

# IV EUROPEAN WORKSHOP ON VERTEBRATE PALAEOLOGY

ALBARRACIN (Teruel, Spain) JUNIO DE 1999



## Programme and Abstracts

### Field guide

Edited by

José Ignacio Canudo

Gloria Cuenca-Bescós

Universidad de Zaragoza  
Zaragoza, Spain



Universidad de Zaragoza





# **IV EUROPEAN WORKSHOP ON VERTEBRATE PALAEOLOGY**

**ALBARRACIN (Teruel, Spain) JUNIO DE 1999**

Organizing Committee

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## **Remmert Daams: In memoriam**

Este libro de comunicaciones del IV European Workshop on Vertebrate Paleontology queremos dedicarlo a la memoria de Remmert Daams (1947-1999).

Remmert era un holandés con las raíces en España. Su memoria perdurará en el Aragoniense y en el Ramblense y en todas las tesis de ardillas, eomyidos, teridomyidos, lirones y otros pequeños vertebrados que se hicieron con su ayuda.

Porque fué un excelente paleontólogo de vertebrados y sobre todo un amigo para todos aquellos que trabajamos con él buscando roedores en las cuencas terciarias españolas.

Porque nos abrió la puerta del Pleistoceno a los que ahora trabajamos en los microvertebrados de Atapuerca.

This book of communications from IV European Workshop on Vertebrate Palaeontology is dedicated in memory of Remmert Daams (September 1947 – Mayo 1999). A Dutch man with many spanish connections and an inspiring colleague in vertebrate palaeontology but above all a dear friend to all of us that wotked with him in the Tertiary rodents of the Spanish basin.



## **TUESDAY, June the 8th**

### **First field trip**

**8,30 - 9,30 h. Registration desk at the Congress Palace**

Phone: (34) 978 710093 / (34) 639 350520

**Departure from: Albarracín old town parking (Explanade  
Cemetery)**

**Time of departure: 9,30**

**1. Tertiary mammals from the Teruel Basin.**

**2. Mesozoic vertebrates from Upper Jurassic and Lower Cretaceous  
Galve Basin**

**Leaders: Gloria Cuenca Bescós, José Ignacio Canudo & Luis Alcalá**

**WEDNESDAY, June the 9th**

**9.00-11 h Registration desk at the Congress Palace**

Phone: (34) 978 710093

**11 h Coffee/tea**

**11.30 h Opening**

**12 h CONFERENCE**

*José Luis SANZ*

The beginning of the modern avian flight

**13-14.20 h Lunch Buffet at the Congress Palace**

**14.20-15.20 h First Poster session**

**Session 1 -Chair: Eric Mulder**

**15.20-15.40 h Neils BONDE**

Descriptive palaeontology and diagnoses in the light of cladistics, a disussion

**15.40-16 h Deborah S. WHARTON**

The evolution of the brain and braincase from the cocodriple to the bird, focusing on the theropod-bird transition

**16-16.20 h Hector BOTELLA & José Ignacio VALENZUELA-RIOS**

Early Devonian microvertebrate remains from Nigiüella (Iberian Chains, Spain)

**16.20-17 h Coffee break**

**Session 2 -Chair: José Luis SANZ**

**17-17.20 h Alexander MUDROCH**

Contribution of Sr-isotope analyses to the paleoecology of fish

**17.20-17.40 h J. P. BILLON-BRUYAT**

Fossil vertebrate footprints: systematic and palaeoecology

**17.40-18 h Nathalie BARDET, Pascal GODEFROIT & Jacques SCIAU**

A new elasmosaurid plesiosaur from the Lower Jurassic of Occitania

**18-18.20 h José Luis BARCO**

Proximal cervical vertebra of a new big sauropod (Saurischia) from the Tithonian-Berriasian (Jurassic-Cretaceous transition) from Galve (Teruel Spain).



**THURSDAY, June the 10th****Session 3 Chair: Neils BONDE**

- 9.00-9.20 h** *Rafael ROYO-TORRES*  
Pelvic girdle of the sauropod (Dinosauria) from Peñarroya de Tastavins (Lower Aptian, Teruel, Spain).
- 9.20-9.40 h** *Jean LE LOUEFF, Eric BUFFETAUT, Varavudh SUTEETHORN, Hayan TONG, Sasidhorn KHANSUBHA, Sutee JONGAUTCHARIYAKUL, Gilles CUNY & Christel SOUILLAT.*  
Early Cretaceous dinosaur footprints from Thailand
- 9.40-10.00 h** *José Luis BARCO, José Ignacio CANUDO, Rafael ROYO-TORRES, & José Ignacio RUIZ-OMENÏ*  
**ACA**  
Bones, teeth and tracks: about sauropod dinosaur remains from Upper Jurassic and Cretaceous of Aragón (Northeastern Spain).
- 10.00-10.20 h** *M. I. BLANCO, Susana CARO, A. LÓPEZ, Feliz PÉREZ-LORENTE, R. REQUETA & M. ROMERO*  
The Las Losas Paleozoological site
- 10.20-11 h** Coffee break

**Session 4 Chair: Jean Le LOUEFF**

- 11-11.20 h** *Eberhard FREY & David M. MARTILL*  
The heritage of the Lost World: Pterosaurs from the Crato Formation
- 11.20-11.40 h** *Gloria CUENCA BESCOS & José Ignacio CANUDO*  
A Lower Cretaceous traveller: *Gobiconodon*: ("Triconodont", Mammalia) from Vallipón (Upper Barremian, Teruel, Spain).
- 11.40-12 h** *Mark B. GOODWIN & John R. HORNER*  
Cranial morphology, histology, and ontogeny of pachycephalosaurid dinosaurs: the "battering-ram" hypothesis takes a hit.
- 12 h** CONFERENCE  
**Nieves López Martínez**  
The Pyrenean record of the mass extinction around the Cretaceous -Tertiary boundary

**13-14.20 h Lunch Buffet at the Congress Palace**

**14.20-15.40 h 2a Poster session**

**Session 5 Chair: Nieves LOPEZ MARTINEZ**

**15.40-16 h** *Coralia Maria JIANU & Gijsbert J. BOEKSCHOTEN*  
A new look at the Hateg Island

**16-16.20 h** *José Ignacio CANUDO, Luis ARDEVOL, Gloria CUENCA-MURELAGA, BESCOS, Nieves LOPEZ-MARTINEZ, Xabier PEREDA-SUBERBIOLA, José Ignacio RUIZ OMEÑACA & Xabier ORUE-EXTEBARRIA*  
New dinosaur localities near the Cretaceous/Tertiary  
from Arén (Southern Pyrennes, Huesca, Spain)

**16.20-17 h Cofee break**

**17-17.20 h** *Rudi W. DORTANGS, John W.M. JAGT, Eric W.A. MULDER & Anne S. SCHULP*  
Excavation of a Late Maastrichtian Mosasaur skeleton at  
the Enci-Maastricht BV Quarry (Maastricht, Southeast  
Netherlands)

**17.20-17.40 h** *Eric W.A. MULDER, Nathalie BARDET, Pascal GODEFROIT & John JAGT*  
Latest Cretaceous elasmosaur remains from the  
Maastrichtian type area, Belgium and Morocco and their  
palaeobiogeographical implications

**17.40-18 h** *Zoltan CSIKI & Dan GRIGORESCU*  
New data on the multituberculate mammals from the  
Uppermost Cretaceous dinosaur-bearing deposits of the  
Hateg Basin

**20.30 - Workshop dinner**

**FRIDAY, June the 11th**

## Session 6 -Chair: Nathalie Bardet

- 9.20-9.40 h**      *Annette V. KRISTOFFERSEN*  
Cranial anatomy of an early Paleogene trogon (Aves: Trogoniformes) from northern Europe.
- 9.40-10.00 h**      *Jan VAN DER MADE & Jorge MORALES*  
Early Miocene Anthracotheres from Europe and the description of a specimen from Loranca, Spain.
- 10.00-10.20 h**      *Adeline AUMONT*  
Morphological variability of north european paromomyid species (preliminary results).
- 10.20-10.40 h**      *Elvira MARTÍN-SUÁREZ & Matthijs FREUDENTHAL*  
A latest Miocene micromammal fauna from the Zorreras member (Sorbas Basin, SE Spain).
- 10.40-11 h**      **Coffee break**

## Session 7 Chair: Eberhard FREY

- 11-11.20 h**      *Mette Elstrup RASMUSSEN*  
Baleen whales (cetacea, Mysticeti) from the Late Miocene Gram Formation in Denmark
- 11.20-11.40 h**      *Hervé MONCHOT*  
Biostratigraphical interest of small bovids from Arago Cave (Tautavel, Pyrénées-orientales, France)
- 11.40-12 h**      *Gloria CUENCA BESCOS, José Ignacio CANUDO & Cesar LAPLANA*  
Evolution of *Mimomys* and the radiation of *Microtus* (Arvicolidae, Rodentia, Mammalia) during the Early Pleistocene the case of Trinchera Dolina 6 (Atapuerca, Burgos, Spain)
- 12 h**              CONFERENCE  
**Juan Luis Arsuaga**  
Sexual dimorphism, body mass and encephalization in Middle Pleistocene Humans
- 13-14.20 h**      **Lunch Buffet at the Congress Palace**

**14.20-15.20 h 3a Poster session****Session 8 Chair: Juan Luis ARSUAGA**

- 15 -15.20 h** *Nuria GARCÍA & Juan Luis ARSUAGA*  
Carnivores at the Dolina sequence with special remarks  
to the TD6 hominid-bearing level
- 15.20 -15.40 h** *Lutz MAUL*  
Phylogeny of the Biharian ground squirrels
- 15.40 -16 h** *VAN DER MADE & J. RODRIGUEZ*  
The evolution of *Ovibos* in relation to environment
- 16-16,20 h** **Coffee break**
- 16,20-16,40 h** *José Miguel CARRETERO, Carlos LORENZO & Juan Luis ARSUAGA*  
Lower Pleistocene human postcranial remains from  
Gran Dolina Site (Sierra de Atapuerca, Burgos, Spain).
- 16,40-17 h** *Sophie MONTUIRE*  
Mammalian faunas as indicators of environmental and  
climatic changes in Europe since the Pliocene.
- 17-17,20 h** *Per CHRISTIANSEN*  
Differential allometry in proboscidean long bones
- 17,20-17,40 h** *Lutz MAUL*  
Giant hamster in the Pleistocene of Europe

**SATURDAY, June the 12th**

**Field - Trip Lower and Middle hominid bearing localities from  
Atapuerca, (Burgos, Spain)**

**Departure from: Albarracín old town parking (Explanade  
Cemetery)**

**Time of departure: 6,30**

**Leaders: Gloria Cuenca Bescós, Jose Ignacio Canudo, Juan Luis  
Arsuaga, Nuria García & César Laplana,**

## POSTERS

- Amo, O., Azanza, B., Sánchez, A., Morales, J. & Sánchez, J.**  
First record of ornithoid prismatic eggshells from the Miocene of Spain.
- Amo, O., Cuenca-Bescós, G. & Canudo, J.I.**  
Vertebrate Eggshell fragments from the Lower Cretaceous (Lower Barremian) of Camino Canales (Galve Basin, province of Teruel, NE Spain)
- Azanza, B., Morales, J., Murelaga, X., Sánchez, A., Amezua, L., Amo, O., Fraile, S., Gómez, E., Nieto, M., Pérez, B., Salesa, M., Sánchez, I. & Soria, D.**  
The middle Miocene vertebrate assemblage of Toril 3 (Zaragoza, Spain). Preliminary analysis
- Badiola, A., Astibia, H., Aranburu, A., Pereda Suberbiola, X., Murelaga, X., Sesé, C., Cuesta, M.A., Moyá-Solá, S., Baceta, J. I. & Köhler, M.**  
A new continental vertebrate locality from the Upper Eocene of Zambrana (Miranda-Treviño Basin, Alava, Basque country).
- Buchy, M.B., Mètayer F. & Frey, E.**  
Vector models as a physical method for reconstructing jaw mechanism in non-kinetic diapsid fossil marine reptiles
- Canudo, J.I., Cuenca-Bescós, G., López Martínez, N. & Ardévol, L.**  
The youngest sauropod of Western Europe
- Cavin, L., Bardet, N., Cappetta, H., Gheerbrandt, E., Mohamed Iarochene, S. & Sudre, J.**  
A preliminary report on new bony fish remains from the Paleocene and Ypresian of the Ouled Abdoun phosphatic basin (Morocco)
- Ferré, C. & Rey, J. M.**  
Gilthead sea bream *Sparus aurata* (Linnaeus, 1758) (Pisces, Sparidae) remains in Archeological sites in Galicia (Northwest Spain)
- Company, J., Murelaga, X., Pereda-Suberbiola, X. & Ruiz-Omeñaca, J. I.**  
The vertebrate fauna from the new Late Cretaceous locality of Chera (Valencia Province, Spain).
- Grandal d'Anglade, A., Vila Taboada, M. & López González, F.**  
Ontogenetic variation and sex dimorphism in the skull of the Pleistocene Cave Bear *Ursus spelaeus* ROSENMÜLLER-HEINROTH
- Hervet, S.**  
The oldest known *Testudo cf. hermanni* and *Emys orbicularis* in France (Montoussè, Hautes-Pyrénées, Pleistocene) and their chronological and geographical ranges during the Quaternary.

**Huguency, M.**

The Oligocene mammalian sequence from Alcorisa (S Ebro Basin, Spain)

**Knoll, F.**

The Family Fabrosauridae.

**Laplana, C. & Cuenca-Bescós, G.**

The ancestor of *Iberomys* Chaline, 1972: *Microtus (Allophaiomys) chalinei* or *Microtus (Allophaiomys) nutiensis*?

**Laplana, C., Montuire, S., Brunet-lecomte, P. & Chaline, J.**

A new *Microtus (Allophaiomys)* species from Les Valerots (Lower Pleistocene, France)

**Laplana, C., Muñoz, A. & Pueyo, E.**

New paleontological and paleomagnetic data about the age of the Villarroya fossil mammal site (La Rioja, Spain; Late Pliocene)

**Laurent, Y., Cavin, L. & Bilotte, M.**

A new Late Maastrichtian vertebrates locality in the french Petites-Pyrénées

**Leidner, A.**

The Synchodontiformes Duffin (Ward 1993) a concept confirmed by scale- morphologic features.

**López González, F., Vila Taboda, M. & Grandal-d'Anglade, A.**

Intraspecific variability of size in *Cervus elaphus* (Cervidae, Mammalia).

**Marcolini, F., Zanchetta, G. & Bonadonna, F. P.**

Preliminary data on two small mammal-bearing paleosoils from thyrrenian and adriatic sides of Italy.

**Mudroch, A., Delsate, D. & Herzog, A.**

On the dentition of *Dapedium* Leach 1822 (Actinopterygii, Semionotiformes).

**Pincemaille, M.**

Discovery of a skeleton of *Rhabdodon priscus* (Ornithopoda, Dinosauria) in the Upper Cretaceous of Vitrolles (Bouches-du-Rhône, France)

**Royo-Torres, R. & Ruiz-Omeñaca, J. I.**

The pubis of *Aragosaurus ischiaticus* Sanz, Buscalioni, Casanovas & Santafé, 1987, a camarasaurid sauropod from the Upper Hauterivian (Lower Cretaceous) of Galve, Teruel, Spain.

**Ruiz-Omeñaca, J. I., Cuenca-Bescós, G. & Canudo, J. I.**

Dinosaur remains in the Barremian (Lower Cretaceous) of the Teruel Province (Iberian Chain, NE Spain).

## FIRST RECORD OF ORNITHOID PRISMATIC EGGSHELLS FROM THE MIOCENE OF SPAIN

*Olga AMO<sup>1</sup>, Beatriz AZANZA<sup>1,2</sup>, Antonio SÁNCHEZ<sup>2</sup>, Israel M.SÁNCHEZ<sup>2</sup> & Jorge MORALES<sup>2</sup>*

1 Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

2 Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

Remains of avian eggshells are described from the middle Miocene locality of Toril 3A (basin of Calatayud-Daroca, Spain). The specimens of eggshells represent 0,77 % of the collected fossils. All of them appeared concentrated in a small area of the total surface excavated of the toril 3A outcrop in the field trip of 1998. Toril 3 has also yielded a diverse and rich fauna of vertebrates. Most of them belong to large and small mammals, but also birds, turtles and amphibians are present. The rodent fauna was dated as Late Aragonian (G3 biozone; MN 7/8). The bird bones represent a relatively high percentage of the vertebrate remains (2, 34 %). Six species are recognised: four belong to galliforms, a common group in the Iberian Miocene, *Tyto* sp. and probably a charadriiform species.

Avian eggshell fragments are relatively common in Tertiary sediments, especially in the Eocene and Oligocene of North-America and Germany, the Paleocene of France, the Eocene and Miocene of Germany and the Eocene of Africa, and the Mio-Pliocene of Turkey and Morocco, but few detailed descriptions exist. In Spain only ornithoid ratite eggshells have been reported (la Gloria 4, Pliocene of Teruel and Miocene of Canarias). Two morphologies have been found among the avian eggshells from Toril 3A, but the basic type is the same, the ornithoid one, and they all can be included in the prismatic morphotype, to date unrecorded in the Spanish Miocene.

The difference between these two types lies mainly in the thickness. In type I eggshell thickness varies from 0.27 to 0.29 mm and in type II from 0.29 to 0.37 mm. In type I, one fragmentary specimen allowed an estimate of the egg shape and size, it was ellipsoidal between 30x40 mm in size. However, in type II we have found only few eggshell fragments, which are not enough to establish their size. A preliminary study of the shell structure using light polarizing microscopy (LPM) and scanning electron microscopy (SEM) is presented. In both types, the outer surface is, in general, smooth and shows no signs of any ornamentation. Single circular pore openings are observed but they were filled by a sedimentary deposit. Pore canals are not observed in radial section. On the inner surface, small mammillae are packed with irregular interstices where rounded pore openings are visible. The eggshell is composed of three distinct layers, the mammillary layer, the layer of interlocking columns (prisms) of the shell unit, and the external zone. The outline of the shell units is not distinct in most thin sections, however, under polarized light, the columnar extinction pattern of the prisms shows a more distinct outline of the shell units.

The prismatic morphotype is compatible with the known avifauna of Toril A. There are few available studies of the comparative morphology in ornithoid



prismatic eggshells. Therefore, to date we have no grounds with which we can attribute the recognised types of avian eggshells to any of the three groups - Galliforms, Strigiforms and Charadriiforms- represented by bone remains at Toril A.

## **VERTEBRATE EGGSHELL FRAGMENTS FROM THE LOWER CRETACEOUS (LOWER BARREMIAN) OF CAMINO CANALES (GALVE BASSIN, PROVINCE OF TERUEL, NE SPAIN)**

*Olga AMO, Gloria CUENCA-BESCÓS & José Ignacio CANUDO.*  
Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

The Galve Region is famous for its Lower Cretaceous vertebrates assemblages. In different localities from the continental sediments of the Galve syncline a diversity of dinosaurs, crocodiles, turtles and mammals have been described.

Some of the vertebrate-bearing levels have reported too eggshell fragments. The first description of this kind of remains from Galve was given by Kohring, (1990) who assigned them to turtles (A, B, C types), dinosaurs (E and F types) and crocodiles (only one type).

Here we classify, identify and systematically describe the vertebrate eggshell fragments from Camino Canales, one of the levels from the lower Barremian of Galve. This is accompanied of the analysis of their macrostructure and microstructure using light polarizing microscopy with thin sections (LPM) and scanning electron microscopy (SEM).

A total of 225 eggshell fragments (about 0,01-0,1 cm<sup>2</sup> in size) have been recovered from this site. They consist of fragments of mixed basic type:

-two types of Testudoid eggshells (Spherurigidus and Spheruflexibilis morphotype).

-One type of Crocodiloid eggshell.

-Four different types of dinosaurian eggshells (Ornithoid, Dinosauroid-spherulitic and Dinosauroid-prismatic morphotypes).

-One type of geckonoid eggshell.

Classification of the ootaxa is in accordance with the most recent classification scheme for fossil eggs, referred to as Veterovata (Amo, 1998).

Amo, O. 1998. *Fragmentos de cáscara de huevo de vertebrados del Cretácico Inferior de Galve (Teruel)*. Tesis de Licenciatura, Universidad de Zaragoza (unpublished), 116 p.

Kohring, R. 1990. Fossile Reptil-Eirschalen (Chelonia, Crocodilia, Dinosauria) aus dem unterem Barremium von Galve (provinz Teruel, SE-Spanien). *Paläontologische Zeitschrift*, 64 (3/4), 329-344.

## **MORPHOLOGICAL VARIABILITY OF TWO NORTH EUROPEAN PAROMOMYID SPECIES (Preliminary Results)**

*Adeline AUMONT*

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,  
8 rue Buffon, 75005 Paris. FRANCE

The Paromomyidae are a family of Plesiadapiformes which are found from the Paleocene to the early Eocene in North America where they are known by four genera. In Europe, the paromomyids are known from the earliest Eocene to the middle Eocene. The diversity of this group is lower than in America, with only four species belonging to one genus.

If the American paromomyids have been the subject of many studies, it is not the case in Europe where a lot of work remains to be done. Here I restudy the two species described by Russell *et al.* in 1967 : *Arcius fuscus* and *A. lapparenti*. Their diagnoses were elaborated following the study of a limited number of isolated teeth (31 and 12 specimens) found in two different localities of the Paris Basin. Those species are the only paromomyids present in northern Europe. Since 1967, new discoveries have been made in this region.

