Zeitschrift: Eclogae Geologicae Helvetiae
Herausgeber: Schweizerische Geologische Gesellschaft
Band: 93 (2000)
Heft: 3

Artikel: A Richardoestesia-like theropod tooth from the Late Cretaceous foredeep, south-central Pyrenees, Spain
Autor: Prieto-Márquez, Albert / Gaete, Rodrigo / Galobart, Angel
DOI: https://doi.org/10.5169/seals-168837

0012-9402/00/030497-5 $1.50 + 0.20/0
Birkhäuser Verlag, Basel, 2000

Eclogae geol. Helv. 93 (2000) 497–501

A *Richardoestesia*-like theropod tooth from the Late Cretaceous foredeep, south-central Pyrenees, Spain

ALBERT PRIETO-MÁRQUEZ[1] RODRIGO GAETE[2], ANGEL GALOBART[2] & LLUÍS ARDÈVOL[3]

Key words: Theropoda; *Richardoestesia*, tooth, Campanian-Maastrichtian, Tremp, south-central Pyrenees

ABSTACT

A theropod tooth reminiscent of the teeth of the North American species *Richardoestesia gilmorei* (Dinosauria: Theropoda) has been identified on the basis of its overall morphology and its rectangular and minute denticles. It was found associated with a dinosaur nesting site in deltaic deposits of the Aren Sandstone Formation near Tremp (Campanian, Late Cretaceous, south-central Pyrenees, Spain). These preliminary results extend the fossil record of this taxon in Spain and would support the hypothetical survival of an Early Cretaceous Euramerican theropod lineage as far as the Late Cretaceous of southwestern Europe.

RESUME

Une dent de théropode, reminiscente de la forme *Richardoestesia gilmorei* (Dinosauria: Theropoda) d'Amérique du Nord, a été identifiée à la base de sa morphologie générale et ses denticles très petits et rectangulaires. Elle a été découverte associée avec un gisement des nids de dinosaures, dans les dépôts déltaïques du Campanien (Crétacé tardif), de la Aren Sandstone Formation, près de Tremp (Lérida, Pyrenées centre-sud, Espagne). Ces résultats préliminaires permettent étendre l'enregistrement de ce taxon à l'Espagne, et peut donner support à une survivance hypothétique d'une ligne de théropodes du Crétacé initial d'Amérique du Nord jusqu'au Crétacé tardif du sud-ouest Européen.

1. Introduction

The Late Cretaceous record of the Coelurosauria (Dinosauria, Theropoda) in Europe is relatively poor. Only a few localities from Portugal (Antunes & Sigogneau-Russell, 1991), southern France (Buffetaut *et al.*, 1986; Le Loeuff *et al.*, 1992), the Hateg Basin in Romania (Csiki & Grigorescu, 1998; Le Loeuff & Buffetaut, 1998) and northwestern and southeastern Spain (Astibia *et al.*, 1990; Canudo *et al.* (1997) have provided remains. However, these remains are often scarce and fragmentary.

We report preliminary results concerning the finding of a theropod tooth from northeastern Spain. The fossil site is called L'Abeller (Figure 1) and is located on top of the Aren Sanstone Formation (Mey *et al.* 1968), exposed along the northern part of the Tremp syncline. The Aren Sandstone Fm is composed mostly of grains of quartz with scarce feldspar, chert, quartzite, debris of mica and fossils (Nagtegaal *et al.* 1983). The sandstones usually show cross-bedding and are mostly deposited in delta-front environments. The Aren Sandstone Fm grades upsection into lagoonal clays and fluvial red beds of the Tremp Formation (Mey *et al.* 1968) that spans the K-T boundary, and was deposited as a deltaic complex in the Late Cretaceous foredeep basin of the south-central Pyrenees. The fossil site of L'Abeller may be assigned to the Late Campanian Aren-2 sequence (Gradstein *et al.* 1995). The age of this sequence is inferred by the occurrence of *Gansserina gansseri* Zone (Elser 1982; X. Orue-Etxeberria, personal communication, 1998).

