

# *Ampelosaurus atacis* (nov. gen., nov. sp), a new titanosaurid (Dinosauria, Sauropoda) from the Late Cretaceous of the Upper Aude Valley (France)\*

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## INTRODUCTION

Excavations led since 1989 at Campagne-sur-Aude (Aude Department, France, fig. 1) by a team from the Musée des Dinosaures in Esperaza (Jean Le Loeuff, Valérie Martin), the CNRS (Eric Buffetaut, Haiyan Tong, Lionel Cavin), and the Muséum d'Histoire Naturelle in Boulogne-sur-Mer (Michel Martin) permitted, in twelve months of fieldwork (with the involvement of several score of volunteers), the discovery of several hundred Maastrichtian reptile bones. The Bellevue layer (layer C3 of Buffetaut et al., 1989) is situated at the base of the member of the Marnes Rouges of the Maurine of the lower Marnes Rouges Formation, of Maastrichtian age (Bilotte, 1985). This continental formation is formed of fluvial deposits (channels and floodplains) and has produced many dinosaur bones (Clottes and Raynaud, 1983; Buffetaut *et al.*, 1989; Le Loeuff, 1991; 1992). The Bellevue layer has yielded in particular very numerous remains of a sauropod dinosaur of the family Titanosauridae, whose diagnosis is proposed here. Other vertebrates have been discovered: the fish *Lepisosteus* is represented by some scales, an indeterminate turtle by fragments of shell, a eusuchian crocodylian by some teeth and cranial fragments, a small theropod dinosaur by some isolated teeth, and the Euornithopoda *incertae sedis Rhabdodon priscus* Matheron, 1869 by a dentary and many postcranial elements. Remains of plants and invertebrates have also been discovered.

## SYSTEMATICS

Sauropoda Marsh, 1878  
Titanosauridae Lydekker, 1893  
*Ampelosaurus*, nov. gen.

*Derivatio nominis*: from the Greek  $\mu$  (fem) (the vineyard; cf. Elien, De la Nature des Animaux, 11, 32) and from the Latin *saurus* (reptile); the layer is situated in the southern border of the Blanquette de Limoux vineyard.

*Species typicus*: *Ampelosaurus atacis*, nov. sp.

*Diagnosis*: the same as that of the type species.

*Ampelosaurus atacis* nov. sp.

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*Derivatio nominis*: from the Latin *Atax*, the Aude river.

*Holotypus*: three dorsal vertebrae in connection (C3-247).

*Referred material*: a tooth (C3-52); dorsal vertebrae (C3-38, C3-59; C3-92; C3-93; C3-94; C3-148); caudal vertebrae (C3-24; C3-25; C3-26; C3-27; C3-46; C3-55; C3-58; C3-63; C3-64; C3-65; C3-95; C3-96; C3-97; C3-98; C3-99; C3-100; C3-101; C3-124; C3-127; C3-147); dorsal ribs (C3-60); chevrons (C3-72; C3-139); sternal plates (C3-XX; C3-80); scapulae (C3-21; C3-145); coracoids (C3-22; C3-161; C3-351); humeri (C3-1; C3-79; C3-81; C3-86; C3-175; C3-312); ulnae (C3-56; C3-83; C3-300); radius (C3-85); pubis (C3-57); ilium (C3-123); ischium (C3-84); femora (C3-20; C3-40; C3-44; C3-61; C3-78; C3-201; C3-203; C3-261); tibiae (C3-137; C3-138; C3-144; C3-173); fibulae (C3-48; C3-137); phalanges (C3-88); dermal plates (C3-136; C3-192; C3-204; C3-205).

All material is in of the collections of the Musée de Dinosaurs of Esperaza (Aude).

*Locus typicus*: Bellevue (Layer C3 of Campagne-sur-Aude; *cf.* Clottes and Raynaud, 1983; Buffetaut *et al.*, 1989).

*Stratum typicum*: Marnes Rouges Inférieures Formation, member of the red marls of the Maurine (Bilotte, 1985).

*Age*: lower Maastrichtian (Bessière *et al.*, 1989).

*Diagnosis*: teeth weakly spatulate; distal extremity of the neural spine of the dorsal vertebrae widened laterally; neural arch of the dorsal vertebrae strongly inclined toward the rear; absence of the distal expansion of the scapular blade; light ventral crest of the scapula; presence of osteoderms (plates, bulbs, spines).

## PRELIMINARY DESCRIPTION

With the exception of the skull (represented by only one tooth), a great part of the skeleton of *A. atacis* is known from disarticulated bones from the Bellevue bonebed.

### Skull

Only one titanosaur tooth, having a very particular morphology, has been recovered at Bellevue (**fig. 2**). The specimen (C3-52) measures 21 mm in height by a maximum width of 6 mm toward the middle of the crown. The axial part of the tooth is more or less cylindrical, with very thin rostral and caudal expansions, that give it a morphology similar to a willow leaf. These expansions stop toward the base of the crown, causing a slight constriction at this level. This tooth is of the spatulate type, in opposition to the cylindrical teeth of the Laño titanosaur (Sanz, 1986; Astibia *et al.*, 1990), more classic in this sauropod family. The surface of enamel is slightly distressed, as in the Laño titanosaur.

### Axial skeleton

Three middle dorsal vertebrae in connection (C3-247) constitute the holotype of *Ampelosaurus atacis* (**fig. 3**). The centra, distinctly opisthocoelous, lengthen toward the rear. The pleurocoels are well defined, with an angular dorsal border. The neural spines are inclined strongly toward the rear. On the most posterior dorsal vertebra, a

supplementary lamina is developed under the posterior infradiapophyseal lamina, and terminates at the level of departure of the infrapostzygapophyseal lamina.