Condè-en-Brie (Aisne, France) is one of the best sampled locality of the early Eocene of Europe (more than 300 paromomyid isolated teeth have been recovered); therefore, it is the best material to start a revision of north European paromomyids. The numerous specimens should allow a better understanding of the group variability.

The morphological study and the biometric approach of Condè specimens show us that the definition of *Arcius fuscus* and *A. lapparenti* is no more accurate. The characters used by Russell to distinguish one species from the other broadly overlap. However, it is difficult to decide what to do with the specimens. The major problem comes from working on isolated teeth which are sometimes difficult to identify: M/1/ can be easily confused with M/2/ and with deciduous premolars.

Most of the morphological and biometrical results suggest the presence of only one species at Condè-en-Brie. However, the data are not always consistent; for example, the morphology of M1/ and the biometry of M3/ could lead to conclude that two species are present. Furthermore, the morphological variability and the coefficients of variation are higher than in any other mammal species of the Eocene.

Two hypotheses can be discussed:

- two species are present but not as Russell supposed, they have to be rediagnosed;
- there is only one species but its variability is high and has to be explained.

The understanding of the Condè-en-Brie assemblage is essential to study all the other localities from the Paris Basin and to link the European paromomyids with their American relatives.

## THE MIDDLE MIOCENE VERTEBRATE ASSEMBLAGE OF TORIL 3 (ZARAGOZA, SPAIN). PRELIMINARY ANALYSIS

Beatriz AZANZA<sup>1,2</sup>, Jorge MORALES<sup>2</sup>, Xabier MURELAGA<sup>3</sup>, Antonio SÁNCHEZ<sup>2</sup>,  
Lara AMEZUA<sup>2</sup>, Olga AMO<sup>1</sup>, Susana FRAILE<sup>2</sup>, Elena GÓMEZ<sup>2</sup>, Manuel NIETO<sup>2</sup>,  
Benigno PÉREZ<sup>2</sup>, Manuel J. SALESA<sup>2</sup>, Israel M.SÁNCHEZ<sup>2</sup>, & Dolores SORIA<sup>2</sup>

<sup>1</sup> Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

<sup>2</sup> Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

<sup>3</sup> Dpto. de Estratigrafía y Paleontología. Universidad del País Vasco.

Aptdo 644. 48080-Bilbao. SPAIN

The fossiliferous beds of Toril 3 belong to the alluvial, grading towards mudflat and paludal-lacustrine deposits, that filled the Neogene basin of Calatayud-Daroca. This basin was included in a complex system of Neogene grabens superimposed on the compressional structure of the Iberian Range. Toril 3 was placed in the central sector of the basin (Daroca zone), where the Aragonian mammal stage stratotype has been established. Toril 3 has yielded a diverse and rich fauna of vertebrates, but only the rodent faunal list, the description of the rhinocerotids and a new bovid species have been published. The rodent fauna was dated as Late Aragonian (G3 biozone; MN 7/8).

Two outcrops (TO3A and TO3B), 100 m apart, were methodologically excavated. To date, more than 2,000 specimens have been collected. Most of these belong to both large and small mammals, but also birds, turtles and amphibians are present. The composition of the identified skeletal-elements includes a relatively high percentage of crania and jaws which are the most resistant bones to transport. The high percentage of bird bones is noteworthy and the presence of avian eggshells in TO3A. Only turtle plates were found in anatomic connection, although some skeletal elements were found in groups belonging mainly to the bigger species. The spatial distribution of the bones is not homogeneous. The bones appear more densely concentrated in breccias cemented by carbonates. Most of these were deposited horizontally and only a slightly predominant NE-SW direction can be observed for the large bones.

Three species of fossil turtles Testudinidae (Geoemydinini and Testudinini) are present. The Geoemydinini are represented by cf. *Mauremys* sp., a turtle with freshwater habits, fluviatile, lacustrine or palustrine. The Testudinini are represented by two terrestrial tortoises, a *Testudo* s.l. sp. and a gigantic tortoise that lives only in warm climates. Most of the bird bones belong to galliforms, a common group in the Iberian Miocene. There are four species (one of them was probably a turkey cock), although their taxonomical study has not yet been completed. There is also one humerus belonging to *Tyto* and a tibiotarsus probably belonging to a charadriiform species. The macromammals found to date are: *Protictitherium crassum*, *Sansanosmilus palmidens*, *Martes* sp., *Gomphotherium angustidens*, *Anchitherium* sp., *Alicornops simorreensis*, *Listriodon splendens*, *Hispanomeryx aragonensis*, *Micromeryx* sp., *Euprox* sp., Palaeomerycidae indet., *Samotragus pilgrimi*, and Bovidae indet.

## A NEW CONTINENTAL VERTEBRATE LOCALITY FROM THE UPPER EOCENE OF ZAMBRANA (MIRANDA-TREVIÑO BASIN, ALAVA, BASQUE COUNTRY)

A. BADIOLA <sup>1</sup>, H. ASTIBIA <sup>1</sup>, A. ARANBURU <sup>2</sup>, X. PEREDA SUBERBIOLA <sup>1,3</sup>, X.  
MURELAGA <sup>1</sup>, C. SESÉ <sup>1</sup>, M.A. CUESTA <sup>5</sup>, S. MOYÁ-SOLÁ <sup>6</sup>, J.I. BACETA <sup>7</sup> & M.  
KÖHLER <sup>6</sup>

1 Universidad del País Vasco/Euskal Herriko Unibertsitatea, Facultad de Ciencias,  
Departamento de Estratigrafía y Paleontología, Apdo. 644, 48080 Bilbao. SPAIN.

2 Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Mineralogía y  
Petrología, Apdo. 644, 48080 Bilbao. SPAIN.

3 Muséum National d'Histoire Naturelle, Laboratoire de Paléontologie, 8 rue Buffon,  
75005 Paris. FRANCE.

4 Museo Nacional de Ciencias Naturales, Departamento de Paleobiología, c/José Gutiérrez  
Abascal, 2, 28006 Madrid. SPAIN

5 Avenida del General Goded, 37, 34005 Palencia. Spain.

6 Institut de Paleontologia "M. Crusafont", c/Escola Industrial, 23,  
08210 Sabadell, Barcelona. SPAIN.

7 Universidad de Huelva, Facultad de Ciencias Experimentales, Departamento de Geología,  
Campus de la Rábida s/n, 21819 Palos de la Frontera, Huelva. SPAIN.

Recent field work in the upper Eocene of Zambrana (Alava) has yielded continental vertebrate remains, the first discovered in the Miranda-Treviño Basin (southern part of the Basque-Cantabrian Region). This discovery increases our knowledge on the Eocene vertebrate faunas of the Iberian Peninsula.

The fossil association consists of turtles (*Chelonii* indet.), crocodylians (*Diplocynodon* sp.) and mammals, including possible insectivores (*Lipotyphla* indet.), carnivores (cf. *Quercygale* sp.), rodents (*Theridomys* aff. *golpei*, *Elfomys* aff. *parvulus*, *Pseudosciuridae* indet., *Gliravus priscus*), artiodactyls (*Xiphodontidae* indet.) and perissodactyls (*Paranchilophus* sp., *Plagiolophus* aff. *mazateronensis*, *Palaeotherium* sp.).

The fossiliferous beds are lacustrine coal-bearing marls and limestones. Although the continental deposits of the Miranda-Treviño Basin have been classically considered as Miocene (IGME, 1979; EVE, 1991), the study of the vertebrate fauna of Zambrana indicates an Eocene age. Moreover, the geological study of the area shows that the Tertiary Miranda-Treviño Basin was highly influenced by tectonic activity, and that the first compressive stresses related to the Pyrenean phase of the Alpine orogenesis took place during the early Eocene.

The Zambrana fauna looks like those of Llamaquique (Asturias, Oviedo Basin; Casanovas *et al.*, 1991) and Mazaterón (Soria, Duero Basin; Cuesta, 1991). However, the more derived dental characters of the perissodactyls (*Paranchilophus* population having narrower and more hypsodont lower molars; *Plagiolophus* populations having larger molars without cingula) and the rodent association as compared to the mentioned localities suggest a younger age for Zambrana, middle-upper Ludian (Priabonian), which corresponds to the biozone MP 18 (scale of Schmidt-Kittler, 1987). Zambrana is the first mention of vertebrates of this biozone in the Iberian Peninsula (see Sudre *et al.*, 1992;

Antunes *et al.* 1997). The mammalian fauna is comparable to the middle-upper Eocene endemic faunas from the western and central Iberian basins (and is clearly different from those of Catalonia and the north-Pyrenean regions).

**PROXIMAL CERVICAL VERTEBRA OF A NEW BIG  
SAUROPOD (SAURISCHIA) FROM THE THITONIAN-  
BERRIASIAN (JURASSIC-CRETACEOUS TRANSITION)  
FROM GALVE (TERUEL, SPAIN).**

*José Luis BARCO*

Area de Paleontología. Universidad de Zaragoza.  
C/ Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN.  
e-mail: 323756@guest.unizar.es

The new sauropod from Galve was found in the Cuesta Lonsal locality, situated in the base of the Villar del Arzobispo Formation (Thitonic-Berriasian). This formation includes the Jurassic-Cretaceous boundary, and, at least, its basal part, in which has been founded the dinosaur, is dated as Jurassic. This means that the sauropod from Cuesta Lonsal is, further the older from Aragón, one of the last dinosaurs from the Jurassic period found until today in Spain. Villar del Arzobispo Formation has been identified as subtidal, intertidal and supratidal facies and means the end of the gradual transition from shallow carbonated marine platform to continental facies (Aurell, 1990). Lithology in Cuesta Lonsal locality is green marls and clays intercalated with white sandstones deposited in intertidal environment.

The remains of the sauropod were excavated in a discontinuous way, by amateurs, in the 80s. In 1992 Gloria Cuenca-Bescós, from the University of Zaragoza, begun a systematic excavation whit the help of Michael Brunet and some students, and they recovered a badly cervical vertebra and fragments of one destroyed by the previous non-professional excavation. The bones unburied until today that we have knowledge are: two cervical vertebrae, one scapula and other remains from the pectoral girdle, the two humeri, one dorsal vertebra, some ribs, four caudal vertebrae (two of them joined for a crust and to the chevron between them), and many pieces unclassified.

Dorsal and caudal vertebrae of this sauropod have been studied previously by Pérez-Oñate *et al.* (1994) which made a previous classification of the sauropod from Cuesta Lonsal as Camarasauridae indet. They observed that the spine of the dorsal vertebra is not bifurcated and the neural arch is laterally expanded. Anyway the dorsal spine and the lateral processes are missing. The caudal vertebra is amphicoelus, whit quite short body without pleurocoels, and remarked hemal facets, and they keep the tranver processes until the 22nd one, while in all the known sauropods they disappear in the 13th to 15th caudal vertebra. The two humeri have been restored by the people who excavated them,



but they are not been studied, anyway in a previous view, some measurements have been taken. They humeri are very long (about 150 cm), which means a really big sauropod dinosaur and, although they have suffered some deformation, they are also quite thin and stylised.

The main objective of this paper is one of the cervical vertebrae. After an initial cleaning and consolidation, a previous description can be done, although the lamination of the neural arch can not be seen yet and the vertebra is quite deformed. The centrum, strongly opisthocoelous, has subcircular cross-section, which indicates a proximal position -4th or 5th- (Upchurch, 1993). The vertebra is fractured due to actual roots that have colonised it, and they have damaged, specially, the cranial face. This fact allows to see, in this cranial part of the body, that the vertebra is a spongy bone. Pleurocoelous are excavated and divided by small laminae. Although is not complete, clearly the spine is simple. The postzigapophysial lamina is elongated and consequently the parapophyses are situated in a high position.

The characters of the cervical vertebra are not clear enough at the moment. The only evident fact is the simple spine. Cervical spines of cetiosaurids, brachiosaurids and titanosaurids are simple, but in camarasaurids and diplodocids, they are bifids (McIntosh, 1990). This fact only allows the classification of this specimen as Sauropoda indet. (whereas Perez Oñate *et al.* classified it as Camarasauridae indet.), due to the existence of a simple spine in the cervical vertebra, and no any other definitely character found in the known bones.

Anyway we are almost sure that we are in front of new dinosaur specie, because the dinosaur from Cuesta Lonsal has some unclassified characters like the processes until the 22nd caudal vertebra. The other known characters, does not allow to introduce the specimen in any of the known genera by the moment.

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## **BONES, TEETH AND TRACKS: ABOUT SAUROPOD DINOSAUR REMAINS FROM ARAGÓN (NORTHEASTERN SPAIN).**

*José Luis BARCO, José Ignacio CANUDO, José Ignacio RUIZ OMEÑACA &  
Rafael ROYO-TORRES*

Paleontología, Universidad de Zaragoza. Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN

Sauropod fossil record in Aragón is very important and, although the known material is fragmentary or isolated, this area show a large diversity: diplodocids, camarasaurids and Titanosauriformes. They range from the Tithonian (Upper Jurassic) to the Aptian (Lower Cretaceous), and there are some remains that have been found in Maastrichtian (Upper Cretaceous). The most complete material comes from Peñarroya de Tastavins (Teruel) and is the result of the first systematic excavation of dinosaurs realised in Aragón. New remains could be found in other areas as a result of future actions.

All the Upper Jurassic sauropods are from Galve Basin. Three localities which show direct remains are found in Galve (Teruel) in the lower part of Villar del Arzobispo Formation, dated as Tithonian. From Collado de la Abeja the only remain is an ungual phalanx, which is unclassified. In Carretera was found the first sauropod tooth in the Jurassic of Spain, that was attributed to Diplodocidae indet. Chronologically, between them is situated the Cuesta Lonsal locality in which, have been found remains of a big sauropod classified as Camarasauridae indet., although this classification is susceptible of variation. The remains excavated until today in Cuesta Lonsal are two cervical vertebrae, one scapula and some remains from the pectoral girdle, two humeri, one dorsal vertebra, some ribs, four caudal vertebrae and chevrons. In the same levels was found one ulna classified as Sauropoda indet. Also in this formation have been recovered, in Lidón (Teruel), an unclassified sauropod caudal vertebra .

There are three reported tracksites in Villar del Arzobispo Formation: Ababuj, Aguilar de Alfambra (Alcalá & Martín, 1995) and Miravete, and except for the last one which could be either Tithonian or Berriasian, is almost sure that they are Lower Berriasian, because they are situated in a very high stratigraphical position. There is two localities (Barranco Luca 1 and 2, Galve), with sauropod tracks, in the base of Villar del Arzobispo Formation (Tithonian) which have not been classified yet.

The Cretaceous record begins in the upper part of the Villar del Arzobispo Fm (Lower Berriasian). In Las Cerradicas II (Galve), a proximal part from a femur classified as Sauropoda indet. was found in the 70s. In Las Cerradicas tracksite some of the traces can be considered as sauropod undertracks.

The only valanginian remain is a recently discovered isolate tooth from Villanueva de Huerva (Zaragoza, Villanueva de Huerva Formation, Aguilón Basin), in study.

In Upper Hauterivian, from the localities called Las Zabacheras (Galve, Castellar Formation), are found the remains of *Aragosaurus ischiaticus* (Sanz *et al.*, 1987), that was the first dinosaur described in Spain. This material, collected in the 50s, consist on one tooth, one scapulocoracoid, one ulna, one radius, part

of pelvic girdle, one femur, one fibula, one tibia, ungual phalanx, metacarpals, caudal vertebrae and ribs. Also in Upper Hauterivian is situated Corrales del Pelejón, a localities in which some sauropod undertracks.

Lapparent (1966) talks about one vertebra (in one locality) and part of a femur, one tibia and one fibula of a big sauropod (in other different one) of the Peñagolosa Basin (Lower Barremian) in Rubielos de Mora (Teruel), but this material is missing. Lapparent *et al.* (1969) found in Castellote NE (Castellote, Teruel, Morella Basin) eight caudal vertebrae, one fragment of a pelvic bone and parts of two metatarsal of Sauropoda indet., that are deposited in the Museum National d'Histoire Naturelle, Paris. In several localities from the Lower Barremian from Galve (Colladico Blanco and Pelejón in the upper part of Castellar Formation and Partida Poyales in Camarillas Formation) has been reported teeth of two different camarasaurids (Camarasauridae indet., A and B types), and other teeth from a brachiosaurid (cf. *Pleurocoelus* sp.) (Sanz *et al.*, 1987). Also in the Lower Barremian there are knowledge of one caudal vertebrae of Titanosauridae indet. from Cerrada Roya (Galve, Camarillas Formation). In another Lower Barremian outcrop, called La Cantalera (Oliete Basin, Teruel), the remains are two teeth classified as Camarasauridae indet.

In the Upper Barremian two localities have supplied remains. Several small teeth belonging to two different small sauropods (either young specimens or small in size) and two caudal vertebrae from Titanosauriformes indet. have been recovered in Vallipon and Vallipon 2 (Castellote, Teruel, Artoles Formation, Morella Basin). In Ariño there are some sauropod tracks from the Upper Barremian (Fm Artoles, Oliete Basin), still in study. Recently has been found a sauropod brachiosaurid/camarasaurid teeth in the locality of Vallipon and new indetermined sauropod and titanosauriformes vertebrae in Vallipon 3

The most complete sauropod unburied in Spain until today is becoming from the Lower Aptian from Peñarroya de Tastavins (Teruel, Morella Basin, Xert Formation). The remains were partially articulated and consist on 3 dorsal vertebrae, 5 sacral vertebrae, 25 caudal vertebrae, 19 chevrons, 2 femora, 1 tibia, 1 fibula, 7 metapodials, 4 ungual phalanx and all the bones from the pelvic girdle.

Chronologically, there is a lack of remains until the Maastrichtian. In this stage we have found four sauropod tracks in Arén (Huesca, Aren Formation) which are still in study. Also in Huesca (Trempe Formation), the proximal part of a sauropod femur has been found recently.

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## A NEW ELASMOSAURID PLESIOSAUR FROM THE LOWER JURASSIC OF OCCITANIA

*Nathalie BARDET*

UMR 8569 du CNRS, Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,  
8 rue Buffon, 75005 Paris. FRANCE

*Pascal GODEFROIT*

Département de Paléontologie, Institut Royal des Sciences Naturelles de Belgique,  
rue Vautier 29, 1000 Bruxelles. BELGIUM

*& Jacques SCIAU*

Musée Municipal de Millau, Hôtel de Pegayrolles, 12100 Millau. FRANCE

The plesiosaurs form a monophyletic group of large predatory marine reptiles whose stratigraphic extension ranges from the latest Triassic to the latest Cretaceous. Among the Plesiosauroidea, the successful elasmosaurids are known as early as the Sinemurian (lowermost Jurassic) up to the Maastrichtian (latest Cretaceous), where they achieved a worldwide distribution and become extinct during the K/T biological crisis.

*Plesiosaurus tournemirensis* Sciau, Crochet and Mattei, 1990, based on a nearly complete skeleton from the Upper Toarcian (Lower Jurassic) of Tournemire (Aveyron Department, Occitania, southern France), is redescribed and systematically reinterpreted (Bardet, Godefroit & Sciau, in press). A preliminary cladistic analysis reveals that it belongs to the Elasmosauridae, on the basis of a weakly excavated ventral cheek margin, no antepterygoid vacuities, more than 38 cervical vertebrae, cervical centra longer than high, platycoelous vertebral articular surfaces and lateral longitudinal crests in mid-anterior cervicals. Moreover, it belongs to a new genus, closely related to *Microcleidus* Watson, 1909 (Toarcian, England). This new genus is mainly characterized by spatulate premaxillae with short facial process, very high postorbital broadly contacting posterior ramus of the maxilla, trapezoidal jugal excluded from orbital margin, orbit diagonally oriented, temporal fenestra with a sigmoidal anterior margin, 43 cervical vertebrae, powerful interclavicle-clavicle complex and coracoids with a pointed protuberance on lateral border and expanded posterolateral cornua. It shares with *Microcleidus* a jugal excluded from the orbital margin by an extended contact maxilla-postorbital but differs from it by a proportionally longer skull, a more spatulate snout, higher postorbitals, shorter facial processes of the premaxillae, trapezoidal jugals, a longer neck and a different pectoral girdle. *Muraenosaurus* Seeley, 1874 (Callovian, Europe and South America) is the sister-group of this new genus plus *Microcleidus*.

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## FOSSIL VERTEBRATE FOOTPRINTS: SYSTEMATIC AND PALAEOECOLOGY

*Jean-Paul BILLON-BRUYAT*

Université de Poitiers, Laboratoire de Géobiologie, Biochronologie et Paléontologie humaine, EP 1596 CNRS, 40 av. du Recteur Pineau, F 86022 Poitiers, FRANCE.

In the Fourth Edition of the International Code of Zoological Nomenclature, an important modification will affect ichnotaxonomy: after 1999, each new genus-group nominal taxon for an ichnotaxon (taxon based on the fossilized work of an animal) will have to include the designation of a type species. This will well define the ichnogenus, give it homogeneity, and codify ichnotaxa as taxa, except for the Principle of Priority where they do not compete.

The naming and classifying of footprints depends on the aim: the identification of the trackmaker or the defining of its activities (Sargeant, 1990)? In other words: one name for the different activities of the same animal with a classification based on the trackmaker's systematic affinity, versus one name for each activity and a functional classification. This is linked to an identification problem: on the one hand to assign footprints to an ichnotaxon and on the other to associate an ichnotaxon to a taxon, because a footprint reflects to only a certain extent the anatomy of the tracemaker's autopod and its morphology can vary according to the animal dynamic and to the sediment nature and state.