[1] Museum of the Rockies, Montana State University, 600 W. Kagy Blvd, Bozeman, MT 59717, USA. E-Mail: redshore@hotmail.com
[2] Institut de Paleontologia "M. Crusafont". Escola Industrial 23. 08201 Sabadell, Spain. E-Mail: m.sabadell.pal@diba.es
[3] GeoPlay.Madrazo 33–37, 4-1. 08006 Barcelona, Spain. E-Mail: geoplay@catalunya.com

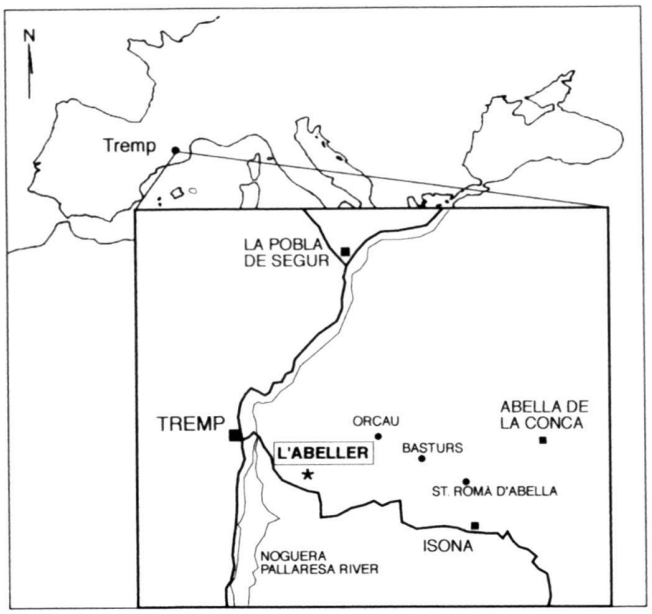


Fig. 1. Geographical location of the L'Abeller site.

2. Stratigaphy and sedimentology of the L-Abeller fossil site

The stratigraphy at the L'Abeller is complex and consists of four units, as described below (Fig. 2). The dominant lithology is sandstone, commonly containing eggshell fragments, eggs and egg clutches. The tooth described in this paper was found upsection, in a body of medium-grained massive sandstones showing large-scale cross-stratifiction.

Unit 1. Lower sandstone body: very coarse-grained structureless sandstones rich in fragments of eggshell. Remains of bones are scarce and generally too fragmentary for proper identification. The top of the unit shows development of paleosols with bioturbation, at least two nests of dinosaur, a few isolated eggs, and badly-preserved dinosaur footprints. Both nests contain five eggs, one clutch being spread across an area 4 meters wide (Figure 3a), the other being scattered within a radius of approximately one meter (Fig. 3b). Each egg is roughly 20 centimeters in diameter.

Unit 2. Clays with nodules of carbonate: a thin level of grayish clays pinching out downdip after a few meters. Neither egg nor eggshells were found in this horizon, but fragments of bone and internal casts of terrestrial gastropods are abundant.