The internal structure of the dorsal vertebrae is spongy with very large cells. Two dorsal vertebrae are preserved with a complete neural arch, but very crushed (C3-59). The neural spine, better conserved than that of the holotype, has a very characteristic shape: it is very widened distally, narrows downwards, and enlarges again at the level of the postzygapophyses (**fig. 4**). It does not possess hyposphene-hypantrum structures.

The caudal vertebrae are laterally compressed; they are all strongly procoelous. The anterior caudals possess very short prezygapophyses, with large prezygapophyseal facets. The diapophyseal rolls are very prominent, with tips directed toward the rear. The neural spine, very narrow and very high, is directed toward the rear; on the most anterior vertebrae, this spine possesses pre- and postspinal laminae. The middle caudal vertebrae are more laterally compressed; the centrum is proportionally more lengthened. The prezygapophyses are also more and more long, with facets less and less developed; correlatively, the postzygapophyses are situated more anteriorly on the centrum.

### **Appendicular skeleton**

A right scapula has been discovered at Bellevue (C3-21), associated with a coracoid (C3-22). The craniocaudal length of the bone is of 72 cm. Contrary to other titanosaurs, the scapular blade of *A. atacis* is of roughly triangular shape, larger toward its base. Indeed, the scapular blade narrows distally and does not present a distal expansion, in contrast to other titanosaurs. The angle between the dorsal (or anterior) border of the scapular blade and the proximal expansion of the scapula is very obtuse, as in the Laño titanosaur. This angle is close to  $90^{\circ}$  in most titanosaurids. The scapula presents a light ventral crest, behind the glenoid fossa; this crest is similar to that preserved on a scapulocoracoid from Mas d'Azil (Caoué layer: Collection Pouech (n<sup>o</sup> Ca-1), Collège Jean XXIII, Pamiers). It is much less developed and more proximal than the posterior ventral scapular crest of the Laño titanosaur and that of "*Titanosaurus indicus*" of Fox-Amphoux (Lapparent, 1947). Contrary to *Magyarosaurus dacus* and *Saltasaurus loricatus*, the scapula does not present the dorsal crest at the base of the scapular blade. The coracoid is of quadrangular shape, the coracoid foramen being situated in a very dorsal position compared to the glenoid fossa.

A pubis (C3-57), 75 cm long, presents a large foramen, and a strong distal expansion, that recalls a titanosaurid from Brazil (*cf.* McIntosh, 1990, p. 371). The ilium (C3-123) does not present craniolateral development of the preacetabular blade, contrary to the South American titanosaurids (Powell, 1992). Many femora are preserved; their length varies from 75 to 115 cm. The proximolateral deflection is well marked.

### **Osteoderms**

Four osteoderms measuring between 25 and 28 cm long are referred to *Ampelosaurus*; they present different morphologies (spines, plates, bulbs). As in many titanosaurids, *A. atacis* was therefore covered in real bony armor (*cf.* Le Loeuff *et al.*, in press, for a description of these structures and their paleobiologic significance).

### **DISCUSSION**

*Ampelosaurus atacis* is one of the best represented European sauropods; this form measured up to 15 m long. *A. atacis* is evidently a titanosaur, with [word missing] strongly procoelous caudal vertebrae, an absence of hyposphene-hypantrum structures in the dorsal vertebrae, and the bony texture of the presacral vertebrae composed of very large cells (Powell, 1986; 1987; 1992; McIntosh, 1990; Le Loeuff, 1993).

The titanosaur of the Haute Vallée de l'Aude is distinctly different from the other forms of the Upper Cretaceous of Europe. It is distinguished at this time from *M. dacus* (in this form: pleurocoels of the dorsal vertebrae very reduced; caudal vertebrae compressed dorsoventrally, dorsomedial crest of the scapula more developed, very reduced proximolateral expansion of the femur) and from the Laño titanosaur: (cylindrical teeth, caudal vertebrae compressed dorsoventrally, posterior ventral crest of the scapula).

## CONCLUSION

The preliminary description of *Ampelosaurus atacis* (a monograph is in preparation) confirms the diversity of the titanosaurs of the European Maastrichtian. Three forms are currently correctly defined (*A. atacis* and the Laño titanosaur in the lower Maastrichtian, and *Magyarosaurus dacus* in the upper Maastrichtian). *Hypselosaurus priscus* Matheron, 1869, from the Maastrichtian of Provence, based on non-diagnostic remains, is a *nomen dubium* (Le Loeuff, 1993). Many other isolated remains discovered in the lower Maastrichtian of the south of France and the north of Spain cannot be referred to these forms (Le Loeuff, 1993): the diversity of the titanosaurs in the beginning of the Maastrichtian was therefore certainly more important than is currently known. Their decline in the upper Maastrichtian, parallel to the development of the Hadrosauridae (Le Loeuff *et al.*, 1993; 1994) is probably due to a climatic deterioration in the last millions of years of the Cretaceous, with the passage of a subtropical climate to a more temperate climate in the south of Europe (a region situated then toward 35° north latitude: *cf.* Bardossy and Dercourt, 1990). Although no French site of the upper Maastrichtian has produced remains of Titanosauridae to this day, their survival until the extreme end of the Maastrichtian is nevertheless attested to in Transylvania, with *M. dacus*, and in Catalonia (Casanovas *et al.*, 1987).

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