In order to do palaeoecology with fossil vertebrate footprints, we must try to identify the trackmaker: footprints are referred to ichnotaxa up to family rank, and ichnofamilies are assigned to suprafamily informal groups like "theropod footprints". Naming and classifying footprints is necessary for a palaeoecological application, given that a new ichnotaxonomic discrimination can reflect the presence of an additional taxon in a palaeobiocoenosis. This is illustrated by the lagerstätte of Crayssac (Tithonian, Southwestern France), where the ichnofauna (pterosaur, dinosaur, turtle trackways) coupled with the fauna (at least 40 ichnotaxa and taxa), reveal a rich littoral ecosystem. The most important is not to identify a trackmaker species, for example a theropod species, but to recognize theropod footprints belonging to a carnivorous bipedal dinosaur and to calculate its height, weight, speed, and understand its presence and trophic position within the palaeobiocenosis. Beyond systematic limits, fossil vertebrate footprints reveal major palaeoecological information.

## THE LAS LOSAS PALEOICHOLOGICAL SITE

*M. I. BLANCO<sup>1</sup>, Susana CARO<sup>1</sup>, A. LÓPEZ<sup>2</sup>, Felix PÉREZ-LORENTE<sup>3</sup>,  
R. REQUETA<sup>1</sup> & M. ROMERO<sup>1</sup>*

<sup>1</sup> Centro Paleontológico. Portillo,3, E-26586. Enciso (La Rioja). SPAIN

<sup>2</sup> Dpto Geología. Universidad. Fuentenueva s/n. E-18002 Granada. SPAIN

<sup>3</sup> Universidad de La Rioja. Obispo Bustamante, 3. E-26004 Logroño. SPAIN

Las Losas site is situated at the point which UTM coordinates as 30TWM596671. Geologically, the site is in C4c113 level (division of the Geological Map of Spain cartography 1:50.000 scale) included in what is traditionally known as the Enciso Group. The age of this Group oscillates between Valanginian and Aptian, which has been dated with ostracods, charophytes and seaweed. There is no doubt that it belongs to the Lower Cretaceous.

The site has approximately 500 m<sup>2</sup> and was cleaned in July 1998; it gave us 379 dinosaur footprints. The footprint bed continues downwards and sideways, and in other sites belonging to the same bed we continue finding more ichnites, even more than 100 m from this point. The 379 footprints are grouped in: 58 trackways, which 268 footprints; 50 other footprints grouped in 25 peers; and 61 prints which apparently don't have any relationship among themselves and neither with any of the others. There is no ornithopod trackway. The trackways found can be separated in two groups: 53 would be of Carnosauria ichnites and 5 of Coelurosauria ones.

This site has a special feature because it has 14 trackways in which all or some of their footprints are plantigrades, which allows us to infer the genesis conditions. Also, there are ichnites that show a longitudinal groove in their toes, which may be caused by the claws dragging along the bottom during the foot movement or by the collapse of the mound in the middle of the toes when it falls towards the inside after lifting the foot from the bottom, or by both causes.

The study of the trackways direction shows more numbers of trackways in some directions. No conclusions about gregarious behaviour have been obtained at the moment. The plantigrades trackways placing lets us distinguish flooded zones and harder mound ones at one historical moment of this site; we can also distinguish the trackways which the trackmaker stepped in through out the site when it was partially flooded.

New parameters are incorporated in this footprint study, and are being tested in the analysis of the dinosaur trackways in La Rioja

## DESCRIPTIVE PALAEOLOGY AND DIAGNOSES IN THE LIGHT OF CLADISTICS A DISCUSSION

*Niels BONDE*

Geological Institute, University of Copenhagen, Oster Voldgade 10,  
DK 1350, Kobenhavn K. Copenhagen, DENMARK

The traditional way of palaeontological taxonomy species descriptions begins with reference to a certain family (or higher category) generally without a diagnosis. Then follows referral to a genus, most often with a diagnosis of "important" characters, being a mixture of relatively primitive and advanced features. The same for the succeeding species level diagnosis, an abbreviated description of some autapomorphic features mixed with some relatively plesiomorphic ones.

Then follows the description paper and a discussion hopefully pointing to differences from other species (or genera) and perhaps scrutinizing the relationships of the species, sometimes even a cladistic analysis is included and a cladogram and remarks on distribution, stratigraphic importance abundance etc. maybe even palaeoecological indications. This state of affair like the nomenclature rules in general is deplorable seen from a modern systematic or cladistic viewpoint it should be changed. The methodologies of phylogenetic systematics dictate that the taxa (as nameable monophyletic units) and their characterization by diagnoses are not a priori such is only known AFTER the character analysis has been performed.

The monophyletic groups/taxa are implied by the cladistic arguments to conform with the hypothesis of interrelationships. The diagnoses or characterization of these groups/taxa are also consequences of the preferred hypotheses of relationships, and the diagnoses must correspond to the features distinguishing each node (clade) and the terminal taxa of the cladogram.

These groups/taxa and their characters constitute those parts of the descriptive analysis supposed to mirror a pattern of Nature. In contrast, the names of the taxa and classification categories assigned to these names are pure conventions, some of them governed by nomenclature rules or recommendations. These rules were invented to conform with a Linnean hierarchies modified and understood by the since the 40ies leading "evolutionary school" of systematics, and as such these rules have stabilized the biological classifications.

Many of these rules and the style of descriptions they have habituated are on collision course with or directly opposed to cladistic philosophy and methods of modern systematics. As a consequence of the latter a description ought to contain: first, description of species or subgroups; second, comparative character analysis; third, preferred cladogram or relationships; fourth, naming of monophyletic taxa; fifth, diagnoses of these groups comprising only the relevant synapomorphies or autapomorphies; sixth, discussion on categories; seventh, perhaps a complete written classification in agreement with the cladogram and some specified conventions (subordination, sequencing, marking of extinct groups, paraphyletic groups and those of uncertain status). Then follow the geo



and stratigraphic distributions of taxa follow, and the more "esoteric" remarks on evolutionary significance, palaeontology etc.

Examples on fossil vertebrates will be presented for discussion about changing strategy and style.

## EARLY DEVONIAN MICROVERTEBRATE REMAINS FROM NIGÜELLA (IBERIAN CHAINS, SPAIN)

*Hector BOTELLA & José I. VALENZUELA-RIOS*

Departamento de Geología, Universitat de Valencia; C/, Dr. Moliner 50;  
E-46100 Burjassot (Valencia), SPAIN.

Numerous beds from the Luesma and Nogueras Fms. (Early Devonian) from two sections at Nigüella (Ni-4 and Ni-2) have yielded a rich and diverse microvertebrate (*pisces*) fauna consisting of scales, teeth, spines, tesseræ and bones of Agnatha, Thelodonti, Acanthodii, Elasmobranchii, Actinopterygii? and Placodermii. This fauna is associated to conodonts, brachiopods and ostracods (among other groups). Therefore, a direct biostratigraphic correlation between conodonts and ichthyolith remains is warranted for the levels studied herein.

The dominant remains belong to the Superclass Gnathostomata, that, except for a few beds, occur in all sampled levels from bed 7a section Ni-4 upwards (Fauna d1cg of the Luesma Fm. and Nogueras Fm.), and all beds from section Ni-2 (Nogueras Fm.)

Within the Acanthodii the following families and genera have been identified: Climatiidae Berg, 1940, genera: *Cheiracanthoides* Wells, 1944; *Climatius* Agassiz, 1845 and *Nostolepis* Pander, 1856. Ischnacanthidae Berg, 1940: scales of *Gomphonchus* sp. Gyraacanthidae Woodward, 1906: *Gyraacanthus* sp. and Gnathostomata *incertae sedis*, genus *Machaeracanthus* Newberry, 1857. It is significant the occurrence of Elasmobranchii in all levels of Ni-2, and from bed Ni-4/13 up; among them, *Iberolepis* sp., *Arauzia federicoi* Mader, 1986 and taxa of the genus *Leonodus* Mader, 1986 stand out. Specially the continuous record of from Ni-4/13 to Ni-2/6 will enable a detailed study concerning morphologic variation and evolutive trends of this genus.

It is remarkable the presence, in Ni-2, of two levels loaded with very well preserved microvertebrate remains; the lower stratum is located 21 m below the Lochkovian/Pragian boundary (L/P), identified in Nigüella by the occurrence of the index fossil *Vandercamenina sollei* Carls, 1986 (Valenzuela-Ríos & Carls, 1998), and the upper one lies about 9,5 m above the boundary. By litho and faunal contents the former bed has been correlated with upper parts of unit d2ba, and the latter one with unit d2ca2, both belonging to Nogueras Fm. in the Iberian Chains. Above and below the L/P boundary there are also such a rich bearing-microvertebrate remains strata in the Iberian Chains (Wang, 1993) and in Ardenne and Rhenish Slate Mountains sections (Blieck *et al.*, 1995). Consequently, microvertebrate remains from Nigüella show a correlative potential through the Iberoarmorican basin during the Lower Devonian.

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## VECTOR MODELS AS A PHYSICAL METHOD FOR RECONSTRUCTING JAW MECHANISM IN NON- KINETIC DIAPSID FOSSIL MARINE REPTILES

*Marie-C line BUCHY, Franck MUTAYER*

Laboratoire de G obiologie, Biochronologie et Pal ontologie Humaine  
40, avenue du Recteur Pineau, F-86022 Poitiers cedex, FRANCE  
& *Eberhard FREY*

Staatliches Museum f r Naturkunde Karlsruhe, Geowissenschaftliche Abteilung,  
Erbprinzenstra e 13, D-76133 Karlsruhe, GERMANY

In recent vertebrates, position, strength and the mode of operation of muscles are, in theory, directly accessible by means of dissection, measurement of occlusion forces and electromyography etc., despite many practical problems (see e.g. Busbey, 1989). In contrast, even if it would be possible to identify insertion areas of a muscle on a fossil, this would never allow conclusions on its absolute or relative volume neither its anatomical features. Furthermore, Mesozoic marine reptiles comprise groups without recent equivalents, being close neither in terms of phylogeny nor ecology. Theoretically, no realistic reconstruction of the jaw mechanism of these animals is possible. Only the direction of force application, the vector, could possibly be taken into account.

Some authors proposed reconstructions of Mesozoic marine reptiles, even under biomechanical aspects: McGowan (1973) on *Ichthyosaurus* sp., Kirton (1983) on *Ophthalmosaurus*, Vogt (1983) on the placodonts *Placodus*, Henodus and *Placochelys*, Rieppel (1989) on the sauropterygians *Simosaurus* and *Serpianosaurus*; Taylor (1992) and Taylor & Cruickshank (1993) on the pliosaurs *Rhomaleosaurus zetlandicus* and *Pliosaurus brachyspondylus* respectively.

In all cases a more or less elaborated two dimensions lever model is applied, which would allow to propose an explanation for the observed cranial architecture. But, the effect of certain structures (e.g. that of M. add. int. pt. post.), requires further detailed studies.

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## THE YOUNGEST SAUROPOD OF WESTERN EUROPE

*José Ignacio CANUDO,<sup>1</sup> Gloria CUENCA-BESCOS<sup>1</sup>·Luis ARDEVOL<sup>2</sup>  
& Nieves LOPEZ-MARTINEZ<sup>3</sup>,*

1: Paleontología, Universidad de Zaragoza. Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN

2: Geoplay, Madrazo 33-37, Suite 4-1, Barcelona, SPAIN

3: Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

Titanosaurids (Titanosauria) are the “sauropods of the Upper Cretaceous” (Salgado *et al.*, 1997). However, sauropods are in general poorly known in western Europe during the Late Maastrichtian though one of the first described Late Maastrichtian dinosaur was the Titanosauridae *Magyarosaurus* from Romania. Recent advances in titanosaurid studies show that the Upper Cretaceous sauropods were faithful diverse during the Campanian and Early Maastrichtian in Western Europe, but Late Maastrichtian sauropods are almost unknown: the Maastrichtian localities of the Tremp Basin with sauropods, in the Lleidan Pyrennes of Spain (Casanovas-Cladellas & Santafé-Llopis, 1993, Le Loeuff, 1993, 1998) are of Early Maastrichtian age. It is the same for the Fontllonga 6 titanosaurid (Vianey - Liaud & López Martínez, 1997).

In this context we shall describe a recently discovered proximal part of a left femur in the Tremp Formation, near Serraduy (Huesca). The fossiliferous level is composed by marshy grey clays and marls. The levels are above the *Abatomphalus mayaroensis* zone (work in prep.) and therefore Latest Upper Maastrichtian in age.

The huge lateral bulge, below great trochanter is an autapomorphy of Titanosauriformes and this character is prominent in the new finding. The 4th trochanter is, at least, 50cm below the cranial side of the head of the femur. This gives us a proximate total length for the femur of Serraduy of 150cm. It is related in size to *Titanosaurus* species. The Titanosauridae indet. from l'Estanyo in Tremp (Masriera & Ullastre, 1988) may have a similar size (there are no femur) and other European titanosaurids are smaller (Le Loeuff, 1993). López Martínez *et al.*, (1998) describe a large sauropod footprints (60cm) in Figuerola de Meia, three meters below Paleocene fossils.

The Titanosauriformes is a taxa defined by Salgado *et al.* (1997) and it includes Braquiosauridae + *Chubutisaurus* +Titanosauria. Until now, Braquiosauridae are unknown in the Maastrichtian and, they have a smaller

lateral bulge. We conclude that the femur from Serraduy belongs to the Titanosauridae clade and it is one of the biggest representants of the group that survived into the Late Maastrichtian in Western Europe.

Titanosauridae have a good diversity in western European during the Late Cretaceous (Le Loeuff, 1998) and in the continental localities of this age in general. However, in western Europe the only, well known, Upper Maastrichtian sauropod is this new finding and some tracksites with sauropod footprints that lead us to the conclusion that sauropods reach the Upper Maastrichtian and the theory of a sauropod replacement in the Late Maastrichtian by hadrosaurid dinosaurs seems more complex that postulated before. The discovery of the sauropod femur in the Tremp Formation in Serraduy shows that those dinosaurs survive up to the Latest Maastrichtian, at least in Western Europe.

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## NEW DINOSAUR LOCALITIES NEAR THE CRETACEOUS/TERTIARY BOUNDARY FROM ARÉN (HUESCA, SPAIN)

*José Ignacio CANUDO*<sup>1</sup>, *Luis ARDÉVOL*<sup>2</sup>, *Gloria CUENCA-BESCOS*<sup>1</sup>, *Nieves LOPEZ-MARTINEZ*<sup>3</sup>, *Xabier MURELAGA*<sup>4</sup>, *Xabier PEREDA-SUBERBIOLA*<sup>4,5</sup>, *José Ignacio RUIZ-OMEÑACA*<sup>1</sup> & *XABIER ORUE-ETXEARRIA*<sup>4</sup>

1: Paleontología, Universidad de Zaragoza. Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN.

2: Geoplay, Madrazo 33-37, Suite 4-1, Barcelona, SPAIN

3: Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

4: Universidad del País Vasco/Euskal Herriko Unibertsitatea, Facultad de Ciencias, Departamento de Estratigrafía y Paleontología, Apdo. 644, 48080 Bilbao, SPAIN

5: UMR 8569 DU CNRS, Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,

8 rue Buffon, 75005 Paris, FRANCE

Several rich sites containing dinosaur bones in the northern flank of the Tremp-Graus basin near Arén (Southern Pyrenees, Huesca, Spain) have been discovered during the geological map project by López Olmedo and Luis Ardévol. The Arén dinosaur sites include six fossiliferous levels, named Blasi-1, 1.5, 2 to 5, situated in a 130 m thick section from the top of the Arén Sandstone to the middle part of the Tremp Formation.

In the Arén Formation there are the levels Blasi 1 to Blasi 3. Blasi 1 contains large, scattered dinosaur bones, as well as crocodylian teeth in an area of several hundred square meters. Bones are fragmentary, without the proximal or distal ends. Among them there are at least one hadrosaurid skull elements. Blasi 3 is a sandstone body with more than 70 dinosaurian bones. Most of them belong to hadrosaurids and are scattered around an area of about 70 m<sup>2</sup>. Eight caudal vertebrae keep the anatomical connection. Additional caudal vertebrae and chevron bones are slightly disarticulated but probably belong to the same individual. Blasi 3 is separated from Blasi 1 by a thick level of grey marls named Blasi 2 containing mainly microfossils of actinopterygians, amphibians, squamates and turtles, as well as some dinosaur teeth (theropods, hadrosaurids) and eggshell remains. Blasi 1,5, which has only yielded fragmentary large dinosaur bones, is situated in a similar lithology about 150 m. westward slightly in a lower stratigraphical position, probably equivalent to the Arén Sandstone.

In the Tremp Formation there are Blasi 4 and 5. Blasi 4 is situated about 3 km. westward and about 70 m above Blasi 3. It contains few hadrosaurid and turtles remains, mainly vertebrae and dermal plates respectively. The bones are cemented in a coarse calcareous microconglomeratic level. Blasi 5 is a grey marl level intercalated in the red clays of the middle part of the Tremp Formation, about 30 m. above Blasi 4. Several fragmentary remains have been recovered among which we identify hadrosaurids, crocodylians and turtles.

Late Maastrichtian *Abathomphalus mayaroensis* biozone (planktic foraminifera) has been recognized in the Esera section near Campo. The base of this zone appears few meters above a shelfal limestone horizon which correlates well with shelf calcarenites situated about 70 m below Blasi 1 site. Thus the Arén dinosaur sites can be correlated with the *Abathomphalus mayaroensis* biozone,



very close to the Cretaceous/Tertiary boundary. Blasi are the first dinosaur sites in the world having a direct correlation with the last Cretaceous biozone of plancktonic foraminifera.

**LOWER PLEISTOCENE HUMAN POSTCRANIAL  
REMAINS FROM GRAN DOLINA SITE  
(SIERRA DE ATAPUERCA, BURGOS, SPAIN)**

*José Miguel CARRETERO*

Departamento de Ciencias Históricas y Geografía, Facultad de Humanidades y Educación,  
Universidad de Burgos, C/ Villadiego s/n, 09001 Burgos, SPAIN.

*Carlos LORENZO & Juan Luis ARSUAGA*

Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

From 1994 to 1996 nearly 80 human fossil remains have been recovered from level 6 of the Lower Pleistocene cave site of Gran Dolina at Sierra de Atapuerca (Burgos, Spain). All these fossils were excavated at the level called TD6 and have been dated in excess of 780,000 years before present. Basing on and dental traits these remains have been recently attributed to a new *Homo* species named *Homo antecessor* that may represent the last common ancestor for Neandertals and modern humans. Within the forty-five postcranial specimens of *H. antecessor* that make up the sample, vertebrae, ribs, clavicles, radii, femur, patellae and hand and foot bones are represented. Four is the minimum number of individuals identified by the postcranial remains recovered up to now, two immature and two adults. Additionally, some of these postcranial remains present cut-marks, that has been interpreted as an evidence of defleshing. All elements are briefly described anatomically, measured and compared with other fossil hominids and modern humans in order to establish, as much as possible, what postcranial morphology characterised this new species of our genus.

The *Homo antecessor* postcrania, as a whole, display a set of morphological traits that are more similar to modern humans than to the Middle and Upper Pleistocene European hominids. Our results do not contradict the previous phylogenetic analysis, i.e., that *H. antecessor* represents the last common ancestor for *H. sapiens* (modern humans) and *H. neanderthalensis* (Neandertals).

## A PRELIMINARY REPORT ON NEW BONY FISH REMAINS FROM THE PALEOCENE AND YPRESIAN OF THE OULED ABDOUN PHOSPHATIC BASIN (MOROCCO)

*Lionel CAVIN*<sup>1</sup>, *Nathalie BARDET*<sup>2</sup>, *Henri CAPPETTA*<sup>3</sup>,  
*Emmanuel GHEERBRANT*<sup>2</sup>, *Sidi MOHAMED IAROCHENE*<sup>4</sup> & *Jean SUDRE*<sup>3</sup>

1 Musèe des Dinosaures, 11260 Espèraza, FRANCE.

2 Laboratoire de Paléontologie, URA 12 du CNRS, Musèum national d'Histoire Naturelle,  
8 rue Buffon, 75005 Paris, FRANCE.

3 Institut des Sciences de l'Evolution, Université Montpellier II, 4 Place Bataillon,  
34000 Montpellier, FRANCE.

4 Collections paléontologiques du Service Géologique du Maroc (CPSGM), Direction de la  
Géologie, Ministère de l'Énergie et des Mines, BP 6208, Rabat Instituts, MAROC.

The Ouled Abdoun phosphatic deposits extend from the Maastrichtian to the Ypresian. The vertebrate faunal list contains 218 selachian species (Noubhani, 1993), actinopterygians, crocodiles, turtles, mosasaurs and mammals.

Arambourg (1952) described several bony fish species on fragmentary remains. We recently obtained new fossils from the Paleocene and Ypresian of the Sidi Daoui area (northeastern part of the basin).

### Osteoglossomorpha

#### Osteoglossiformes

Osteoglossidae      cf. *Brychaetus muelleri*

Arambourg (1952) referred isolated teeth and fragmentary skull remains to *B. muelleri*. A nearly complete skull is now under study. It probably differs from *B. muelleri*.

### Elopomorpha

Albuliformes      Albulidae gen. et sp. nov.

A crushed large braincase is now under study. It constitutes a new genus and new species of a primitive albulid. Arambourg (1952) referred isolated crushing teeth to *Albula oweni*: they probably belong to the new species.

### Otocephala

#### Otophysi

Siluriformes indet.

This taxon is known by several dorsal and pectoral fine spines. It is apparently the first occurrence of Siluriformes remains from the Moroccan phosphatic basins.

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## DIFFERENTIAL ALLOMETRY IN PROBOSCIDEAN LONG BONES

*Per CHRISTIANSEN,*

Zoological Museum, Universitetsparken 15, 2100 Copenhagen, DENMARK.