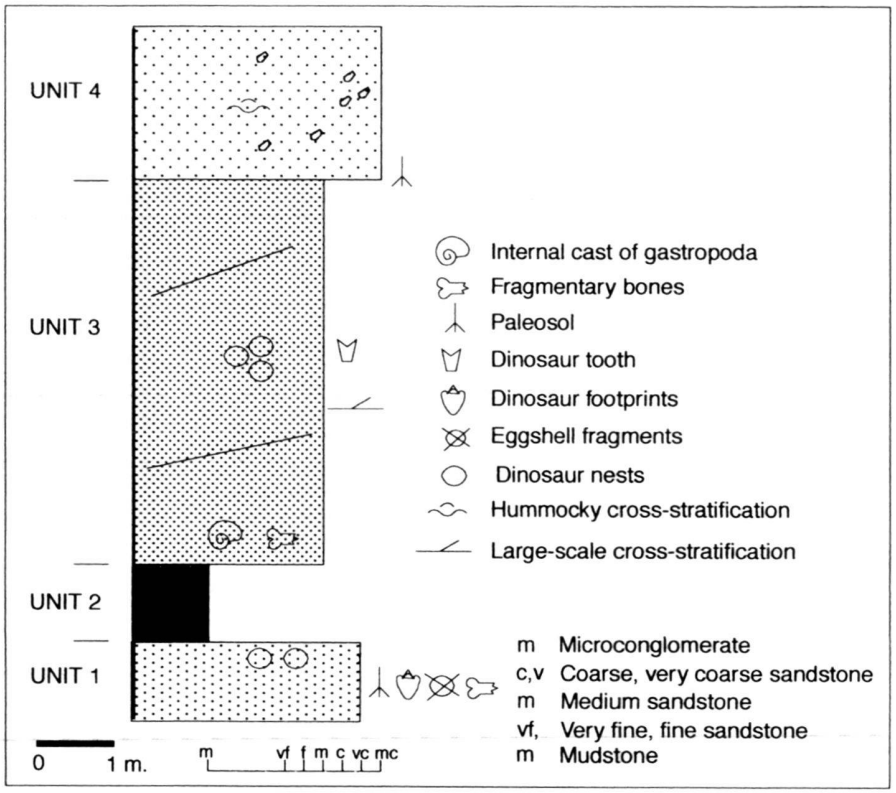


Fig. 2. Stratigraphic section of the L'Abeller site.

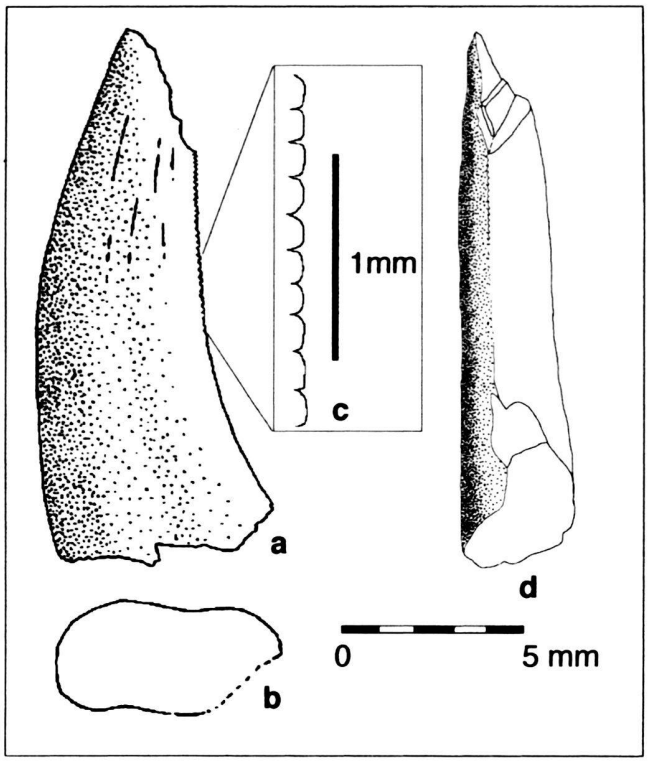


Fig. 3. IPS 18.372. a: laterial view; b: basal cross-section; c: detail of denticles; d: posterior view.

Tab. 1. Morphometric table of tooth characters of the most similar maniraptoran theropods, compared with the specimen IPS 18.372. Only observable characters in the L'Abeller specimen are used for comparison. (1): Calculated from Farlow *et al.* 1991, BW = 0.71 * FABL (mm) – 1.26. (2): Currie *et al.* 1990, Fig. 8.6, J-M (specimen TMP 81.16.194). (3): Currie *et al.* 1990, Fig. 8.2. (4): Currie *et al.* 1990, Fig. 8.6. (5): Baszio 1997.

