in spite of the great number of conflicting characters, Osmólska places the new taxon from the Nemegt Formation among the Avetheropoda, a position that is concordant with that suggested by us for '*Elopteryx*' and partially with that for '*Bradycneme*'.

Bagaraatan osborni thus presents some of the peculiar features noted by us in the isolated theropod hindlimb material from Hateg Basin, showing that our cautioning ("further discoveries of better preserved specimens may show that some of these remains with different affinities may in fact represent a single

taxon of new, peculiar small theropods") may turn out to be correct. Consequently, rather than representing a wide assemblage of small theropods, the hindlimb elements from the Hateg Basin, discussed in the paper, might as well belong to a new, unusual theropod taxon. May it be like this, the new theropod taxon from Hateg might be closely related to *Bagaraatan osborni* (and possibly to the Iren Nor avimimid, as well), thus presenting evidence of the Asian affinities of the Hateg fauna (already suggested by Csiki, 1995).

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