Extant elephants are characterized by a very apomorphic locomotor style, in which the limbs are kept nearly vertically, scapular rotation is decreased, and at least one foot is firmly on the ground, even during the fastest gait, the amble. The limbs work mainly as inverted pendulums. Associated with this is a very apomorphic appendicular anatomy, with long propodia, short epopodia, long bone epiphyses roughly perpendicular to the long axis of the diaphyses, and very short metapodia, with rather abbreviated phalanxes and a posterior heel pad, resulting in plantigrade feet, despite inclined metapodia. This apomorphic appendicular anatomy implies that inferences about the locomotion of extinct proboscidean taxa may be made. Although possibly absent in the most plesiomorphic proboscideans (Court 1994), the appendicular anatomy of taxa belonging to Deinotheriidae+Elephantiformes (sensu Tassy 1996) indicates that the apomorphic locomotor style of extant elephants was present. Nearly vertical limbs implies great reduction in torsional moments about the diaphyses (Carrano 1998), and conversely the bone strength of the long bones of extant elephant is only around 10 Gpa (Christiansen 1997). As such, the suggestions of Haynes (1991), that long bones of *Mammut* and *Mammuthus* were proportionally more massive than those of extant elephants, appears surprising. Part of this was attributed to differences in body proportions, and hence mass, at any given shoulder height, but not all large study has been undertaken, analyzing long bone allometry in proboscideans, of which the preliminary results will be presented.

Although there is indication that some proboscideans may have had proportionally stouter long bones, the often rather low correlation coefficients of the samples and therefore greater residual variances, imply that significance cannot be assumed. In some cases (e.g. humerus) *Mammuthus* actually appears to have been proportionally more slender than *Elephas* or *Loxodonta*. The main difference appears to be found in femoral proportions (the only bone analyzed by Haynes [1991]), where *Mammut* scaled with higher regression coefficients ( $C = \text{Length}^{1.664}$  **Erreur!**) than either *Elephas* ( $C = 1.292$  **Erreur!**) or *Loxodonta* ( $C = 1.529$  **Erreur!**), although the wide-confidence limits (95% CI) precludes

assumptions of significance. Most samples were not different from isometry, and when comparing more advanced proboscideans (Elephantidae) with more archaic forms (taxa from both Deinotheriidae and Elephantiformes, excluding Elephantidae, i.e. a paraphyletic group) no significance was found.

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## THE VERTEBRATE FAUNA FROM THE NEW LATE CRETACEOUS CHERA LOCALITY (VALENCIA PROVINCE, SPAIN)

*Julio COMPANY*<sup>1,2</sup>, *Xaber MURELAGA*<sup>3</sup>, *Xabier PEREDA-SUBERBIOLA*<sup>3,4</sup> & *José Ignacio RUIZ-OMEÑACA*<sup>5</sup>

1 Colegio Universitario C.E.U. San Pablo, Avenida Seminario s/n,  
46113 Moncada, Valencia, SPAIN.

2 Departamento de Geología, Facultad de Biología,  
Universidad de Valencia, 46100 Burjassot, Valencia, SPAIN.

3 Laboratorio de Paleontología, Facultad de Ciencias,  
Universidad del País Vasco/EHU, 48080 Bilbao, SPAIN

4 Museum National d'Histoire Naturelle, Laboratoire de Paléontologie,  
8 rue Buffon, 75005 Paris, FRANCE.

5 Departamento de Ciencias de la Tierra, Area de Paleontología,  
Universidad de Zaragoza, 50009 Zaragoza, SPAIN.

Recent field work in the Chera area (province of Valencia, eastern Iberian Peninsula) has yielded a Late Cretaceous continental vertebrate assemblage, mainly dominated by reptiles. The vertebrate remains found in Chera come from the upper part of the Calizas y Margas de Sierra Perenchiza Formation. Up to now, there are four vertebrate-bearing levels in the section (Chera I to IV). The sedimentary sequence includes micritic limestones with interbedded lenses of silty marls and clays. The facies indicate a continental sedimentation in shallow-water conditions (Vilas *et al.*, 1982). The carbonate sequence grades downwards to marine limestones, and is overlain by alluvial deposits which are probably Maastrichtian-Paleogene in age.

The vertebrate fauna of Chera is composed of bony fishes, amphibians, lizards, chelonians, crocodylians and dinosaurs. In addition, the Chera outcrops have yielded fresh-water gastropods, ostracods, and characeans. Among actinopterygians, there are scales and teeth of lepisosteids. Indeterminate amphibians and lizards are represented by miscellaneous jaw and appendicular elements. Turtles are represented by dermal plates of cryptodires (cf. *Solemys*) and pleurodires (cf. *Polysternon* and cf. *Dortoka*). Crocodylians are known by teeth, jaw bones, vertebrae and osteoderms of indeterminate eusuchians. Dinosaur remains consists of fragmentary teeth, vertebrae and limb bones of the euornithopod *Rhabdodon*, caudal vertebrae of titanosaurid sauropods, an isolated tooth of a medium-sized theropod, and small fragments of ankylosaur teeth. Sanz (1986) described a dermal scute of a nodosaurid ankylosaur from

this area. Moreover, dinosaur eggshell fragments were recovered by screen-washing sediments.

The composition of the Chera vertebrate fauna is similar to that of other Late Cretaceous localities from southwestern Europe, mainly Laño and Armuña in the Iberian Peninsula, and Villeveyrac, Champ-Garimond and Cruzy in Languedoc (Astibia *et al.*, 1990; Buscalioni & Martínez Salanova, 1990; Buffetaut *et al.*, 1996, 1999; Sigé *et al.*, 1997). The absence of hadrosaurids is worthy of consideration. A late Campanian to early Maastrichtian age is likely for the Chera assemblage.

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## NEW DATA ON THE MULTITUBERCULATE MAMMALS FROM THE UPPERMOST CRETACEOUS DINOSAUR-BEARING DEPOSITS OF THE HATEG BASIN

*Zoltan CSIKI & Dan GRIGORESCU*

Faculty of Geology & Geophysics, University of Bucharest; Dept. of Paleontology. Bd. N.  
Balcescu Nr. 1. ROM-70111 Bucharest. ROMANIA

Multituberculate mammals are common components of most North American and Asian Late Cretaceous continental vertebrate assemblages; however, they are almost completely absent from contemporary European deposits. The only Late Cretaceous European multituberculates came from the Late Maastrichtian of the Hateg Basin, Romania.

Several reports were published on the Hateg multituberculate fauna up until now, it included indeterminate cimolodontans (represented by I2 i1s and m2, all found in isolation), as well as two new taxa: *Barbatodon transylvanicum* Radulescu & Samson, 1986 (based on an isolated right M1 from Pui; the same specimen was interpreted as a left m1 of *Paracimexomys? dacicus* Grigorescu & Hahn, 1987), and *Kogaionon unguoreanui* Radulescu & Samson, 1996 (based on an almost complete skull without dentaries, coming from Sanpetru). The assemblage was known only from the deposits of the Sanpetru Formation, of Latest Cretaceous (Maastrichtian) age.

Recent fieldwork in the Densu-Ciula Formation (northwestern part of the Hateg Basin), of the same age as the Sanpetru Formation, led to the identification of two new fossil mammal localities. An isolated, bicusped, fully enamel covered I2 was recovered from the Tutea dinosaur nesting site, in a microvertebrate assemblage that includes frogs, albanerpetontids, turtles, crocodylians and dromaeosaurid theropods. It probably belongs to an indeterminate cimolodontan.

Most of the new specimens come from the Fontanele microvertebrate fossil site near Vlioara. This locality yielded a diverse assemblage of fishes, anurans, albanerpetontids, chelonians, lacertilians, crocodylians, theropod, sauropod and ornithomimid dinosaurs and multituberculates, besides characeans, ostracods, gastropods, pelecypods and eggshell fragments.

The multituberculates are represented by isolated, usually well preserved teeth, including two well-preserved, small P1s with bulbous, quasi-circular crowns bearing two conical, sub-equal cusps, separated by a deep and wide valley. The cusps are ornamented with radiating ridges. A right m1 is roughly rectangular in occlusal view, with the lateral side labially bulging posteriorly. The cusp formula is 3:3; the cusps are pyramidal. Ridges descend toward the central valley from the second and third cusps of both rows. A left i1 is elongated, gently curved, of typical ptilodontoid pattern, adapted for puncturing and grasping. The enamel has reduced thickness dorsally and lingually. Finally, the finds include a very fragmentary P3 and p4. The p4 shows a largely rounded anterior profile, a small basal notch for p3, and a cusp-like first serration without descending ridge. Two weak ridge, parallel to the anterior margin, stops well above the base of the crown in lingual view.

Comparison of the better preserved remains from Fontanele (P1, m1) with other Late Cretaceous-Paleogene multituberculates (the members of Cimolodonta) reveals greatest similarities to the representatives of the genus *Hainina* from the Montian (Middle Paleocene) of Belgium and Thanetian (Late Paleocene) of France. Taking into account the overall morphological similarity and small cusp count, these teeth are referred to *Hainina*. Owing to striking size differences between the P1s and m1, they most probably belong to different species inside *Hainina*, provisionally identified as *Hainina* sp. A (P1) and *Hainina* sp. B (m1). Despite its fragmentary state, the p4 is also referable to *Hainina*. Its relative size compared to the P1s is similar to the ratio seen in *H. belgica*, suggesting that it may as well belong to *Hainina* sp. A.

The new taxa are distinct from the previously known multituberculates from Hateg, on morphological and dimensional grounds. However, based on comparison with the new m1 and those of *Hainina*, the holotype of *Barbatodon*/?*Paracimexomys* is regarded as a m1, comparable to the formers; consequently, *Barbatodon*/?*Paracimexomys* is tentatively synonymized with *Hainina*.

The finds document the presence of the multituberculates in the Densu-Ciula Formation, that of the Paleocene genus *Hainina*, with two different species, as well as that of an indeterminate cimolodontan in the Late Cretaceous of Hateg, considerably increasing the multituberculate diversity in the Maastrichtian of Europe.

**A LOWER CRETACEOUS TRAVELLER:  
GOBICONODON: (“TRICONODONT”, MAMMALIA)  
FROM VALLIPÓN (UPPER BARREMIAN, TERUEL,  
SPAIN)**

*Gloria CUENCA BESCÓS & Jose Ignacio CANUDO*

Paleontología, Universidad de Zaragoza. Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN.

The fossil vertebrate locality of Vallipón, in the Mas de las Matas-Castellote area of Teruel (Spain) is a rich fossil assemblage of mainly isolated bones and teeth, probably accumulated by tidal action in an ancient beach of Upper Barremian age. It is at the transitional marine-continental sediments of the Artoles Formation. The mammals are part of a rich and diverse vertebrate fauna (35 taxa) which includes: Pycnodontiformes, Semionotiformes, Amiiiformes, Hybodontiformes, Rajiformes, Lamniformes; Heterodontiformes; Crocodylia, Ornithischia, Saurischia, Pterosauria, and Sauria. Mammals are represented by Multituberculata, Theria?, and new Symmetrodonta and “triconodonts”.

As new material from Vallipón becomes available, we report here for the first time an isolated tooth of the “triconodont” Family Gobiconodontidae Chow & Rich, 1984. Sigogneau - Russell (1991) label *Gobiconodon* “le voyageur” (the traveller) as it appears in the Lower Cretaceous of Mongolia as well as in United States of America (Jenkins & Schaff, 1988 and Kielan Jaworowska & Dashzeveg, 1998). The first Mesozoic mammal ever found in Siberia is also *Gobiconodon* (Maschenko & Lopatin, 1998). Moreover, gobiconodontids may arise in China during the middle-late Jurassic (Chow & Rich, 1984). Triconodonts and specially gobiconodonts are of special interest since they may be at the roots of the mammalian family tree.

In Vallipón we describe an isolated upper left molar probably the M3 or M4 with cusps A, C and the anterior cusp (B) that is broken on the lingual side. The three main cusps form a slightly obtuse angle. The cusp C is worn in a distolingual direction. There is a narrow distal cingulum (cusp D) worn also lingually. The wear facets development fits well with the reconstructed occlusion pattern for *Gobiconodon* and it is supposed to be the amphilestid-gobiconodontid condition (Kielan-Jaworowska & Dashzeveg, 1998) whereas in the more generalized “triconodon” condition as *Jeholodens* the main cusps a of lower molar occludes into the valley or groove between cusps A and B of the opposite upper molar. The small *Gobiconodon* from Vallipón is distinguished from other members of the genus by the upper molar cusps nearly subequal in height and reduced lingual cingulum in the upper molars. The occlusal outline is more rounded than in *Gobiconodon borissiaki*, *G. hoburensis* and *G. ostromi*. We conclude that this upper molar a new species of *Gobiconodon* which is a quite diverse and widespread genus during the Early Cretaceous in the northern hemisphere.

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**Kielan-Jaworowska, Z. & Dashzeveg, D.** (1998): Early Cretaceous amphilestid (“triconodont”) mammals from Mongolia. *Acta Palaeontologica Polonica*. 43(3), 413-438.

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**Sigogneau-Russell, D.** (1990): Les mammifères aus temps des dinosaures. Mason, 169 p.

**Chow, M. & Rich, T. H.V.** (1984): A new triconodontan (Mammalia) from the Jurassic of China. *Journal of Vertebrate Paleontology*. 3(4), 226-231.

## LOWER PLEISTOCENE ARVICOLIDS (RODENTIA, MAMMALIA) OF TRINCHERA DOLINA 6 (ATAPUERCA, BURGOS, SPAIN)

*Gloria CUENCA BESCÓS, Jose Ignacio CANUDO & César LAPLANA*  
Paleontología, Universidad de Zaragoza. Pedro Cerbuna, s/n. Zaragoza 50009. SPAIN  
UA Microvertebrados UZ-MNCNM

The TD6 level in the Trinchera Dolina Section at Atapuerca, Burgos, Spain, is a hominid-bearing level associated with a rich small mammal assemblage. Our study shows that the rodent assemblage of Trinchera Dolina level TD6 differs from findings of previous authors.

The arvicolids are represented by *Mimomys savini*, *Iberomys huescarensis*, *Microtus seseae*, *Terricola arvalidens*, *Stenocranius gregaloides*, *Pliomys episcopolis* and *Allophaiomys chalinei*.

This assemblage is typical of the end of the Lower Pleistocene and beginning of the Middle Pleistocene. A more precise age for this assemblage has been gained through the study of the evolutionary stages of some of the rodent species. The *M. savini* evolutionary stages seem to be good biostratigraphical markers when percentages of enamel islet and root development are considered. We propose that *M. savini* assemblages with more than 10% of M1 with enamel islet are older than the assemblages of *M. savini* with less than 10%. Using the Trinchera Dolina Section as a standard, we propose that the assemblages over the 10% are Lower Pleistocene and below the 10% are Middle Pleistocene. Further studies of *M. savini* in well-calibrated sections should support or refute this hypothesis. Nevertheless, the changes seem not to be occurring equally throughout the entire distribution of the species (in Western Europe) as there are assemblages such as Hohen Sulzen and Kozi Grzbiet that have fewer individuals with enamel islet. Hohen Sulzen is thought to be older than TD6, based on its *Mimomys savini*-*Mimomys pusillus* association. However, the disappearance of *M. pusillus* (or small-sized *Mimomys*) provides an insufficient time marker, since they are found in localities above the Matuyama/Brunhes boundary, such as Karlich E.

The species *M. seseae*, up until now found only in Trinchera Dolina TD5, TD6, is morphologically close to *M. nivaloides*, *M. malei*, *M. nivalinus* and

*Tyrrhenicola*. The species *M. seseae* represents one of the first species of a second radiation of the *Microtus* s.s. lineage at the end of the Early Pleistocene.

The primitiveness of the assemblages of *T. arvalidens* and *S. gregaloides* in TD3-TD6 levels could indicate an early radiation of those species at the end of the Early Pleistocene. The primitive stage of *M. savini*, *Iberomys*, *S. gregaloides* and *T. arvalidens* indicate a Lower Pleistocene age. On the basis of the *Mimomys* and, more generally, the arvicolid assemblage, TD6 is more modern than the Jaramillo faunas at Untermassfeld and Les Valerots, and could be equivalent to Shamin, early Tiraspolian and early Cromerian faunas.

On the basis of the vole species of TD6 we propose that the hominids of the Trinchera Dolina level 6 are of late Lower Pleistocene age. This makes them younger than the humans that made the artefacts of Les Valerots, Le Vallonnet, Fuente Nueva 3, but older than the Middle Pleistocene humans of Cullar de Baza 1, Boxgrove, Mauer, and Arago. Moreover, microvertebrates; macrovertebrates (herbivores, Van der Made, 1999 and carnivores, García & Arsuaga, 1999) and radiometric data (Falguères *et al.*, 1999) provide confirmation of a late Early Pleistocene age (780-857 ka) for the *Homo antecessor* bearing level TD6.

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**García, N., & Arsuaga, J.L.** (1999). Carnivores from the Early Pleistocene hominid-bearing Trinchera Dolina 6 (Sierra de Atapuerca, Spain). *J. hum. Evol.* (in press)

**Made, Van der J.** (1999). Ungulates from Atapuerca TD6. *J. hum. Evol.* (in press)

**EXCAVATION OF A LATE MAASTRICHTIAN  
MOSASAUR SKELETON AT THE ENCI-MAASTRICHT  
BV QUARRY (MAASTRICHT, SOUTHEAST  
NETHERLANDS)**

*Rudi W. DORTANGS*

Hoofdstraat 36, NL-6436 CG Amstenrade HOLLAND

*John W.M. JAGT,*

Natuurhistorisch Museum Maastricht, Postbus 882, NL-6200 AW Maastricht. HOLLAND

e-mail: mail@nhmmaastricht.nl

*Eric W.A. MULDER*

Museum Natura Docet, Oldenzaalsestraat 39, NL-7591 GL Denekamp. HOLLAND

*& Anne S. SCHULP*

Institut voor Aardwetenschappen, Vrije Universiteit de Boelelaan 1085,

NL-1081 HV Amsterdam. HOLLAND.

e-mail: schu@geo.vu.nl

During fieldwork at the ENCI-Maastricht BV quarry, south of Maastricht, on August 8, 1998, a portion of the vertebral column of a mosasaurid lizard was discovered in the upper Lanaye Member (Gulpen Formation, Late Maastrichtian, *Belemnitella junior* Zone, ca. 66.5 Ma). Subsequent excavations at the site have shown this to represent a fully-grown individual of the largest mosasaurid species known to date, *Mosasaurus hoffmanni* Mantell, 1829. Additional portions of the vertebral column, a coracoid-scapula (still articulated) as well as the skull have been recovered so far (Natuurhistorisch Museum Maastricht collections, NHMM 1998141). Digging at the site was postponed to the spring of 1999, since night temperatures fell below freezing point. Puzzling is the position of the skull, with the premaxilla pointing posteriorly, lying next to the vertebral column, close to the beginning of the tail. Evidence of post-mortem scavenging is furnished by the find of selachian remains associated with the mosasaur skeleton (Dortangs *et al.*, 1999; Jagt *et al.*, in press).

The present find is of special note in allowing a detailed analysis of mosasaur taphonomy for the first time in the area, where more or less complete skeletons are extremely rare. In addition, active quarrying with blasting and large-scale extraction explains why mosasaur remains in the area are virtually always scattered and fragmentary.

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**GILTHEAD SEA BREAM *SPARUS AURATA* (LINNAEUS, 1758) (PISCES, SPARIDAE) REMAINS IN ARCHAEOLOGICAL SITES IN GALICIA (NORTHWEST SPAIN).**

*Carmén FERRÉ, C. & José Miguel REY*

Departamento de Biología Animal, Facultad de Biología, Universidad de Santiago de Compostela, Campus Sur s/n, 15706-Santiago de Compostela, A Coruña. SPAIN

E-mail: \*bacarmen@usc.es, \*\*bavert1@usc.es.

Gilthead sea bream is a sedentary demersal fish of salt or brackish coastal waters. In the Iberian Peninsula, it is currently common on the western Mediterranean coast and somewhat scarcer on the Atlantic coast and in the Bay of Biscay. Bone remains of this species are frequently found in Holocene archaeological sites, as it has frequently been used as a food source. It is readily identified in bone middens by its characteristic cranial bones and large kidney-shaped molars.

A review of the literature reveals that bone remains of *S. aurata* have been found at numerous Iberian Holocene sites, dating from the Neolithic to the Medieval period. Analysis of the findings of those studies that have attempted to estimate the relative abundance of *S. aurata* (during the period in which the bone midden in question was laid down) indicate that the patterns of abundance observed over the Holocene have differed markedly from those observed today. Possible explanations for these findings are discussed, including local-scale variation in environmental conditions, specialization in the capture of this fish, and local-scale climate change related to upwelling phenomena on the Galician Atlantic coast.



## THE HERITAGE OF THE LOST WORLD: PTEROSAURS FROM THE CRATO FORMATION.

*Eberhard FREY*

Staatliches Museum für Naturkunde, Erbprinzenstrasse, 13, D-76133, Karlsruhe, GERMANY  
e-mail: Dino\_Frey\_SMNK@compuserve.com

*& David M. MARTILL*

Department of Geology, University of Portsmouth, Portsmouth PO1 3QL, UNITED  
KINGDOM  
e-mail: david.martill@port.ac.uk

The millimetrically laminated limestones of the Crato Formation (Lower Cretaceous, ?Aptian) are famous for their exceptionally well preserved insect fauna and diverse flora. With the exception of the gonorhynchiform fish *Dastilbe elongatus* vertebrate remains are rare, especially those of tetrapods. Until 1994 only two specimens of pterosaurs were reported in the literature (Frey & Martill 1994). This has drastically changed since then (Campos & Kellner 1997, Martill & Frey 1998).