Parameter (data in mm)		*Dromaeosaurus albertensis*	*Saurornitholestes langstoni*	*Richardoestesia gilmorei*	Tremp theropod
FABL (fore-aft basal length)	Currie *et al.* 1990	6 – 8	2.1 – 5.1	3.7 – 7.5	5.85
	Baszio, 1997	2.8 – 8 (avg: 4,79)	avg: 3,80	avg: 3,04	
Crown height (Farlow *et al.*, 1991)		12 – 19	3 – 9.2	6 – 19	14.03
Denticles/5mm on posterior keel (Farlow *et al.*, 1991)		15 – 18	20 – 32	24 – 31	34
Denticles/mm on posterior keel (Currie *et al.*, 1990)		3.3	4 – 6.4	4.8 – 6.2	6 - 8
Denticles/mm on posterior keel (Baszio, 1997)		3 – 6 avg: 4.5	3 – 6 avg: 4.7	5 – 12 avg: 7.5	6-8
Denticle basal length (Farlow *et al.*, 1991)		0.26 – 0.34	0.16 – 0.25	0.15 – 0.19	0.10 – 0.16
Tooth basal width (BW) (Farlow *et al.*, 1991)		3 – 4.42 (1) 2.14 – 4.88 (5)	0.94 – 2.36 (1)	1.5 – 4.06 (1)	3.11
Labio-lingual compression index (L= FABL:BW)		1.81 – 2	2.16 – 3.3	1.84 – 2.72	1.88
Num. Serrated keels (Cur rie *et al.*, 1990)		Both	Both (occasionally only posterior)	Often posterior	Visible only posterior
Posterior keel longitudinal position (Currie *et al.*, 1990)		Close to midline (4)	Close to midline (3)	Labio-lingually displaced (2)	Labio-lingually displaced
Denticle morphology (Currie *et al.*, 1990)		Rectangular	Hooked	Rectangular	Rectangular
Basal cross-section (Currie *et al.*, 1990)		Oval or subrectangular	Subrectangular	Subrectangular (2)	Subrectangular

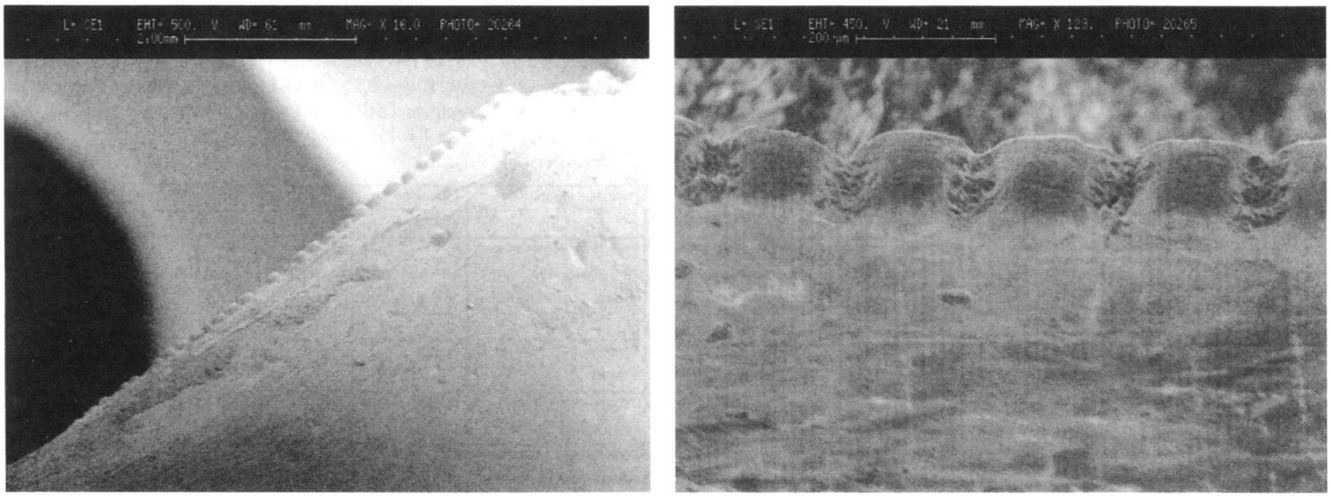
Unit 3. Upper sandstone body: medium-grained massive sandstones rich in fragments of eggshell showing large-scale cross-stratification. They contain at least two partially eroded nests with five eggs in vertical cross-section, and several isolated eggs microstructurally identified as *Megaloolitus pseudomamillare* (Vianey-Liaud & López-Martínez 1997). The tooth of the theropod described and discussed in this paper was found associated with the eggs. The body of sandstone shows a lobate form and pinches out onto the paleosol on top of the lower body of sandstone. The unit is capped by azoic pebbly sandstones with hummocky cross-stratification *(Unit 4).*