Many new pterosaur specimens are now known from the Crato Formation. Most specimens are articulated or partial skeletons lacking the skull or isolated skulls. (Campos & Kellner 1997, Martill & Frey 1998). Some specimens exhibit spectacular soft tissue preservation, which is mostly consisting of a goethitic stain often preserving the form and not only the outline. Occasionally the soft tissue is phosphatised three dimensionally. In the skulls of tapejarid pterosaurs the soft part of the head crest is drastically larger than its bony part. Therefore the assumed life style as a fructivore (Wellnhofer 1993) have to reconsidered, not to speak of the consequences for flight. In two specimens the ceratineous parts of the beak are also preserved.

Another specimen does not only demonstrate the attachment of the wing membrane at the ankle and the presence of webbing between the toes, but also huge claws and a sole pad is preserved. This foot would fit the track way described by Stokes (1957).

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## **CARNIVORES (MAMMALIA) AT THE DOLINA SEQUENCE WITH SPECIAL REMARKS TO THE TD6 HOMINID-BEARING LEVEL**

*Nuría GARCÍA & Juan Luis ARSUAGA*

Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

The carnivores from Trinchera Dolina level 6 (TD6) in Sierra de Atapuerca, include *Ursus* sp., *Crocota crocuta*, *Mustela palerminea*, *Lynx* sp., *Canis mosbachensis* and *Vulpes praeglacialis*. Approximately 80 human remains were found in the Aurora stratum (A.s.) located in the upper part of the TD6 level. The carnivores from this stratum are taxonomically similar to the rest of the TD6 level, differing only in that *Lynx* sp. is poorly recorded in the A.s.. The spotted hyaena (*Crocota crocuta*) inhabited the Atapuerca Sierra during the early Pleistocene and up to the Middle Pleistocene; subsequently it is absent. Palaeomagnetic, U/Th and ESR results, suggest the fossils from TD6 to be placed at the early Pleistocene; therefore here is represented the earliest certain occurrence in Europe of *Crocota crocuta* in association with *Mimomys savini*. Spotted hyaena might have arrived somewhat earlier, during the late Early Pleistocene, subsequently invading the rest of the continent during the Middle and Late Pleistocene.

*Crocota* from TD6 is of relatively small size compared with the Middle-Late Pleistocene specimens. Atapuerca TD6-A.s. represents the most ancient deposits in Europe where *Homo* and spotted hyaenas coexisted and probably competed ecologically.

The carnivores from TD6 are biochronologically consistent with the end of Early Pleistocene and early Cromerian. This timespan could correspond with oxygen isotope stages 19, 20 or 21. The carnivore assemblage is continuous from the lowermost levels TD3/4 and TD5 and up to TD8. The bio-stratigraphical sequence at TD shows a radical 'faunal change' within TD8 (talla 24/25) probably due to a stratigraphical hiatus.

All the carnivore taxa recovered from the uppermost levels TD10 and TD11, are typical Middle Pleistocene forms and most of them are also present in Galería and/or Sima de los Huesos Middle Pleistocene sites (placed in Sierra de Atapuerca). This assemblage change can also be detected in the rest of faunal groups.

## **CRANIAL MORPHOLOGY, HISTOLOGY, AND ONTOGENY OF PACHYCEPHALOSAURID DINOSAURS: THE “BATTERING-RAM” HYPOTHESIS TAKES A HIT.**

*Mark B. GOODWIN*

Museum of Paleontology, University of California, Berkeley, California 94720. USA

*& John R. HORNER*

Museum of the Rockies, Montana State University, Bozeman, Montana 94720. USA

The function of the dome in pachycephalosaurid dinosaurs has puzzled paleontologists for decades. Since Ned Colbert (1955:195) first suggested (as a very wild surmise) the skull was used as a sort of battering ram, interpretation of the structure and function of the dome has not progressed very much beyond speculative inference and simple analogies with bighorn sheep. Galton (1970) independently interpreted the pachycephalosaur frontoparietal dome as “an ideal battering-ram” based on radiating structures in the dome. He conjectured that these “trabeculae” or “bony fibers” contributed to a thickened dome that “formed an ideal battering-ram.” In order to test the head-butting hypothesis and the contention that pachycephalosaurs possessed a dome suited for this type of behavior, six pachycephalosaurid frontoparietal domes (not con-specific) were thin-sectioned.

Our results show that pachycephalosaur domes possess a unique and complex tissue structure arranged into three distinct histologic zones, designated Zones I, II, and III, from directly above the roof of the braincase to the dorsal surface of the frontoparietal dome. These Zones are distinguished by: (a) a difference in the degree of vascularization of the bone tissue; (b) the arrangement and development of primary osteons; and (c) the presence of Haversian bone. Sharpey’s fibers are present in all three Zones and provide evidence that the surface of the dome possessed an attached keratinous covering. Ontogenetically, a decrease in vascularization of the frontoparietal dome occurs with an increase in size. A sub-adult age is assigned to unfused, thick but not domed frontals and parietals, characterized by a fast growing fibrolamellar complex of primary bone. The histological data reveals no evidence of the dome having been altered by trauma, and therefore does not support a head-butting hypothesis. Cranial horns, frills and accompanying bony ornaments used in display behavior serve as one of the primary means of identifying and distinguishing species among dinosaurs (Dodson 1975; Molnar 1977; Sampson 1997a,b). The late ontogenetic development of the frontoparietal dome, squamosal horns and bony knobs in pachycephalosaur skulls further supports their role in sexual display behavior of

adults engaged in mate competition and selection. The primary function of the dome was most likely for sexual display, to attract mates, and competition with rivals, not for use as a battering-ram in head to head encounters.

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**ONTOGENETIC VARIATION AND SEX DIMORPHISM  
IN THE SKULL OF THE PLEISTOCENE CAVE BEAR  
*URSUS SPELAEUS* ROSENMÜLLER-HEINROTH**

A. GRANDAL d'ANGLADE, M. VILA TABOADA, & F. LÓPEZ GONZÁLEZ,

Instituto Universitario de Xeoloxía. Universidade da Coruña.  
15071 A Coruña. SPAIN  
Laboratorio Xeolóxico de Laxe.15168 O Castro, A Coruña. SPAIN.  
E-mail: xeaurora@udc.es

The Cave Bear skull is characterized -in classic descriptions- by a strong development in the frontal area. This fact gives it a characteristic step profile in lateral view. Such a morphology is usually shown by some adult males, but it is not noticed in females nor young individuals. In this work it is carried out a study of size and shape variations in Cave Bear skulls all along the ontogenic development, and also the variability due to sex dimorphism in adult individuals. In order to study these features, a group of non conventional metric data have been taken, using landmarks established by us. Multivariate statistics methods (such as Principal Component Analysis) have been used when the number of available samples was large enough.

**THE OLDEST KNOWN *TESTUDO* CF. *HERMANNI*  
AND *EMYS ORBICULARIS* IN FRANCE (MOUTOUSSÈ,  
HAUTES-PYRÉNÈES, PLEISTOCENE) AND THEIR  
CHRONOLOGICAL AND GEOGRAPHICAL RANGES  
DURING THE QUATERNARY.**

*Sophie HERVET*

Musèum National d'Histoire Naturelle, Laboratoire de Paléontologie,  
8 rue Buffon, 75005 Paris, FRANCE  
E.Mail: [Hervet@mnhn.fr](mailto:Hervet@mnhn.fr)

The Montoussè site (Hautes-Pyrénées, Southern France) includes different famous bone beds which were excavated during the 70's (Clot, 1975; Clot *et al.*, 1976 a & b). These bone beds have yielded different fauna from Lower Pleistocene and Middle Pleistocene. Montoussè 5 (Mn 17, Lower Pleistocene, 1.3 Ma) and Montoussè 3 (Middle Pleistocene, Mindel, 0.34-0.65 Ma) delivered remains of several inedita turtles, described only recently in a global work on Quaternary Turtles from France (Hervet, submitted). To distinguish each remain of different species, a morphological comparison was made between the three living species in France (*Emys orbicularis*, *Mauremys leprosa* and *Testudo hermanni hermanni*) and *Testudo graeca graeca*. This study provides new morphological data that allow to distinguish *Testudo h. hermanni* and *Testudo g. graeca* (which were often confused in French Pleistocene localities) and to admit that only *Testudo h. hermanni* can be found in fossiliferous French sites (with freshwater turtles). Fossils found in about eighty fossiliferous localities were reported (with inedita material), which enables us to discuss their geographical and chronological ranges during the last two million years: *Mauremys leprosa* is found in only one locality (Grotte de la Salpêtrière, Chalcolithic; Cheylan, 1982); *Testudo hermanni hermanni* was abundant during the Pleistocene but became scarce during the Holocene period; *Emys orbicularis*, rare during the Pleistocene, was frequently consumed during the last 10 000 years by Man.

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## THE OLIGOCENE MAMMALIAN SEQUENCE FROM ALCORISA (S EBRO BASIN, SPAIN).

*Marguerite HUGUENEY*

Centre de paléontologie stratigraphique et paléoécologie (ERS 2042), Université Claude-Bernard-Lyon 1, 27-43 bvd du 11 novembre 1918, 69622 Villeurbanne cedex, FRANCE.  
e-mail: m-hugue@cismsun.univ-lyon1.fr

Mammal remains were discovered by E. Moissenet near Alcorisa, a little town of lower Aragon situated in the transition from the Iberian Range to the Ebro basin, on the Southern flank of the Guadalopillo syncline (topographical map of Spain, sheet 29-19 (494), Calanda). Three superposed fossiliferous levels, dipping toward the North have been excavated in this section. Above the grey marls of Alcorisa gris (AlcG), the lignitous and very rich brown marls of Alcorisa noir (AlcN) are covered by the red deposits of Alcorisa rose (AlcR). Among the rodent faunas yielded by these localities, the Issiodoromyini and Archaeomyini lineages give relevant indications on the biostratigraphic levels of these faunas; these are corroborated by the evolutionary stages of other taxa, particularly Cricetids. So these localities can be compared to the Paleogene mammalian reference level scale : AlcG corresponds to MP 25 whereas AlcN and AlcR are to be placed in MP 26. Moreover they can be compared to the Paleogene zonation of mammalian Spanish localities proposed by Agusti *et al.*, 1985 and Freudenthal, 1997: AlcG is very near to Mirambueno 4C - which seems to be a little older than previously thought -, Carrascosa, Pajera and Can Quaranta-Campins 1 (Arbiol, 1993); the two upper levels have no equivalent in the Mirambueno sequence - being distinctly older than MIR 1 - but could be near of Gandesa (Ebro basin).

Furthermore, the three levels of Alcorisa document the local evolution of the faunas and will allow a more precise appraisal of the relationships and evolutionary tendencies of the different taxa and of the particularities of the Oligocene Spanish faunas.

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## A NEW LOOK AT THE HATEG ISLAND

*Coralia Maria JIANU*

Muzeul Civilizatiei Dacice si Romane Deva Str. 1 Decembrie nr. 39.  
RO-2700 HD Deva. ROMANIA

*& Gijsbert J. BOEKSCHOTEN*

Instituut voor Aardwetenschappen, Vrije Universiteit. De Boelelaan 1085.  
NL-1081 HV Amsterdam. HOLLAND

The Hateg island concept was coined by Franz Nopcsa (Nopcsa, 1914). He saw the Hateg fauna as an island assemblage characterised by the retention of primitive features from a widespread Early Cretaceous fauna (Nopcsa 1923).

Now, after a hundred years since its discovery in 1895, the Hateg fauna proves to be the richest and most diverse fauna from Late Maastrichtian (Le Loeuff 1992; Le Loeuff & Buffetaut, 1995). This diverse and balanced fauna is very improbable to have been supported by a small island. Corroborating new tectonic interpretation of the area (Sanders, 1998), the sedimentology of the dinosaur bearing deposits, and the paleontological aspects of the Hateg fauna, we try to emphasise a new model for the Hateg area.

The Hateg landmass occupied much of the Mesozoic Carpathians and the Apulian Plate, being intermittently interconnected with other landmasses, both to the east and to the west (Jianu & Boekschoten, 1998). This new interpretation may provide a better tool to help us understand the peculiarities of this fauna.

Comparison of European Upper Cretaceous faunae including the Hateg one, with contemporary faunae from other places in the world, provides much support for this theory.

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## THE FAMILY FABROSAURIDAE

*Fabien KNOLL*

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle  
8 rue Buffon 75005 Paris, FRANCE  
e-mail knoll@mnhn.fr

The family Fabrosauridae was originally created by Galton (1972) as the basal family of ornithischian dinosaurs from which all other ornithischian dinosaurs were ultimately derived. This family can be diagnosed by six main apomorphies : slot in the maxilla for the insertion of the lachrymal; especially short forelimb ; brevis shelf on the ilium that curves medially then downward ; dorsal groove on the shaft of the ischium; pedal digit I reduced ; "fabrosaurid type" of tooth. The type of *Fabrosaurus australis* is not diagnostic at the specific level but at the family one. *Fabrosaurus australis* is thus a nomen dubium but the familial name is however valid.

Most of the fabrosaurid material so far well described from southern Africa should be identified as *Lesothosaurus diagnosticus*. The "cf. *Lesothosaurus* sp." of La Quinta (Venezuela) appears to be at best a Fabrosauridae genus et species indet.

The systematic positions of the Chinese ornithischian taxa *Yandusaurus hongheensis*, *Yandusaurus multidentis*, *Gongbusaurus shiyii*, *Gongbusaurus wucaiwanensis*, *Xiaosaurus dashanpensis* and *Agilisaurus louderbacki* are reviewed. *Y. hongheensis* is a Hypsilophodontia of still undetermined family. The same is true for *Y. multidentis* herein reallocated to *Proyandusaurus* nov. gen. *G. shiyii* is a nomen dubium of an indeterminate fabrosaurid. *G. wucaiwanensis*, a valid fabrosaurid, is consequently transferred to the new genus *Eugongbusaurus*. *X. dashanpensis* may be considered as a valid taxon, the precise affinity of which within the Dinosauria remains irresolute. *A. louderbacki* is a valid fabrosaurid.

## CRANIAL ANATOMY OF AN EARLY PALEOGENE TROGON (AVES: TROGONIFORMES) FROM NORTHERN EUROPE

*Annette V. KRISTOFFERSEN*

Geological Museum, University of Copenhagen, Oester Voldgade 5-7,  
DK-1350 Copenhagen. DANMARK

The beautifully coloured trogons, family Trogonidae, are confined to the tropical regions of the Americas, Africa and Asia. They are restricted to tropical latitudes, but some species occur in temperate altitudes (Eisenmann, 1985). They are primarily inhabitants of forests or woodlands, and most species appear to be sedentary.

On the basis of a humerus, fossil trogons (trogonidae) were first described from the Lower Miocene (Aquitanian) of Allier, France, by Milne-Edwards (Mourer-Chauvirè, 1980). Later Milne-Edwards (1892) described fossil trogons, on the basis of postcranial elements, from the Upper Eocene to Lower Oligocene Phosphorites du Quercy, France, erecting a new genus *Archaeotrogon* for them. Since then, several postcranial elements from the Phosphorites du Quercy have been referred to *Archaeotrogon* (Mourer-Chauvirè, 1980). The genus was transferred from the family Trogonidae to Archaeotrogonidae fam. nov. by Mourer-Chauvirè (ibid.), and their previously assumed close relationship with the Trogoniformes was debated (ibid.; Olson, 1985). Newly described material from the Middle Eocene Grube Messel (Mayr, 1998) referred to Archaeotrogonidae has not contributed to an elucidation of the relationship between Trogonidae and Archaeotrogonidae (Mayr, 1998).

So far, the earliest true trogons (Trogonidae) recorded are based on postcranial remains from the early Oligocene Glarner Fischschiefer in Switzerland (Olson, 1976). A possible trogon is reported from the Oligocene of Caucasus (Karkhu, 1992 in Feduccia, 1996).

Now, a well-preserved, diagnostic, albeit incomplete, skull from the latest Paleocene - earliest Eocene Fur Formation in Denmark, is allocated to Trogonidae, and taxonomic as well as functional interpretations of the fossil skull will be given.

A well-known problem in palaeontology is incomplete skeletons and lack of correspondence in the skeletal elements found. Although exhibiting diagnostic features of Trogonidae the Danish skull may pertain to postcranial elements of *Archaeotrogon*. Postcranial remains of a single individual from the Fur Formation have been described as *Archaeotrogon*-like (Kristoffersen, 1997). Only future finds of associated cranial and postcranial elements will settle the ongoing debate of the systematic position of Archaeotrogonidae.

The fossil record of trogons indicates that they had a wide distribution in tertiary Europe, whereas in the New World fossil trogons are known only from the Pleistocene of Brazil and Dominican Republic (Brodkorb, 1971).

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## **THE ANCESTOR OF *IBEROMYS* CHALINE, 1972: *MICROTUS (ALLOPHAIOMYS) CHALINEI* OR *MICROTUS (ALLOPHAIOMYS) NUTIENSIS*?**

*César LAPLANA & Gloria CUENCA-BESCÓS*

Paleontología, Universidad de Zaragoza. 50009 Zaragoza, SPAIN.

UA Microvertebrados UZ-MNCNM

*Iberomys* is one subgenus of *Microtus* that includes the recent species *M. (I.) cabreræ*, and the fossil ones *M. (I.) brecciensis* and *M. (I.) huescarensis*. Molars of the species of this subgenus are characterized by their strong transversal asymmetry. Along its evolution, the different species of this lineage had a limited distribution in South-Western Europe (Spain, Portugal, Italy and France).

The oldest representant of this lineage, *M. (I.) huescarensis*, was first recognized in one locality of South Spain, Huéscar-1 (Granada, Basin). A similar, slightly more derived form is present at some karst fillings from the Sierra de Atapuerca (Burgos, North-Central Spain) dating for the late Lower Pleistocene. The main morphological features of this form are the presence of first lower molars with and without connected T4 and T5 triangles, and an anterior cap with predominant *hintoni* morphotypes.

Different authors have pointed at two species of *Allophaiomys* as possible ancestors of *Iberomys*. Chaline (1972), Cuenca-Bescós et al. (1999) and Laplana et al. (in ref.) established an ancestor-descendent link between *M. (A.) nutiensis* and *Iberomys*. On the other hand, Chaline et al. (1985), Chaline (1987, 1990), Agustí et al. (1987, 1993) and Agustí (1998), in base of the similarity of the juvenile specimens of *M. (A.) chalinei* with the adult ones of *Iberomys*, suggested a phylogenetic relationship between these species.

In this work, a detailed comparison between both *M. (A.) hintoni nutiensis* and *M. (A.) chalinei* and the primitive representants of *Iberomys* is developed using the biometric method proposed by Brunet-Lecomte (1990). The results support the hypothesis that *M. (A.) hintoni nutiensis* is the most probable ancestor of *Iberomys*.

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## A NEW *MICROTUS* (*ALLOPHAIOMYS*) SPECIES FROM LES VALEROTS (LOWER PLEISTOCENE, FRANCE)

*César LAPLANA*<sup>1, 2</sup>, *Sophie MONTUIRE*<sup>3</sup>, *Patrick BRUNET-LECOMTE*<sup>3</sup> &  
*Jean CHALINE*<sup>3</sup>

1 Museo Nacional de Ciencias Naturales (CSIC), Dpto. de Paleobiología.

José Gutiérrez Abascal, 2. 28006 Madrid, SPAIN.

2 Paleontología. Universidad de Zaragoza. Pza. San Francisco, s/n. 50009 Zaragoza, SPAIN.

e-mail: claplana@posta.unizar.es

3 BIOGEOSCIENCES UMR CNRS 5561. Laboratoire de Paléobiodiversité et Préhistoire de l'EPHE, Université de Bourgogne, Centre des Sciences de la Terre, 6 bd. Gabriel, 21000 Dijon, FRANCE.

The Valerots karst filling (Cote d'Or, France) is one of the reference localities in the study of arvicoline evolution from the Lower Pleistocene in Europe. The fossil voles were studied in the sixties by Chaline, who described two new species, *Microtus* (*Allophaiomys*) *nutiensis* and *Suranomys malei burgondiae* (Chaline, 1972).

A biometrical analysis has been carried out on the *Allophaiomys* material from Les Valerots using 21 variables measured on the first lower molars (following Brunet-Lecomte, 1990). This analysis led to the recognition of a new species and to the reconsideration of the status of *Microtus* (*Allophaiomys*) *nutiensis*.

The new species is characterized by its small size, and it is probably the smallest species of *Allophaiomys* so far known.

As a result of this analysis, *M. (A.) nutiensis* seems to be very similar to "*Pitymys*" *hintoni*, but the lack of a good understanding of this species at its type-locality impede to establish a correct comparison between both taxa.

The reinterpretation of the Valerots association of voles allows to clarify the relationships between *Allophaiomys* and other younger subgenera of *Microtus*. It is suggested that *M. (A.) hintoni nutiensis* is the ancestor of the *Iberomys* lineage, and *M. (A.) burgondiae* is probably related to the *Chionomys* group. The new species could be a primitive form of the *Stenocranius* lineage.

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## NEW PALEONTOLOGICAL AND PALEOMAGNETIC DATA ABOUT THE AGE OF THE VILLARROYA FOSSIL MAMMAL SITE (LA RIOJA, SPAIN; LATE PLIOCENE)

*César LAPLANA, Arsenio MUÑOZ & Emilio PUEYO.*  
Paleontología. Universidad de Zaragoza. 50009 Zaragoza, Spain.

The Pliocene locality of Villarroya was discovered in the twenties and from this date a considerable number of works have been devoted to the description of this rich assemblage of fossil vertebrates. Major contribution on the mammals include those made by Villalta (1952), Heinz (1970), Michaux (1971), Alberdi (1974), Soria (1979), Azanza *et al* (1989), among others.

There is no general agreement on the age of the Villarroya fauna. Based mainly on the presence of *Hipparion rocinantis crusafonti* and *Anancus arvernensis* and in the absence of *Equus* and *Mammuthus*, some authors have proposed that Villarroya should be included in the lower part of the Neogene Mammal Zone MN16 (Alberdi, 1986; Aguirre & Morales, 1990). Nevertheless, recent paleomagnetic data suggest a younger age of this fauna (Pueyo *et al*, 1996), and a discussion has been opened on this subject (Alberdi & Azanza, 1997). Taking into account the important role of small mammals for the Pliocene chronology, it was thought opportune to organise a collecting campaign of microvertebrates to get new and complementary data about the age of this locality. Fieldwork in 1998 provided about 100 specimens of small mammals near the classical locality.

The obtained small mammal association supports the inclusion of Villarroya in MN17 unit better than in MN16. The mammalian fauna from Villarroya is of great significance since it allows the Neogene macro- and micromammal chronology with the magnetostratigraphy to be cross-correlated. The age suggested by the small mammal association is in agreement with the new paleomagnetic data (Pueyo *et al.*, in prep.), which correlate the fossil locality with the Reunion I subcron. With the new interpretation of the age of this site, the presence of *Hipparion* at Villarroya become one of the youngest (if not the youngest one) records of this genus in Europe.

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## A NEW LATE MAASTRICHTIAN VERTEBRATE LOCALITY IN THE FRENCH PETITES-PYRÉNÉES

*Yves LAURENT<sup>1,2</sup>, Lionel CAVIN<sup>1</sup> & Michel BILOTTE<sup>2</sup>*

1 Musée des Dinosauriens, 11260 Espéraza, FRANCE

e-mail : musee.dinosauriens@wanadoo.fr

2 Université Paul Sabatier, Laboratoire de Dynamique des Bassins Sédimentaires,  
39 allées Jules Guesde, 31062 Toulouse cedex 4, FRANCE

Despite an early report of reptile bones and *Lepidotus* scales at Montsaunés (Haute Garonne, France), discoveries of Maastrichtian vertebrate faunas in the French Petites-Pyrénées have remained sporadic and limited until now. The new locality of Lestailats was discovered in 1993, and excavations were conducted by the Musée des Dinosauriens d'Espéraza in 1994 and 1997.

This new Late Maastrichtian locality from the Petites-Pyrénées has yielded an important vertebrate fauna. It includes Chondrichthyes (undetermined neoselachian), Osteichthyes (Lepisosteidae, Phyllodontinae, Sparidae ?), Chelonia (Pleurodira), Crocodylia, and Dinosauria (Theropoda, Hadrosauridae, Nodosauridae). It is the first mention of a Cretaceous phyllodontine and the first mention of an ankylosaur in the French Late Maastrichtian. Lestailats is the richest Late Maastrichtian locality in Southern France because of the occurrence of both a microfauna and macrovertebrates. It offers new perspectives for the knowledge of the diversity and the evolution of the European vertebrate assemblages in the latest Cretaceous.

## THE SYNECHODONTIFORMES DUFFIN (WARD 1993) A CONCEPT CONFIRMED BY SCALE-MORPHOLOGIC FEATURES

*Armin LEIDNER*

Institut für Geologie und Palaeontologie, Universität Hannover,  
Callinstr. 30, D-30167 Hannover, GERMANY.

In a comprehensive work on scale morphology of Late Jurassic elasmobranchs, extracted scales of *Sphenodus macer* Quenstedt 1852 and *Notidanoides muensteri* Agassiz 1843, as well as from undescribed material, was examined with a scanning electron microscope. From the extracted scales it was possible to determine features that appear in both the Synechodontiformes Duffin (Ward 1993) and the Hexanchiformes Buen 1926 exclusively and are judged, therefore, to be synapomorphic, detaching these orders from all other Neoselachii with which members of the Synechodontiformes Duffin (Ward 1993) have been grouped in earlier classifications. The scales of *Synechodus jurensis* Schweizer 1964 were previously figured, but not examined in detail. Comparison with the undescribed specimen shows consistent features in different growth-stages. Further comparison with synechodontiform scales from the Liassic of England and Germany is difficult being limited to light-microscopic observations and drawings of scales, which consequently obscures the detailed ornamentation that can be observed in scanning electron microscopy. The important features of the scales are situated on the neck and anterior margin of the scale, a part of the scale not, or only incidentally documented by previous authors using SEM.

The relationship of the Synechodontiformes Duffin (Ward 1993) has been previously examined in detail exclusively on the base of oral tooth morphology. These results are confirmed by the synapomorphic scale morphology, which in turn supposes an even closer relationship between the two groups. In consequence it is proposed here to rank the former order Hexanchiformes Buen 1926 down to a suborder Hexanchoidae, grouped together with the Synechodontoidei in the order Synechodontiformes Duffin (Ward 1993). The order Chlamydoselachiformes Rass (Lindberg 1971, partim), widely accepted as related taxon is grouped here in the Superorder Squalomorphii Compagno 1973 of the Subcohort Neoselachii Compagno 1977, mostly because of convenience; former SEM-pictures lack information about the diagnostic features of the scale-neck. As an application of scale morphology the stratigraphic range of the Synechodontiformes Duffin (Ward 1993) is extended back to the Late Permian by comparison with figured isolated scales.

## EARLY CRETACEOUS DINOSAUR FOOTPRINTS FROM THAILAND

*Jean Le LOEUFF<sup>1</sup>, Eric BUFFETAUT<sup>2</sup>, Varavudh SUTEETHORN<sup>3</sup>, Haiyan TONG<sup>2</sup>, Sasidhorn KHANSUBHA<sup>3</sup>, Sutee JONGAUTCHARIYAKUL<sup>3</sup>, Gilles CUNY<sup>4</sup> & Christel SOUILLAT<sup>1</sup>*

1. Musée des Dinosauriens, 11260 Espéraza, FRANCE.

2. CNRS (UMR 5561). Cour du Liégar, 75013 Paris, FRANCE.

3. Geological Survey Division, Department of Mineral Resources,  
Rama VI Road, Bangkok 10400, THAILAND.

4. Dpt of Earth Sciences, University of Bristol, Wills Memorial Building, Queens Road,  
Bristol BS8 1RJ, UNITED KINGDOM.

The Phra Wihan Formation of Northeastern Thailand is palynologically dated of the early Early Cretaceous. It has so far yielded no fossil bones (underlying Phu Kradung Formation and overlying Sao Khua Formation have yielded rich vertebrate assemblages). The Thai-French Dinosaur Team mapped two footprint sites of the Phra Wihan Formation in February-March 1999.

The Hin Lat Pa Chat site (Phu Wiang Hills, Changwat Khon Kaen) shows some large and small theropod prints and essentially several tracks made by small ornithopods (calculated height at the hip : 53 cm). The Phu Faek site (Changwat Kalasin) is a sandstone outcrop in a river bed. It shows several theropod trackways of different size. At least two large pes prints can be referred to a sauropod (the first sauropod footprints reported from Thailand).

The Phra Wihan footprints thus show that large and small theropods, small ornithopods and fairly large sauropods existed in the Early Cretaceous of Southeast Asia. This is very similar to the assemblage of the Late Jurassic Phu Kradung Formation, showing no drastic modifications at the Jurassic Cretaceous boundary in Southeast Asia. The faunal content of the overlying Sao Khua Formation shows more drastic faunal changes during the Early Cretaceous. An alternative explanation would be possible : vertebrates occur at the top of the thick Phu Kradung Formation, very near the overlying Phra Wihan footprints. The top of the Phu Kradung could thus also be of early Early Cretaceous age.

## INTRASPECIFIC VARIABILITY OF SIZE IN *CERVUS ELAPHUS* (CERVIDAE, MAMMALIA)

F LÓPEZ GONZÁLEZ, M. VILA TABOADA,  
& Aurora GRANDAL-d'ANGLADE,

Instituto Universitario de Xeoloxía. Universidade da Coruña. 15071. A Coruña. SPAIN  
Laboratorio Xeolóxico de Laxe. Fund. Isidro Parga Pondal. 15168 O Castro, A Coruña.  
SPAIN.

E-mail: xefer@mail2.udc.es

Cervids are one of the most dominant groups, talking about large mammals, of the Pleistocene succession in number of species as well as in fossil remains abundance. In the particular case of *Cervus elaphus*, it appears -for first time- in Middle Pleistocene stratigraphic levels. Thus, it has been widely distributed all over Europe and, moreover, it is known that this species has been present in a continuous way, both in glacial events and interglacial warmer terms.

In osteometric analysis carried with *Cervus elaphus* remains out, it is obvious sexual dimorphism, the existence of a time cline and also a geographic cline: then, individuals body size was getting smaller from the Pleistocene till nowadays; this decrease is also noted the furthest (in Southern and Western Europe direction) we get. Therefore, a good absolute dating of the remains is essential, as well as a proper individual age determination and the geographic location of the site.

In this work we effect a morphometric study of *Cervus elaphus* remains from different sites placed in the Iberian Peninsula and South of France. Skeletal size variations have been analyzed according time, by determining the evolution of proportions of the skull and limb bones. We also compare *C. elaphus* fossil remains from the Liñares (Lugo) site, which belong to two different morphotypes, large and small. Moreover, we have compared these data with others from different sites and chronological periods, also taking into account another ungulate species.

## EARLY MIOCENE ANTHRACOTHERES FROM EUROPE AND THE DESCRIPTION OF A SPECIMEN FROM LORANCA, SPAIN

*Jan van der MADE & Jorge MORALES*

Museo Nacional de Ciencias Naturales, José Gutierrez Abascal 2, 28006 Madrid, SPAIN.

Anthracotheriidae are bunodont or selodont Suiformes. The oldest anthracotheres are from the Eocene of Asia and Europe and from the Oligocene of Africa and America. They went extinct in America and on the mainland of Europe during the Early Miocene. They persisted till the Late Miocene in Africa and on the island of Tuscany, till the Late Pliocene in India and till the Pleistocene in Indonesia.

The most common European Oligocene anthracotheres belong to the genera *Anthracotherium*, *Microbunodon* and *Elomeryx*. These genera went extinct within a short time. Their last records are respectively: MP28, MP29 and MN1. *Elomeryx* lived thus on till the earliest Miocene.

*Elomeryx* entered Europe during the earliest Oligocene (MP21), probably coming from Asia. There are three species: *E. crispus*, *E. cluae* and *E. borbonicus*. It is the last species that lived on till the early Miocene, Neogene Mammal Unit MN1. The early Miocene form differs from the typical form in having smaller premolars and has been given subspecific status, *E. borbonicus minor*. When this form went extinct, there were no anthracotheres in Europe anymore.

When, in MN3, Africa became connected to Europe, the genus *Brachyodus* dispersed to the Indian Subcontinent, Asia and Europe. There is a good record from MN3-4. During this time there was a marked size increase and two species are recognized on the basis of size; *B. intermedius* (early MN3) and *B. onoides* (late MN3 and part of MN4).

A molar fragment that was found on the surface in Loranca del Campo belongs to *Brachyodus*. Beds with a fossil record dating from MN2 and MN4 crop out in the area. The fossil is probably derived from the younger beds and represents one of the latest European anthracotheres.

## THE EVOLUTION OF *OVIBOS* IN RELATION TO ENVIRONMENT

*Jan van der MADE & Jesús RODRIGUEZ*

Museo Nacional de Ciencias Naturales, José Gutierrez Abascal 2, 28006 Madrid, SPAIN.

The musk oxen *Ovibos* and *Praeovibos* are closely related. During the early Early Pleistocene, a *Praeovibos* of intermediate size entered Europe. It probably had an Asian origin. By the Middle Pleistocene, there were a large *Praeovibos* and a small *Ovibos* in Europe. If a particular derived morphology of the horn cores is found, the animal is usually placed in *Ovibos*. Apart from this, the genera are rather similar. The metapodials of *Ovibos* became more robust with time, till finally they were extremely robust.

Robust metapodials occur in living bovids that are adapted to:

- cold (*Ovibos*, *Poephagus*, *Budorcas*)
- mountainous environments (*Hemitragus*, *Poephagus*, *Budorcas*)
- wet environments (*Bubalus*)
- island environments (*Anoa*)

In certain fossil bovids these tendencies are even clearer (fossil *Bubalus* from Java, *Myotragus* from the Balears).

The evolution towards robust metapodials in *Ovibos* is interpreted as an adaptation to cold. This adaptation was probably a long process. The earliest musk oxen, which at present live in the Arctic, lived in the same environment as hippos, which at present are restricted to the tropics. This adaptation to the arctic environment was not gradual, but seems to have experienced a rather late acceleration. This is probably no isolated case. Living *Alces* is adapted to low temperatures. One of the adaptations involves the nasal morphology. This morphology is reflected in the facial skeleton. Middle Pleistocene *Alces* did not yet have retracted nasals.

The interpretation of Early and early Middle Pleistocene *Ovibos* and *Praeovibos* as typical of cold environments is probably not correct. Adaptation to cold environments may have occurred in various animals, including musk oxen and elks, during glaciations with a particular impact on the fauna.

## PRELIMINARY DATA ON TWO SMALL MAMMAL-BEARING PALEOSOILS FROM THYRRENIAN AND ADRIATIC SIDES OF ITALY

*Federica MARCOLINI, G. ZANCHETTA, & F. P. BONADONNA*

Universita di Pisa. Dip. Scienze della Terra, Via S. Maria 53, 56126 Pisa, ITALY

In a viewpoint of continental biochronologic reconstruction, paleosoils are commonly retained to be important for the fossil content they may have (Bown & Kraus, 1981), even if scanty or badly preserved, since they usually have a defined stratigraphic position. Moreover, they gain more importance when, as in this case, they are overlain by levels that can be or are dated. The upper paleosoil of Campani quarry is directly overlapped by a volcanic ash level, which has been dated with fission tracks either on the glasses ( $0.59^{+}0.08$  My;  $0.62^{+}0.07$ My) and on the apatites ( $0.46^{+}0.05$ My) (Bigazzi *et al.* 1999).

Campani quarry is located on the orographic left-hand of the Arno River, in the Lower Valdarno area, where four sedimentary units outcrops ranging from middle Pliocene to upper Pleistocene. The Pleistocene sequence of Campani quarry develops within a basal portion of gravels and frequent reworked fragments of marine Pliocene fossils. In the upper portion finer grained facies are dominant, which can be correlated to alluvial plain and channel belt environments. Interbedded within these, there are laterally continuous bodies interpreted as poorly developed soils (Zanchetta *et al.* 1998). At the top of the sequence there's the previously quoted ash level.

At least six paleosoils can be recognised in the succession. Some of them have yielded continental molluscs and large mammals bony fragments. They have been investigated also for small mammals, and preliminary results are given in this study: only the highest paleosoil, has yielded small mammals remains: rodents (mostly arvicolids and murids) and insectivores.

In the surroundings of Pescara (southern Italy) another paleosoil is under study: it contains small mammals and terrestrial molluscs and it is overlapped by an ash level too. A middle Pleistocene age is inferred from stratigraphic evidences. Preliminary comparisons between the two middle Pleistocene small mammals remains are made.

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## A LATEST MIOCENE MICROMAMMAL FAUNA FROM THE ZORRERAS MEMBER (SORBAS BASIN, SE SPAIN)

*Elvira MARTÍN-SUÁREZ*

Departamento de Estratigrafía y Paleontología, Facultad de Ciencias,  
Universidad de Granada, E-18071, Granada, SPAIN,  
e-mail [elvira@goliat.ugr.es](mailto:elvira@goliat.ugr.es).

*& Matthijs FREUDENTHAL*

Nationaal Natuurhistorisch Museum, Postbus 9517, NL-2300 RA, Leiden, THE  
NETHERLANDS,  
e-mail [freudenthal@naturalis.nnm.nl](mailto:freudenthal@naturalis.nnm.nl).

The Sorbas Basin is situated in the SE part of the Iberian Peninsula, in the province of Almería. It contains one of the most complete Late Miocene successions of the western Mediterranean, consisting of open marine marls with diatomites (Abad Member), followed by a thick sequence of marine evaporites (Yesares Member). These evaporites are overlain by coastal sequences (Sorbas Member), and finally continental deposits (Zorreras Member).

In the lower part of the red detritic deposits of the Zorreras quarry, two nearly parallel levels of gray, fine-grained, locally clayey sands were sampled at several points, numbered 1 to 5. Both levels contain micromammal fossils, though they are very poor. Through the processing of large amounts of sediments (12 tons at site 3A, and lesser quantities at other points) we have obtained a small collection of micromammals:

ZOR-2B (Co-ordinates UTM 30SWG795069): *Protatera* sp., *Occitanomys alcalai*, fragment of *Paraethomys meini*, Cricetodontinae indet. and Ochotonidae indet.

ZOR-3A (Co-ordinates UTM 30SWG791067): *Protatera almenarensis*, *Occitanomys alcalai*, *Paraethomys meini*, *Stephanomys ramblensis*, *Apodemus cf. gorafensis*, some fragments of Ochotonidae indet., and an upper incisor of a Soricini or Crocidurini indet.

The association of *Occitanomys alcalai*, *Paraethomys meini*, *Stephanomys ramblensis*, *Apodemus cf. gorafensis* and *Protatera almenarensis* indicates a latest Turolian age (Latest Messinian in marine terms), very close to the Mio - Pliocene boundary. This relative age is consistent with the early Pliocene age of

the marine sediments of the uppermost part of the Zorreras Member (Ott d'Estevou, 1980).

## GIANT HAMSTERS IN THE PLEISTOCENE OF EUROPE. COMMENTS ON TAXONOMY, PHYLOGENY AND PALAEOECOLOGY

*Lutz MAUL*

Bereich Quartaerpalaeontologie Weimar. Institut für Geowissenschaften, FSU,  
Steubenstr. 19a. D-99423 Weimar. GERMANY

Remains of so called "Giant hamsters", larger than the recent common hamster *Cricetus cricetus* have been recorded in many Pleistocene localities of Europe. They are referred either to *Cricetus major*, first described by Woldrich from the Late Pleistocene locality Vypustek - or to *Cricetus runtonensis* established by Newton based on material of the Type Cromerian site of West Runton.

Since the time of the descriptions of both species at around the beginning of the 20th century controversy has persisted about their taxonomy, palaeoecology and phylogeny. Some authors have interpreted them as only extreme variants of *Cricetus cricetus*, others as two taxa distinct from the common hamster on specific or subspecific rank, and still others as one valid taxon and one synonym.

Because all discussions based on comparisons with the type specimens of *C. major* and *C. runtonensis* were restricted to the entire tooth row lengths without adding any new information, it is probable that nobody has re-examined these materials since the time of Woldrich and Newton. Indeed, according to some authors the material of Vypustek was commonly thought to be lost.

The nearly complete skull (holotype) of *Cricetus major* has recently been re-discovered in the collection of the Natural History Museum of Vienna. A comparison with the type material of *Cricetus runtonensis* (stored in the British Museum), has now established the existence of two distinct species based on clear differences in the size of the teeth. On the base of these fossils and on other records of these taxa, together with stratigraphical ages and palaeoecological interpretations, various alternative views of the evolutionary history of the giant hamsters are discussed.

## PHYLOGENY OF THE BIHARIAN GROUND SQUIRRELS. EVIDENCE FROM CENTRAL EUROPE

*Lutz MAUL*

Bereich Quartaerpalaeontologie Weimar. Institut für Geowissenschaften, FSU,  
Steubenstr. 19a. D-99423 Weimar. GERMANY

Ground squirrels of the genus *Spermophilus* are typical steppic elements. At the present day they are distributed over Eastern Europe, Asia and mainly Northern America. During arid and continental phases of the Pleistocene they also occurred regularly in Central and even Western Europe.

European Toringian faunas are characterised by the existence of forms equal to and larger in size than the recent *Spermophilus citellus*. During the Biharian, in contrast, all *Spermophilus* taxa (*Spermophilus primigenius*, *S. polonicus*, *S. dietrichi* from Central and *S. nogaici* from Eastern Europe) were of larger size.

The rather rich population of Untermassfeld is referred to a new species, *Spermophilus* n. sp., clearly distinct from the smaller material of *Spermophilus primigenius* from the type locality Villany 3 and from that of *Spermophilus polonicus* from the type locality Kamyk. It is, on the other hand, smaller than *Spermophilus dietrichi* from Voigtstedt. When compared with the finds from localities in Germany, Poland, and France (Voigtstedt, Kamyk, Kozi Grzbiet, Zalesiaki, Les Valerots u. a.) a successive regular increasing of size seems to be evident, and is supported by gradual changes in tooth proportions and morphology. Therefore referral of all these to one lineage appears very likely.

*Spermophilus* populations of Biharian localities from Hungary, Czech Republic, Ukraina and Russia show also a size increase with time. However, this trend is less sharp than in the populations mentioned above, and points to regional differences of this general tendency.

## BIOSTRATIGRAPHICAL INTEREST OF SMALL BOVIDS FROM ARAGO CAVE (TAUTAVEL, PYRÉNÉES-ORIENTALES, FRANCE)

*Hervé MONCHOT*

Laboratoire d'Anthropologie - Faculté de Médecine - Secteur Nord. Boulevard Pierre-Dramard 13916 Marseille Cedex 20. FRANCE  
e-mail: Herve.Monchot@medecine.univ-mrs.fr

Near the antique mouflon (*Ovis antiqua*), the tahr of Bonal (*Hemitragus bonali*) and the chamois (*Rupicapra sp.*), the presence of two species *Capra sp.*, and *Hemitragus cf. cedrensis* is justify by characteristic anatomical features. The stratigraphic position of this species shows that Arago cave is an important site for the evolution of small bovids during the Middle Pleistocene in France and Western Europe.