3. Description of specimen IPS 18 372

The specimen IPS 18 372 (Fig. 3, 4), deposited in the "Institut Paleontologic Crusafont" (Sabadell, Spain), is a blade-like tooth of a theropod dinosaur. It lacks the root and some of its apical region, but is otherwise nearly complete. The crown is distally recurved with a concave posterior keel and a convex anterior one (Fig. 3a, d). The crown is laterally compressed so that its labio-lingual thickness is about half of the antero-posterior width, and it has a subrectangular basal cross-section. The fore-aft basal length (FABL) (Tab. 1) is 5.8 mm and the basal width 3.1 mm (Fig. 3b). Perpendicular to FABL the height of the tooth is 14.0 mm. However, when measured from the most distal point of the truncated tip to the most proximal end of the base, the height is 15.3 mm. The crown is slightly concave in the proximal part on both the labial and lingual surfaces.

Only the apical end of the posterior carina displays serrations, with 34 small denticles preserved (the specimen is broken at the tip) (Figs. 3c, 5a, b) and a denticle density of 6–8 denticles per mm (Tab. 1). The denticles start halfway along the anterior keel of the crown, and gradually grow in size towards the apex, the largest being the most terminal ones. Each denticle has a roughly squared overall morphology, slightly rounded on the top. The serrated carina is somewhat displaced from the medial plane of the posterior edge of the crown.

The anterior edge shows a large wear facet adjacent to the apex. This single wear surface covers almost two thirds of the length of the anterior carina. Where not affected by the wear facet, the anterior keel is smooth and labio-lingually rounded.



a b

Fig. 4. SEM photographs of anterior keel denticles of IPS 18.372. a, magnification X = 16; b, magnification X = 129.

4. Discussion. Affinities of IPS 18 372

The possession of serrated margins, labio-lingual compression, and blade-like overall shape identifies the tooth as belonging to the Theropoda. The most similar teeth are those of the Dromaeosauridae and the Canadian species. *Richardoestesia gilmorei*. These taxa share with the tooth from L'Abeller a subrectangular basal cross-section and square-shaped denticles.

The hooked denticles of velociraptorine dromaeosaurids, as exemplified by *Saurornitholestes langstoni*, differ from the squared morphology of those of the L'Abeller site and *R. gilmorei* (Currie *et al.* 1990). The denticles of the dromaeosaurine *Dromaeosaurus albertensis* are somewhat distally recurved (Currie *et al.* 1990). Such a feature is not observed in the L'Abeller tooth. Those from *Dromaeosaurus*, *Richardoestesia* and the theropod of L'Abeller are rectangular with short and shallow interdenticle slots (Currie *et al.* 1990).