## **MAMMALIAN FAUNAS AS INDICATORS OF ENVIRONMENTAL AND CLIMATIC CHANGES IN EUROPE SINCE THE PLIOCENE**

*Sophie MONTUIRE*

UMR CNRS 5561 et Lab. EPHE (Paléobiodiversité et Préhistoire), Centre des Sciences de la Terre, Université de Bourgogne, 6 Bld Gabriel, 21 000 Dijon - FRANCE.  
E.Mail: Sophie.Montuire@u-bourgogne.fr

The study of mammal communities provides useful knowledge of paleoenvironments and paleoclimates, and better documentation about the main fossil sites is making this task easier. Paleocological reconstructions are based on the cenogram method for the palaeoenvironment and also on the study of rodent evolution and species diversity using to develop new methods for quantifying climatic parameters (Temperatures and precipitations).

These analyses applied to Pliocene-Quaternary faunal sequences of Europe and in particular in Spain indicate that a climatic change occurred at the end of the Pliocene when considerable cooling acted the onset of the glacial-interglacial cycles and that subsequently, in the Quaternary, alternating environmental patterns occurred with a rather open and arid environment during the cold phases contrasting with a somewhat more closed and comparatively wet environment during warmer phases.

These observations can be generalised nearly to all regions of Europe with a few nuances. For example, climatic conditions were less harsh and more arid in Spain than elsewhere in Europe.

## CONTRIBUTION OF SR-ISOTOPE ANALYSES TO THE PALEOECOLOGY OF FISH

*Alexander MUDROCH*

Institut für Geologie und Palaeontologie, Universität Hannover,  
Callinstr. 30, D-30167 Hannover, GERMANY.  
e-mail: mudroch@mbx.geowi.uni-hannover.de

Beside the occasional use of  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios in fish debris for chemostratigraphical purposes (Strontium Isotope Stratigraphy, Veizer *et al.* 1997), there is a certain potential for using them as palaeosalinity indicators. Normally freshwater isotope signatures are clearly distinct from equilibrated seawater isotope composition, because high relative  $^{87}\text{Sr}$  portions are mainly gained from continental weathering. These distinct isotope signatures are recorded in fish remains from environments of different salinity, because Sr isotopes are not fractionated by the physiology of the organism.

Apart from using Sr isotopes for determination of marine or freshwater provenance of certain fish taxa (Poyato-Ariza *et al.* 1998) they can be very useful for the study of fossil habitats. Schmitz *et al.* (1991) showed that, for most of the 38 Phanerozoic fish fossils they chose, the presumed habitat salinity could be corroborated by means of  $^{87}\text{Sr}/^{86}\text{Sr}$  analyses. Schmitz *et al.* (1997) tested various skeletal apatites - including fish remains - from marine, brackish and freshwater palaeoenvironments of the early Tertiary in comparison with Recent material and found that despite a visible diagenetic overprint in some of their samples a certain amount of original Sr isotope signature containing the salinity information is still present. Mudroch *et al.* (1998, in press) showed that it is necessary, before using the information potential of Sr isotopes, to deal with postmortal chemical alteration of the fossils and presented a method for evaluating Sr isotope data. With the application of a two-component mixture model, it is also much easier now to discuss  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios from transitional environments, where a mixture of saltwater and freshwater leads to lower marine or brackish salinities.

Schmitz *et al.* (1991) stated that, apart from post-depositional alteration, certain migratory habits of some of the fishes they analysed could be the reason why some of the assumed marine values are slightly higher than expected. Koch *et al.* (1992) were able to show that the migration of Recent and fossil salmon from seawater to freshwater and vice versa is measurable from the inside to the outside of their vertebrae, because the  $^{87}\text{Sr}/^{86}\text{Sr}$  of their changing habitats is

imprinted during ontogeny. This might be also detectable in other continuously growing skeletal parts of fossil fish that are composed of hard tissues that are more resistant to chemical alteration than bone, e.g. scales or teeth. Future enhancements of analytical technique will give us the possibilities to study diadromy even in fossil fish.

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## ON THE DENTITION OF *DAPEDIUM* LEACH 1822 (ACTINOPTERYGII, SEMIONOTIFORMES)

*Alexander MUDROCH*

Institut für Geologie und Palaeontologie, Universität Hannover,  
Callinstr. 30, D-30167 Hannover, GERMANY  
E-mail: mudroch@mbx.geowi.uni-hannover.de

*Dominique DELSATE*

Musée National d'Histoire Naturelle de Luxembourg, 25,  
Rue Münster, L - 2160 Luxembourg - Grund, LUXEMBOURG

& *Annette HERZOG*

IMGP, Universität Göttingen, Goldschmidt-Str. 3, D-37077 Göttingen, GERMANY.

Several specimens of three different Late Liassic species of *Dapedium* Leach 1822, *D. caelatum*, *D. pholidotum*, and *D. punctatum*, were studied for their dentition pattern. Especially, three partially disarticulated specimens from the *Posidonia* Shale (Toarcian) of Southern Germany give an exceptional insight into skull anatomy and show most of the tooth-bearing bones of *Dapedium*.

In the upper jaw the fused premaxilla bears 3-4 strong unicuspidate teeth with a blunt conical enamel cap. The maxilla is edentulous and believed to have been very mobile. A row of smaller, mostly unicuspidate teeth with sharp apices is sitting on a bone behind the maxilla; this bone is fused with the palatoquadrate and assumed to be the ectopterygoid or the dermopalatine. On the rostral and median parts, the vomer (paired or unpaired) is covered with many small blunt multicuspidate teeth that have a flattened molar-like enamel cap with 4 or more (up to 9+) apices. These teeth are believed to have a certain tritoral function. The specimens studied do not reveal if the parasphenoid bears teeth or not, but if this is so, they most probably are small and blunt like on the vomer.

The lower jaw consists of several bones that are fused to form a paired mandibular element. The anterodorsal edge of the dentary has 2-4 strong unicuspidate teeth that resemble those of the premaxilla on its rostral end. Distally behind the dentary are two coronoids each of which has an outer row of smaller unicuspidate and two inner rows of bi- sometimes tricuspidate teeth. Lingually behind the coronoids lies the prearticular that is covered with small blunt multicuspidate teeth that resemble those of the vomer. The splenial on the outside of the mandibular element is edentulous, like the angular and the surangular.

We compared these tooth morphologies with isolated teeth from the Toarcian localities of Halanzky (B), Belvaux (L) and Longlaville (F) in the Lorraine Basin. We were able to find all the described morphotypes of the dentition of *Dapedium* in the microvertebrate-rich residues gained from these middle Toarcian (bifrons-zone, crassum-beds) sediments. According to the results of this study, it should be possible now to identify clearly the genus *Dapedium* in other microvertebrate assemblages of Liassic age.

## LATEST CRETACEOUS ELASMOSAUR REMAINS FROM THE MAASTRICHTIAN TYPE AREA, BELGIUM AND MOROCCO AND THEIR PALAEOBIOGEOGRAPHICAL IMPLICATIONS

*Eric W.A. MULDER<sup>1</sup>, Nathalie BARDET<sup>2</sup>, Pascal GODEFROIT<sup>3</sup> & John JAGT<sup>4</sup>*

1Museum Natura Docet Oldenzaalsestraat 39, NL-7591 GL Denekamp, THE NETHERLANDS

2 UMR 8569 du CNRS, Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,

8 rue Buffon, 75005 Paris. FRANCE

3 Département de Paléontologie, Institut Royal des Sciences Naturelles de Belgique, rue Vautier 29, 1000 Bruxeller. BELGIUM

4 Natuurhistorisch Museum Maastricht, Postbus 882, NL-6200 AW Maastricht. HOLLAND

e-mail: mail@nhmmaastricht.nl

Ever since the first unambiguous record by Herman von Meyer (1860) it has become apparent, that remains of plesiosaurs from Late Maastrichtian strata in the type area of that stage are extremely rare in comparison with sharks, mosasaurs and turtles. Until now only very few elasmosaur teeth and vertebrae are known. Possibly causes for this scarcity will be discussed, as well as the presence of elasmosaurs in the latest Cretaceous (Northern) Atlantic Ocean. As a consequence comparisons with Plesiosaur remain from other areas with sediments of the same age will be made.

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**DISCOVERY OF A SKELETON OF *RHABDODON PRISCUS* (ORNITHOPODA, DINOSAURIA) IN THE UPPER CRETACEOUS OF VITROLLES (BOUCHES-DU-RHÔNE, FRANCE)**

*Marie PINCEMAILLE*

Musée des Dinosaurés, 11260 Espèraza, France (GIS Paléontologie et Sédimentologie),  
Université Paul Sabatier, Toulouse). FRANCE  
e-mail: pincemi@club-internet.fr

*Rhabdodon priscus* was described in 1869 by the geologist P. Matheron from a few fragmentary bones. Then, a lot of bones were discovered in Upper Campanian to lower Maastrichtian continental formations from Southern France and Spain. Nevertheless, these rests kept isolate and fragmentary. In 1995, an excavation was leaded by the University of Montpellier in the lower Maastrichtian of Couperigne near Vitrolles and for the first time gave a nearly-complete skeleton of one *Rhabdodon priscus* specimen.

This discovery revealed numerous unknown pieces like a complete dentary, scapula, coracoid, ischion, pubis and some sacral vertebrae. The detailed study of these bones precised the osteology and for the first time the phyletic position of this species. It confirmed that *R. priscus* is different from the Romanian *Rhabdodon*, referred to the species *R. robustus* (Nopcsa, 1901).

A preliminary cladistic analyse, made on 17 ornithopod taxa and 60 anatomic characters, clearly isolated *Rhabdodon priscus* from the more primitive Hypsilophodontidae and closed it to the Iguanodontidae. Moreover, results suggested that the genus *Rhabdodon* form a clade with *Tenontosaurus* (North-America) and *Muttaborrasaurus* (Australia). *Muttaborrasaurus* would be the sister-group of *Rhabdodon*.

## **BALEEN WHALES (CETACEA, MYSTICETI) FROM THE LATE MIOCENE GRAM FORMATION IN DENMARK**

*Mette Elstrup RASMUSSEN*

Geologisk Museum, University of Copenhagen, Oester Voldgade 5-7,

DK-1350 Copenhagen. DENMARK.

e-mail: metter@savik.geomus.ku.dk

Cetacean remains are common in the Late Miocene (Tortonian stage, 10-6 Ma) marine clay, forming the pre-Quaternary surface in SW Jutland, Denmark (Rasmussen, E. S. 1996). Mining of the clay for brick manufacturing near the village of Gram exposed fossil bones, which have been scientifically collected since the early 1970s (Roth 1993-94) (for thorough description of the extensive molluscan fauna, see Rasmussen, L. B. 1966). The deposits constituting the Gram Formation can be followed beneath younger deposits in NW Germany.

Until now the remains of 17 mysticete whales have been recovered from the clay pit near Gram, including almost complete skeletons. In contrast, only fragmentary remains of three odontocetes have been found. The mysticetes identified so far all belong to the family Cetotheriidae that has affinity to the modern fin whales (Balaenopteridae). This includes the type specimen of *Mesocetus argillarius* Roth 1978, as well as two well preserved partial skulls which have been referred to *Amphicetus rotundus* Van Beneden 1880. The latter were identified mainly on the basis of the form of their relatively large tympanic bullae (Becher 1993). Three other partial mysticete skulls have been recovered, but await identification and description. A seemingly complete skull and partial postcranial skeleton of a juvenile baleen whale of currently unknown affinities is undergoing the final preparation. The posteroventral part of this skull is excellently preserved, whereas the rostrum and the dorsal side are more fragmented. This is characteristic of the varying preservational state of the fossils from Gram.

My current study focuses on an almost complete, articulated skeleton, lacking the tip of the rostrum, all phalanges, some vertebrae and most of the ribs. The skull is locally fragmented and pyrite-infested but in places undamaged and three-dimensionally preserved, for example in the ear-region. Removal of the right bulla has revealed a well preserved cochlea. A future study of the ear region and the mandibles is planned, to assess the hearing ability. The mandibular canal, opening on the presently exposed medial side of the relatively well preserved mandibles, is wider than in extant mysticetes. This feature is even more pronounced in *M. argillarius* (Roth 1978), and it probably indicates a sense of hearing adapted for higher frequencies compared to that of modern mysticetes.

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**PELVIC GIRDLE OF THE SAUROPOD (DINOSAURIA)  
FROM PEÑARROYA DE TASTAVINS (LOWER APTIAN,  
TERUEL, SPAIN).**

*Rafael ROYO-TORRES.*

Departamento de Ciencias de la Tierra, Area de Paleontología,  
Universidad de Zaragoza, 50009 Zaragoza, SPAIN.  
e-mail: 309037@docto.unizar.es

The results here presented are an abstract of the sauropod pelvic girdle from Peñarroya de Tastavins, lower Aptian. Description of the pelvic bones:

In the lateral view the ilium is subrectangular in shape. The preacetabular process is expanded with half circumference in shape. In a dorsal view this process is deflected laterally, the ventral margin of preacetabular process is straight. The postacetabular process is narrow dorsoventrally and triangular in shape. The dorsal edge on ilium laminae is straight and is situated inclined caudally. The lateral side is concave. The region of acetabulum is broad and circular in shape. The ilium forms the major part of the acetabulum. The pubic process is well developed, is rectangular in cranial view and expanded transversally. The ischiatic process is short with subcircular shape in ventral view and has one slot in the middle. In the medial side the laminae has three crest and depressions for the muscles attachments. On the medial side the acetabular margin there is a concavity. It is used for the sacrocostal yoke. The width of the edge varies along the ilium, cranially and caudally, it is thick whilst the dorsal edge is noticeable narrow.

The pubis is composed by three parts, the iliac process and the ischiac process are in a parasagittal plane whilst the rest of the pubis composed by the pubic branch is inclined. In anterior or posterior view it twists laterally. It is similar from other pubis with apron like. The iliac process is rectangular in shape from dorsal view, containing the symphysis to the ilium and the acetabular margin which is poorly developed. The pubic branch goes straight down and the distal part is expanded lateromedially, it is convex in ventral side and it projects towards lateral side. The ischiac process has a close oval like foramen. The ischiatic symphysis is well developed ventro-dorsally and is S-like. The ambiens process is absent. The caudal view is U-shaped at the proximal part.

The ischium is the smallest bone of the hip, the three branches well developed. The iliac branch has a symphysis to ilium subcircular in shape. In the

lateral view is seen with an inverted cone. Between the iliac branch and the pubic branch there is on the acetabular margin one acetabular laminae. The pubic process is very long, expanded cranio-caudally and dorso-ventrally. It is concave in medial side and convex in lateral side. The ventral branch is the ischiatic branch, long and rectangular in shape. The ratio between the length of the pubic branch and of the ischiatic branch (LPB/LIB), is 0,8 ( The ratio is near 0,1 in primitive sauropods and near 1 in the derived, condition). Its distal extremity is narrow and expanded latero-medially as in *Diplodocus* . This bone is twisted from proximal extremity to distal and it is not coosified.

It has been compared with all sauropods pelvic girdle available in bibliography. We think that ilium is related to *Brachiosaurus brancai* and *B. althitorax* because similar cranial process expanded, dorsal edge inclined caudally, broad acetabular margin and triangular shape in the postacetabular cavity. The pubis can be related morphologically to *Camarasaurus*, *Aragosaurus* and *Brachiosaurus* . In the case of ischium, it is similar to character with *B. atalayensis*. The ratio LPB/LIB is 0,8 equal *Andesaurus* and *Aelorosaurus*.

It is very probable that this sauropod is a new genus and species. In a work preparation it will be diagnosed and described. The main conclusion of the present study is that it can be a new sauropod related to the titanosauriforme clade.

**THE PUBIS OF *ARAGOSAURUS ISCHIATICUS* SANZ,  
BUSCALIONI, CASANOVAS & SANTAFÉ, 1987, A  
CAMARASAURID SAUROPOD FROM THE UPPER  
HAUTERIVIAN (LOWER CRETACEOUS) OF GALVE,  
TERUEL, SPAIN.**

*Rafael ROYO-TORRES & José Ignacio RUIZ-OMENACA*  
Departamento de Ciencias de la Tierra, Area de Paleontología,  
Universidad de Zaragoza, 50009 Zaragoza, SPAIN.  
e-mail: 309037@docto.unizar.es>

The genus *Aragosaurus* was established in 1987 by the following Spanish palaeontologists: J. L. Sanz, A. D. Buscalioni, M. L. Casanovas & J. V. Santafé, to name a sauropod found in the locality of "Las Zabacheras" whose existence had been previously published by French palaeontologist A. F. de Lapparent in 1960. "Las Zabacheras" is placed in the Lower Cretaceous (Upper Hauterivian, Castellar Fm.) of Galve (Teruel, Iberian Range).

Lapparent (1960) briefly studied the materials obtained in 1958 (eighth caudal vertebrae, fragments of cervical and thoracic ribs, proximal and distal parts of scapula, left radius and ulna, a carpal, eight fragments of metacarpals, two manual phalanx, partial left ischium, left pubis, left femur, proximal and distal parts of left fibula fragment of tibia), and thought that it represented an undescribed new genus of sauropod, in relation with the camarasaurids. Sanz (1982) studied an isolated tooth from a level close to "Las Zabacheras" site, which he interpreted as a Brachiosauridae indet. Sanz *et al* (1984) listed the Lapparent remains and new materials from "Las Zabacheras" site as Brachiosauridae indet. Later, Sanz *et al.* (1987) studied those new materials (four caudal vertebrae, eight chevrons, right scapula, a carpal?, right ischium, left femur, a pedal phalanx, and an ungual phalanx), and created the new genus and species *Aragosaurus ischiaticus*. These authors assigned Lapparent's remains and the isolated tooth to the new genus .

The Lapparent's material has remained unstudied in the Museo de Teruel collections. Some of the Lapparent's identifications are incorrect: the distal part of scapula, the distal part of fibula and the femur, are in fact a coracoid, the iliac peduncle of left ischium and an humerus, respectively. In addition, the partial left ischium is not from Las Zabacheras, is from another locality of Galve (La Maca) and it belongs to an iguandontid not to a sauropod. The left pubis



remained unstudied until the fall of 1998, when one of us restored this bone for his master thesis (Royo-Torres, 1999).

The left pubis was figured by Lapparent and briefly described. The ischiatic peduncle is partially missing, there is a part of the ischiatic symphysis, but it is not complete. The pubis is robust compared with other sauropods (e.g. Peñaroya de Tastavins sauropod, *Camarasaurus*), with proximal and distal ends very width. In lateral view, the iliac branch is like an inverted cone. Cranially, there is one flat zone for the insertion of the *Muscle ambiens*, it is triangular in anterior view. The acetabular margin is deep and well developed. Although the ischiadic branch is not complete, the obturator foramen was closed and the pubic branch was very expanded and triangular in shape. The pubic branch is straight, with an oval cross-section. Bellow Ischiac branch is the symphysis pubic in posteromedial position, also there is a slot-like gap. The distal end is convex and very rugged in ventral view. In anterior and posterior views, the pubis is twisted, but less than in other sauropods (e.g. Peñaroya de Tastavins sauropod, *Camarasaurus*).

Other characteristics of *Aragosaurus* are: the pubis and the ischium are approximately of the same length, and the femur is longer than humerus (humerus/femur = 0,82). In Titanosauriformes, the pubis is longer than the ischium, and in Brachiosauridae the humerus is longer than the femur.

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## **DINOSAUR REMAINS IN THE BARREMIAN (LOWER CRETACEOUS) OF THE TERUEL PROVINCE (IBERIAN CHAIN, NE SPAIN)**

*José I. RUIZ-OMENACA, Gloria CUENCA-BESCOS & José I. CANUDO*

Departamento de Ciencias de la Tierra, Paleontología, Universidad de Zaragoza,  
50009 Zaragoza, SPAIN.

e-mail: jigruiz@posta.unizar.es

Dinosaur remains are frequent in the region of Aragon. There is fossil record in the Tithonian-Cenomanian in the Iberian Chain (provinces of Teruel and Zaragoza), and in the Maastrichtian in the Pyrenees (province of Huesca). Barremian dinosaurs are the most common in the province of Teruel, and they are represented by bones, isolated teeth, and eggshells. Although dinosaur tracks are best represented in other periods in the province of Teruel (Tithonian-Barremian, Hauterivian, Cenomanian), up to the moment there are only two barremian tracksites.

Lower Barremian (LB) and Upper Barremian (UB) dinosaur-bearing formations are present, W to E, in the Oliete Basin (Blesa Fm., LB and UB, Alacón Fm., UB), Galve Basin (Castellar and Camarillas Fms., LB) and Morella Basin (Mirambel Fm., LB., Artoles Fm., UB). French paleontologist A. F. de Lapparent found in the sixties 6 localities in the "weald" of Teruel, in Galve, Morella, Salzedella and Peñagolosa Basins, but their exact location remains unknown; two of them may be UB.

With regard to direct remains (i.e. bones and teeth), currently, we have 22 localities in the LB (Oliete, Galve and Morella Basins) and 5 localities in the UB (Oliete and Morella basins), five of them consist of isolated remains, and the remainder are isolated carcasses or concentrations of bones, teeth or both. The principal concentration of sites is in Galve (Galve Basin) and Castellote (Morella Basin). There are representative remains of sauropod, theropod, ornithopod and thyreophoran dinosaurs.

There are Sauropoda in the LB (a tibia of Sauropoda indet., isolated teeth of two different Camarasauridae indet. and the brachiosaurid cf. *Pleurocoelus* sp., vertebrae of Titanosauriformes indet.) and in the UB (vertebrae of two types of Titanosauriformes indet, isolated teeth of Camarasauridae/Brachiosauridae).

Among Theropoda, the most representative remains are isolated teeth of very different sizes (ranging from 1 to 34 mm of fore-aft basal length), in LB and UB.

There are representatives of Theropoda indet. (at least five types), Baryonychidae indet., small unserrated coelurosaurians, "paronychodontids", dromeosaurs (at least six types: Dromeosauridae indet., Dromaeosaurinae indet. and Velociraptorinae indet.). Bony remains are infrequent (vertebrae of Theropoda indet in LB and UB, ungual phalanx in LB). Eggshells of the oofamily Elongatoolitidae may belong to oviraptorosaur theropods (Amo, 1998), other eggshells of ratite morphotype may represent undetermined theropods.

Ornithopods are the most frequent group, with some cranial material, abundant postcranial material, and isolated teeth. In the LB there are a partial articulated skeleton of a new *Othnielia*-like hypsilophodontid, an incomplete femur of a possibly driosaurid (? *Valdosaurus* sp.), articulated vertebrae and appendicular elements of Iguanodontidae indet., and cranial remains of *Iguanodon atherfieldensis*. Isolated teeth indicate the presence of at least three hypsilophodontids in the LB and one in the UB, two iguanodontids in the LB and UB, and one Ornithopoda indet. in the LB.

Thyreophorans are only represented in the LB: a dorsal spine of a nodosaurid ankylosaur and a fragment of a dorsal plate of an stegosaur (Nodosauridae indet., Stegosauria indet.).

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## THE BEGINNING OF THE MODERN AVIAN FLIGHT

*José L. SANZ & Bernardino P. PÉREZ-MORENO*

Unidad de Paleontología. Departamento de Biología. Facultad de Ciencias.

Universidad Autónoma de Madrid 28049 Madrid. SPAIN.

Extant birds are effective volant machines. These skills have been achieved during 150 m.y. of evolutionary history, from *Archaeopteryx* on. The history of the avian flight, through the study of bird fossil record, can be analyzed under two main interacting areas: the mechanical and the physiological ones. The first one is related with the biomechanical characteristics of bones, muscles and feathers in order to perform flight. The second one has to do with the history of the avian breathing devices.

Modern avian flight starts within the clade Ornithothoraces, in which *Iberomesornis* is the most basal taxon. This genus is characterised by the presence of a derived coracoid, furcula, and pygostyle. The inferred presence of a triosseal foramen indicates wing motion mechanisms very similar to those of extant birds. The pygostyle implies the existence of a rectricial bulb that allowed rectrice feathers to spread and fold. Thus, the flight capability of *Iberomesornis*, would be close to that of extant birds. Nevertheless, this Lower Cretaceous Spanish genus can not be considered as an active flier in the sense of an extant bird. In fact, in *Iberomesornis* the allegiance between pectoral and tail modules was beginning to evolve. On the other hand, the decoupling between hindlimbs and tail was not completely accomplished yet.

Modern avian wings are known to evolve during the Lower Cretaceous. The enantiornithine genus *Eoalulavis* documents the first presence of an alula, characteristic of most extant birds. The alula allows to brake during the performance of flight, permitting more efficient landing and some kind of manoeuvres. On the other hand, *Eoalulavis* had an elliptical wing characterized by a low aspect ratio. This kind of wing is present in most Passeriformes and doves, indicating a very active, powered flapping flight. This elliptical wing is aerodynamically advanced, characteristic of extant birds living in forest and shrub habitats.

The improving of breathing mechanisms is closely related to the history of avian flight. In spite of recent claims, nonavian theropods had a costal lung ventilation, very different of the hepatic piston present in extant crocodiles. Avian costal breathing is associated with a parabronchial lung and air sacs. We are not sure about the time of appearance of these breathing devices in the history of theropod dinosaurs. The pneumatic foramina, present in neornithine theropods, clearly indicate the existence of air sacs in this clade, whose first representatives appeared, at least, during the Upper Cretaceous. Air sacs are not directly involved in the improvement of flight skills, but allow to perform flight under low oxygen pressures. In conclusion, avian history is characterized by a biomechanical improvement of flight capability correlated with an improvement of breathing mechanisms that allow the appearance of avian forms with increasing capability to flight at elevated altitude.

## **THE EVOLUTION OF THE BRAIN AND BRAINCASE FROM THE CROCODILE TO THE BIRD, FOCUSING ON THE THEROPOD-BIRD TRANSITION.**

*Deborah S. WHARTON,*

The Department of Earth Sciences, The University of Bristol, The Wills Memorial Building,  
Queen's Road, Bristol, BS8 1RJ, UNITED KINGDOM  
and Laboratoire de Géobiologie, Biochronologie et Paléontologie Humaine,  
l'Université de Poitiers, 40, Avenue de Recteur Pineau, 86022 Poitiers, Cedex, FRANCE.

The evolution of birds, true flying, homoeothermic bipedal vertebrates, from their archosaur ancestors, presumably terrestrial quadrupeds with a heterothermic physiology, and represented today by extant crocodylians, involved a series of profound changes in physiology, locomotory abilities and ecological adaptations. Comparing extant crocodylians and birds it is also clear that the architecture of the brain and, concomitantly, of the brain case has also undergone some important changes both topographically and volumetrically. These include enlargement of the cerebellum, optic lobes and cerebral hemispheres and the reduction of the olfactory lobes.

The exact sequence of these changes has yet to be established, but it is clear that they took place within non-avian theropods and early pre-neornithine birds, and it has generally been assumed that major innovations in the relative size of the different brain structures and their slightly rearranged topography took place very soon after the theropod-bird transition.

Recently, the fossil record of theropods and early birds has been considerably expanded with the discovery, for example, of *Majungatholus*, *Shuvuia* and *Sinosauropteryx*. Preliminary studies of some of this material suggests a gradual acquisition of avian brain characters over a long period of time. Some of these characters, such as expanded and more dorsally placed optic lobes, comparatively enlarged cerebral hemispheres and the initiation of increases in the size of the cerebellum occurred in derived theropods, while further expansion of cerebral and cerebellar regions, and the primary major reductions of the olfactory apparatus are first recorded in early birds. However, the modern avian brain state seems to be confined to neornithines. Further work on critical taxa such as *Caudipteryx*, *Confusciornis* and basal neornithines is needed to establish more clearly the basic pattern of brain evolution in theropods and early birds.

## PARTICIPANTS

ALCALA, Luis

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

ALONSO, Ana María

Departamento de Petrología y Geoquímica. Facultad de Ciencias Geológicas. Universidad Complutense de Madrid. 28040 Madrid. SPAIN

AMEZUA, Lara

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

AMO, Olga

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

ARANBURU, A.

Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Mineralogía y Petrología, Apdo. 644, 48080 Bilbao. SPAIN.

ARDEVOL, Lluís

Geoplay, Madrazo 33-37, Suite 4-1. Barcelona, SPAIN

ARSUAGA, Juan Luis

Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

AUMONT, Adeline

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle, 8 rue Buffon, 75005 Paris. FRANCE

AZANZA Beatriz

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

BACETA, J.I.

Universidad de Huelva, Facultad de Ciencias Experimentales, Departamento de Geología, Campus de la Rábida s/n, 21819 Palos de la Frontera, Huelva, SPAIN

BADIOLA, A.

Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Estratigrafía y Paleontología, Apdo. 644, 48080 Bilbao. SPAIN.

BAHAIN, Jean Jaques

Laboratoire de Préhistoire du Muséum National d'Histoire Naturelle, UMR 6569 du CNRS, IPH, 1, Rue R. Panhard, 75013, Paris, FRANCE

BARCO, José Luis

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

BARDET, Nathalie

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle, 8 rue Buffon, 75005 Paris. FRANCE

BERMUDEZ de CASTRO, José María

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

BILLON-BRUYAT, Jean-Paul

Université de Poitiers, Laboratoire de Géobiologie, Biochronologie et Paléontologie humaine, EP 1596 CNRS, 40 av. du Recteur Pineau, F 86022 Poitiers, FRANCE.

**BILOTTE, Michel**

Université Paul Sabatier, Laboratoire de Dynamique des Bassins Sédimentaires, 39 allées Jules Guesde, 31062 Toulouse cedex 4, FRANCE

**BOEKSCHOTEN, Gijsbert J.**

Instituut voor Aardwetenschappen, Vrije Universiteit. De Boelelaan 1085. NL-1081 HV Amsterdam. HOLLAND

**BONDE, Niels**

Geological Institute, University of Copenhagen, Oster Voldgade 10, DK 1350, Kobenhavn K. Copenhagen, DENMARK

**BOTELLA, Hector**

Departamento de Geología, Universitat de Valencia; C/, Dr. Moliner 50; E-46100 Burjassot (Valencia), SPAIN.

**BRUNET-LECOMTE, Patrick**

Biogeosciences UMR CNRS 5561. Laboratoire de Paléobiodiversité et Préhistoire de l'EPHE, Université de Bourgogne, Centre des Sciences de la Terre, 6 bd. Gabriel, 21000 Dijon, FRANCE.

**BUCHY, Marie-Céline**

Laboratoire de Géobiologie, Biochronologie et Paléontologie Humaine 40, avenue du Recteur Pineau, F-86022 Poitiers cedex, FRANCE

**BUFFETAUT, Eric**

CNRS (UMR 5561). Cour du Liégat, 75013 Paris, FRANCE.

**CALVO, José Pedro**

Departamento de Petrología y Geoquímica. Facultad de Ciencias Geológicas. Universidad Complutense de Madrid. 28040 Madrid. SPAIN

**CANUDO, José Ignacio**

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

**CAPPETTA, Henri**

Institut des Sciences de l'Evolution, Université Montpellier II, 4 Place Bataillon, 34000 Montpellier, FRANCE.

**CARBONELL, Eudald**

Laboratorio de Arqueología. Universidad Rovira i Virgili. Pza. Imperial Tarraco, 1. 43005 Tarragona, SPAIN

**CARRETERO, José Miguel**

Departamento de Ciencias Históricas y Geografía, Facultad de Humanidades y Educación, Universidad de Burgos, C/ Villadiego s/n, 09001 Burgos, SPAIN.

**CAVIN, Lionel**

Musée des Dinosaures, 11260 Espèraza, FRANCE.

**CHALINE, Jean**

Biogeosciences UMR CNRS 5561. Laboratoire de Paléobiodiversité et Préhistoire de l'EPHE, Université de Bourgogne, Centre des Sciences de la Terre, 6 bd. Gabriel, 21000 Dijon, FRANCE.

CHRISTIANSEN, Per

Geological Institute, University of Copenhagen, Oster Voldgade 10, DK 1350, Kobenhavn K. Copenhagen, DENMARK

CSIKI, Zoltan

Faculty of Geology & Geophysics, University of Bucharest; Dept. of Paleontology. Bd. N. Balcescu Nr. 1. ROM-70111 Bucharest. ROMANIA

COMPANY, Julio

Colegio Universitario C.E.U. San Pablo, Avenida Seminario s/n, 46113 Moncada, Valencia, SPAIN.

CUENCA-BESCOS, Gloria

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

CUESTA, M.A.

Avenida del General Goded, 37, 34005 Palencia. SPAIN

CUNY, Gilles

Dpt of Earth Sciences, University of Bristol, Wills memorial Building, Queens Road, Bristol BS8 1RJ, UNITED KINGDOM.

DAM, Jan van

Departament of Geology. Institute of Earth Sciences. Budapestlaan 4, 3584 CD Utrecht. HOLLAND

DELSATE, Dominique

Musée National d'Histoire Naturelle de Luxembourg, 25, Rue Münster, L - 2160 Luxembourg - Grund, LUXEMBOURG

DORTANGS, Rudi, W.

Hoofdstraat 36, NL-6436 CG Amstenrade HOLLAND

FALGUERES, Christophe

Laboratoire de Préhistoire du Muséum National d'Histoire Naturelle, UMR 6569 du CNRS, IPH, 1, Rue R. Panhard, 75013, Paris, FRANCE

FERRE, Carmén

Departamento de Biología Animal, Facultad de Biología, Universidad de Santiago de Compostela, Campus Sur s/n, 15706-Santiago de Compostela, A Coruña. SPAIN

FRAILE, Susana

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

FREUDENTHAL, Matthijs

Nationaal Natuurhistorisch Museum, Postbus 9517, NL-2300 RA, Leiden, THE NETHERLANDS

FREY, Eberhard

Staatliches Museum für Naturkunde Karlsruhe, Geowissenschaftliche Abteilung, Erbprinzenstraße 13, D-76133 Karlsruhe, GERMANY



GARCIA, Nuría

Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

GHEERBRANDT, Emmanuel

Institut des Sciences de l'Evolution, Université Montpellier II, 4 Place Bataillon,  
34000 Montpellier, FRANCE.

GODEFROIT, Pascal

Département de Paléontologie, Institut Royal des Sciences Naturelles de Belgique,  
rue Vautier 29, 1000 Bruxelles. BELGIUM

GOMEZ, Elena

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

GOODWIN, Mark B.

Museum of Paleontology, University of California, Berkeley, California 94720. USA

GRANDAL d'ANGLADE, Aurora

Instituto Universitario de Xeoloxía. Universidade da Coruña. 15071 A Coruña. SPAIN  
Laboratorio Xeolóxico de Laxe.15168 O Castro, A Coruña. SPAIN.

GRIGORESCU, Dan

Faculty of Geology & Geophysics, University of Bucharest; Dept. of Paleontology.  
Bd. N. Balcescu Nr. 1. ROM-70111 Bucharest. ROMANIA

HERVET, Sophie

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,  
8 rue Buffon, 75005 Paris. FRANCE

HORNER, John R.

Museum of the Rockies, Montana State University, Bozeman, Montana 94720. USA

HUGUENEY, Marguerite

Centre de paléontologie stratigraphique et paléocéologie (ERS 2042), Université Claude-  
Bernard-Lyon 1, 27-43 bvd du 11 novembre 1918, 69622 Villeurbanne cedex, FRANCE

JAGT, John W. M.

Natuurhistorisch Museum Maastricht, Postbus 882, NL-6200 AW Maastricht. HOLLAND

JIANU, Coralia Maria

Muzeul Civilizatiei Dacice si Romane Deva Str. 1 Decembrie nr. 39.  
RO-2700 HD Deva. ROMANIA

JONGAUTCHARIYAKUL, Sutee

Geological Survey Division, Department of Mineral resources,  
Rama VI Road, Bagkok 10400, THAILAND.

KHANSUBHA, Sasidhorn

Geological Survey Division, Department of Mineral resources,  
Rama VI Road, Bagkok 10400, THAILAND.

KNOLL, Fabien

Laboratoire de Paléontologie, Muséum National d'Histoire Naturelle,  
8 rue Buffon, 75005 Paris. FRANCE

KOHLER, Meike

Institut de paleontologia "Miquel Crusafont", Escola Industrial, 23,  
08210 Sabadell, Barcelona SPAIN

KRISTOFFERSEN, Annette V.

Geological Museum, University of Copenhagen, Oester Voldgade 5-7,  
DK-1350 Copenhagen. DANMARK

LAPLANA, Cesar

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

LAURENT, Yves

Musée des Dinosaurés, 11260 Espéraza, FRANCE

LEIDNER, Armin

Institut für Geologie und Palaeontologie, Universität Hannover,  
Callinstr. 30, D-30167 Hannover, GERMANY.

LOEUFF, Jean Le

Musée des Dinosaurés, 11260 Espéraza, FRANCE

LOPEZ ANTOÑANZAS, Raquel

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

LOPEZ GONZALEZ, F.

Instituto Universitario de Xeoloxía. Universidade da Coruña. 15071 A Coruña. SPAIN  
Laboratorio Xeolóxico de Laxe.15168 O Castro, A Coruña. SPAIN.

LOPEZ MARTINEZ, Nieves

Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

LORENZO, Carlos

Departamento de Paleontología, Facultad de Ciencias Geológicas,  
Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040 Madrid, SPAIN

MADE, Jan van der

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

MAUL, Lutz

Bereich Quartaerpalaeontologie Weimar. Institut für Geowissenschaften, FSU,  
Steubenstr. 19a. D-99423 Weimar. GERMANY

MARCOLINI, Federica

Universita di Pisa. Dip. Scienze della Terra, Via S. Maria 53, 56126 Pisa, ITALY

MARTILL, David M.

Department of Geology, University of Portsmouth, Portsmouth PO1 3QL, UNITED  
KINGDOM

MARTIN SUAREZ, Elvira

Departamento de Estratigrafía y Paleontología, Facultad de Ciencias,  
Universidad de Granada, E-18071, Granada, SPAIN,

METAYER, Franck

Laboratoire de Gèobiologie, Biochronologie et Paléontologie Humaine  
40, avenue du Recteur Pineau, F-86022 Poitiers cedex, FRANCE

MOHAMED IAROCHE, Sidi

Collections paléontologiques du Service Géologique du Maroc (CPSGM), Direction de la  
Géologie, Ministère de l'Énergie et des Mines, BP 6208, Rabat Instituts, MAROC

MONCHOT, Hervé

Laboratoire d'Anthropologie - Faculté de Médecine - Secteur Nord. Boulevard Pierre-  
Dramard 13916 Marseille Cedex 20. FRANCE

MONTUIRE, Sophie

UMR CNRS 5561 et Lab. EPHE (Paléobiodiversité et Préhistoire), Centre des Sciences de la  
Terre, Université de Bourgogne, 6 Bld Gabriel, 21 000 Dijon - FRANCE.

MORALES, Jorge

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

MOYA-SOLA, Salvador

Institut de paleontologia "Miquel Crusafont", Escola Industrial, 23,  
08210 Sabadell, Barcelona SPAIN

MUDROCH, Alexander

Institut für Geologie und Palaeontologie, Universität Hannover,  
Callinstr. 30, D-30167 Hannover, GERMANY

MULDER, Eric W. A.

Museum Natura Docet, Oldenzaalsestraat 39, NL-7591 GL Denekamp. HOLLAND

MURELAGA, Xabier

Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Estratigrafía y  
Paleontología, Apdo. 644, 48080 Bilbao. SPAIN.

MUÑOZ, Arsenio

Departamento de Ciencias de la Tierra. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

NIETO, Manuel

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

ORUE EXTEBARRIA, Xabier

Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Estratigrafía y  
Paleontología, Apdo. 644, 48080 Bilbao. SPAIN.

PARDO, Alfonso

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

PEREDA SUBERBIOLA, Javier

Universidad del País Vasco/EHU, Facultad de Ciencias, Departamento de Estratigrafía y  
Paleontología, Apdo. 644, 48080 Bilbao. SPAIN. Laboratoire de Paléontologie, Muséum  
National d'Histoire Naturelle, 8 rue Buffon, 75005 Paris. FRANCE

PEREZ, Benigno

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

PEREZ MORENO, Bernardino P.

Unidad de Paleontología. Departamento de Biología. Facultad de Ciencias.  
Universidad Autónoma de Madrid 28049 Madrid. SPAIN.

PINCEMAILLE, Marie

Musée des Dinosaurés, 11260 Espéraza, FRANCE

PUEYO, Emilio

Departamento de Ciencias de la Tierra. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

REY, José Miguel

Departamento de Biología Animal, Facultad de Biología, Universidad de Santiago de Compostela, Campus Sur s/n, 15706-Santiago de Compostela, A Coruña. SPAIN

RODRIGUEZ, Jesús

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

ROYO TORRES, Rafael

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

RUIZ OMEÑACA, José Ignacio

Paleontología. Universidad de Zaragoza. 50009-Zaragoza. SPAIN

SALESA, Manuel

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

SANCHEZ, Antonio

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

SANCHEZ, Israel M.

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

SANZ, José Luis

Unidad de Paleontología. Departamento de Biología. Facultad de Ciencias.  
Universidad Autónoma de Madrid 28049 Madrid. SPAIN.

SCHULP, Anne S.

Institut voor Aardwetenschappen, Vrije Universiteit de Boelelaan 1085,  
NL-1081 HV Amsterdam. HOLLAND.

SCIAU, Jacques

Musée Municipal de Millau, Hôtel de Pegayrolles, 12100 Millau. FRANCE

SUTEETHORN, Varavudh

Geological Survey Division, Department of Mineral resources, Rama VI Road,  
Bagkok 10400, THAILAND.

SESE, Carmen

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

SORIA, Dolores

Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal, 2. 28006-Madrid. SPAIN

SOUILLAT, Christel

Musée des Dinosaurés, 11260 Espéraza, FRANCE

TONG, Haiyan

CNRS (UMR 5561). Cour du Liégat, 75013 Paris, FRANCE.

VALENZUELA-RIOS, José Ignacio

Departamento de Geología, Universitat de Valencia; C/, Dr. Moliner 50;  
E-46100 Burjassot (Valencia), SPAIN.

VILA TABOADA, M.

Instituto Universitario de Xeoloxía. Universidade da Coruña. 15071 A Coruña. SPAIN  
Laboratorio Xeolóxico de Laxe.15168 O Castro, A Coruña. SPAIN.

WHARTON, Deborah S.

The Department of Earth Sciences, The University of Bristol, The Wills Memorial Building,  
Queen's Road, Bristol, BS8 1RJ, UNITED KINGDOM. Laboratoire de Géobiologie,  
Biochronologie et Paléontologie Humaine, l'Université de Poitiers, 40, Avenue de Recteur  
Pineau, 86022 Poitiers, Cedex, FRANCE.