Most coelurosaur taxa have denticles on both carinae. The difference in size between anterior and posterior denticles is a diagnostic feature of dromaeosaurid theropods (Buffetaut *et al.* 1986; Ruiz-Omeñaca *et al.* 1995). However, Canudo *et al.* (1997) report the discovery of teeth with only one serrated carina, and teeth with single serrated keels have been found within taxa containing teeth with both serrated keels. This is the case with *Saurornitholestes langstoni* and *Richardoestesia gilmorei* (Currie *et al.* 1990), and is relevant to the specimen from L'Abeller, for which only the posterior denticles are observable. However, the erosion of much of the anterior margin makes it impossible to decide if the anterior keel was serrated.

Neither velociraptorines nor dromaeosaurines have tiny serrations (Currie *et al.* 1990). However, the denticles of *R. gilmorei* are especially minute (Currie *et al.* 1990; Baszio 1997). The measure defined by Farlow *et al.* (1991) as number of denticles per 5 mm of carina places the velociraptorine *Saurornitholestes*, *Richardoestesia* and the theropod of L'Abeller in the same range of denticle densities (Tab. 1). However the minute size and the similar morphology of the denticles of *R. gilmorei* place the Spanish theropod closer to this species than to any other known taxon.

5. Conclusions

This is the first instance of a theropod tooth from the southern Pyrenees. In overall form, basal cross-section, location of the serrated carina, size, density and morphology of the denticles, the tooth of the theropod from L'Abeller (IPS 18 372) is most similar to the teeth of cf. *Richardoestesia* (specimen TMP 81.16.194. Currie *et al.* 1990, Fig. 8.6, J–M). We therefore tentatively assign the specimen to a maniraptoran (sensu Maniraptora Gauthier 1986) theropod clade close to the Canadian species *Richardoestesia gilmorei*. This species of coelurosaur theropod has not yet been placed in any of the named families below the clade Maniraptora, within the order Theropoda, and its phylogenetic relationships remain unclear (Currie *et al.* 1990).

This is the first Coelurosauria reported from the Late Cretaceous foredeep of the south-central Pyrenees. The scarcity of the L'Abeller material and the problematic status of *R. gilmorei* (Currie *et al.* 1990) makes its assignment below the level of the clade Maniraptora inappropriate, even though the specimen shows close affinities with North-American taxa.

At the same time, the presence of a *Richardoestesia*-like theropod in the Late Cretaceous of the Pyrenees would extend fifty millions of years the fossil record of this form in Spain

(Canudo *et al.* 1997) and would add a new piece of evidence concerning the presence of surviving ther opods following the scenario postulated by Le Loeuff & Buffetaut (1998). These authors noted the presence of maniraptoran theropods both in North America and Europe, pointing out that a common Euramerican stock existed during the Early Cretaceous, then in the Late Cretaceous evolving separately in each continent.

Acknowledgments

We thank Dr. Lourdes Casanovas for her advice and for allowing us access to her data. We also appreciate the assistance given by Dr. Philip J. Currie, Dr. John R. Horner and Dr. David B. Weishampel, who made comments on the manuscript. Finally we would like to thank Julio Company for his critical remarks and fresh ideas during the draft stage of the paper, and to Steven Robinson, who reviewed it in its final stage of preparation.

REFERENCES

ANTUNES, M. T. & SIGOGNEAU-RUSSELL, D. 1991: Nouvelles donnés sur les Dinosaures du Crétace superieur du Portugal. Comptes Rendus de l'Académie des Sciences de Paris, 313, II, 113–119.

ASTIBIA, H., BUFFETAUT, E., BUSCALIONI, A. D., CAPPETTA, H., *et al.* (14 other authors) 1990: The fossil vertebrates from Laño (Basque Country, Spain); new evidence on the composition and the affinities of the Late Cretaceous continental faunas of Europe. Terra Nova 2, 460–466.

BASZIO, S. 1997: Systematic paleontology of isolated dinosaur tooth from the latest Cretaceous of southern Alberta, Canada. Courier Forschungsinstitut Senckenberg 196, 33–77.

BUFFETAUT, E., MARANDAT, B. & SIGÉ, B. 1986: Découverte de dents de Deinonychosaures (Saurischia, Theropoda) dans le Crétacé supérieur du Sud de la France. Comptes Rendus des Sciences de Paris 303, II, 15, 1393–1396.

CANUDO, J.I., CUENCA-BESCÓS, G. & RUIZ-OMEÑACA, J.I. 1997: Dinosaurios dromaeosáuridos (Saurischia, Theropoda) en el Barremiense superior (Cretácico inferior) de Castellote, Teruel. Geogaceta 22, 39–42.

CSIKI, Z. & GRIGORESCU, D. 1998: Small theropods from the Late Cretaceous of the Hateg Basin (Western Romania) – an unexpected diversity at the top of the food chain. Oryctos 1, 87–104.

CURRIE, P. J., RIGBY JR., J. K. & SLOAN, R. 1990: Theropod teeth from the Judith River Formation of southern Alberta, Canada. In: Dinosaur Systematics: Perspectives and Approaches (Ed. by CARPENTER, K. & CURRIE, P. J.), Cambridge University Press, 107–125.

ELSER, W. 1982: Quantitative biofazies-analyse im Maastrict der Südpyrenäen: Unpublished Ph. D. thesis, University of Tübingen, Germany, 212 pp.

FARLOW, J. O., BRINKMAN, D. L., ABLER, W. L. & CURRIE, J. P. 1991: Size, shape, and serration density of theropod dinosaur lateral teeth, Modern Geology 16, 161–198.

GRADSTEIN, F. M., AGTERBERG, F. P., OGG, J. G., HARDENBOL, J., VAN VEEN, P., THIERRY, J. & HUANG, Z. 1995: A Triassic, Jurassic and Cretaceous time scale. In: Geochronology, time scales and global stratigraphic cor relation (Ed. by BERGGREN, W. A., KENT, D. V., AUBRY, M.-P. & HARDENBOL, J.) SEPM, Special Publication 54, 95–126.

LE LOEUFF, J., BUFFETAUT, E., MECHIN, P. & MECHIN-SALESSY, A. 1992: The first record of dromaeosaurid dinosaurs (Saurischia, Theropoda) in the Maastrichtian of southern Europe: palaeobiogeographical implications. Bulletin de la Société Géologique de France 163, 337–343.

LE LOEUFF, J. & BUFFETAUT, E. 1998: A new dromaeosaurid theropod from the Upper Cretaceous of southern France. Oryctos 1, 105–112.

MEY, P. H. W., NAGTEGAAL, P. J. C., ROBERTI, K. J. & HARTEVELT, J. J. A. 1968: Lithostratigraphic subdivision of post-Hercynian deposits in the south-central Pyrenees. Leidse Geologische Medelingen 41, 221–228.

NAGTEGAAL, P. J. C., VAN VLIET, A. & BROUWER, J. 1983: Syntectonic coastal offlap and concurrent turbidite deposition: the Upper Cretaceous Aren Sandstone in the southcentral Pyrenees, Spain. Sedimentary Geology 34, 185–218.

RUIZ-OMEÑACA, J. I., CANUDO, J. I. & CUENCA-BESCÓS, G. 1995: Dientes de dinosaurios (Ornithischia y Saurischia) del Barremiense superior (Cretcico inferior) de Vallipón (Castellote, Teruel). Grupo de Estudios Masinos. Mas de las Matas (Teruel) 15, 59–103.

VIANEY-LIAUD, M. & LÓPEZ-MARTÍNEZ, N. 1997: Late Cretaceous dinosaur eggshells from the Tremp Basin, Southern Pyrenees, Lleida, Spain. Journal of Paleontology 71, 1157–1171.

Manuscript received August 12, 1999
Revision accepted August 28, 2000