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The "sauropod" from the Albian of Mesnil-Saint-Père (Aube, France): a pliosaur, not a dinosaur.

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Abstract: A vertebra from the Albian of Mesnil-Saint-Père (Aube, eastern Paris Basin), previously identified as the first caudal of a sauropod dinosaur, is shown to be a dorsal vertebra of a large pliosaur. The specimen resembles vertebrae from the Albian of England and eastern France that have been referred to the pliosaur *Polyptychodon*, a taxon in need of revision.

Key Words: Vertebra; Cretaceous; France; Plesiosauria; Sauropoda

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Résumé : Le "sauropode" de l'Albien de Mesnil-Saint-Père (Aube, France) est un pliosaure, non un dinosaure.- Il est montré qu'une vertèbre provenant de l'Albien de Mesnil-Saint-Père (Aube, E du Bassin de Paris), précédemment identifiée comme une première caudale d'un dinosaure sauropode, est en fait une vertèbre dorsale d'un grand pliosaure. Le spécimen évoque des vertèbres de l'Albien d'Angleterre et de l'Est de la France qui ont été attribuées au pliosaure *Polyptychodon*, taxon qui a besoin d'être révisé.

Mots-Clefs : Vertèbre ; Crétacé ; France ; Plesiosauria ; Sauropoda

Introduction

In 2000, KNOLL *et alii* described an isolated vertebra from the Albian of Aube (eastern Paris Basin) as an anterior caudal of a sauropod dinosaur (see also the French translation: KNOLL *et alii*, 2002). This identification was subsequently accepted by ALLAIN & PEREDA SUBERBIOLA (2003), and on its basis WEISHAMPEL *et alii* (2004, p. 560) listed the occurrence of Sauropoda indet. in the Albian of Aube in their review of dinosaur distribution.

We have re-examined the specimen and found that its identification as a sauropod vertebra is erroneous. The vertebra from Mesnil-Saint-Père in fact does not belong to a dinosaur; as shown below, it is clearly a dorsal vertebra of a large pliosaur.

Redescription and reinterpretation of the specimen

As noted by KNOLL *et alii* (2000), the vertebra found by one of us (J.-L. P.) at Mesnil-Saint-Père apparently comes from clayey layers overlying the "Sables verts" (Greensand), and is considered to be Early Albian in age. The specimen is in the J.-L. PETIT collection in Troyes and can be examined through contact with the Association Géologique Auboise; a cast of it is kept at the Musée des Dinosaures, Espéraza, France.

The specimen (Fig. 1) is generally well-preserved, although some abrasion of the surface of the bone probably indicates transport. It consists of a fairly complete centrum: only the posterodorsal and right posterolateral regions are damaged and partly missing. Contrary to the description by KNOLL *et alii* (2000), the neural arch is not completely missing, for its pedicels are clearly visible in the

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anterior half of the specimen, enclosing the floor of the neural canal (the posterior part of the pedicels is largely missing). The anterior articular surface is nearly circular in outline, and very shallowly concave. It shows a well-marked central elevation or papilla. Similarly, the posterior articular surface, which is slightly more concave, appears to have been circular in outline, and bears a central elevation. The lateral faces of the centrum are concave anteroposteriorly and show no sign of a rib articulation or transverse process. The ventral face is concave anteroposteriorly, with a prominent posterior margin (exaggerated by

deformation). There are no chevron facets. No large foramina are visible on the ventral and lateral surfaces of the centrum, although small, irregularly distributed foramina, can be seen. Those visible on the left side of the centrum appear as oval pits with a maximum diameter of 4 mm.

KNOLL *et alii* (2000) considered the specimen from Mesnil-Saint-Père as the first caudal vertebra of a sauropod dinosaur. However, this identification is untenable, for the simple reason that in sauropods the first caudal (like the other anterior caudals) bears well-

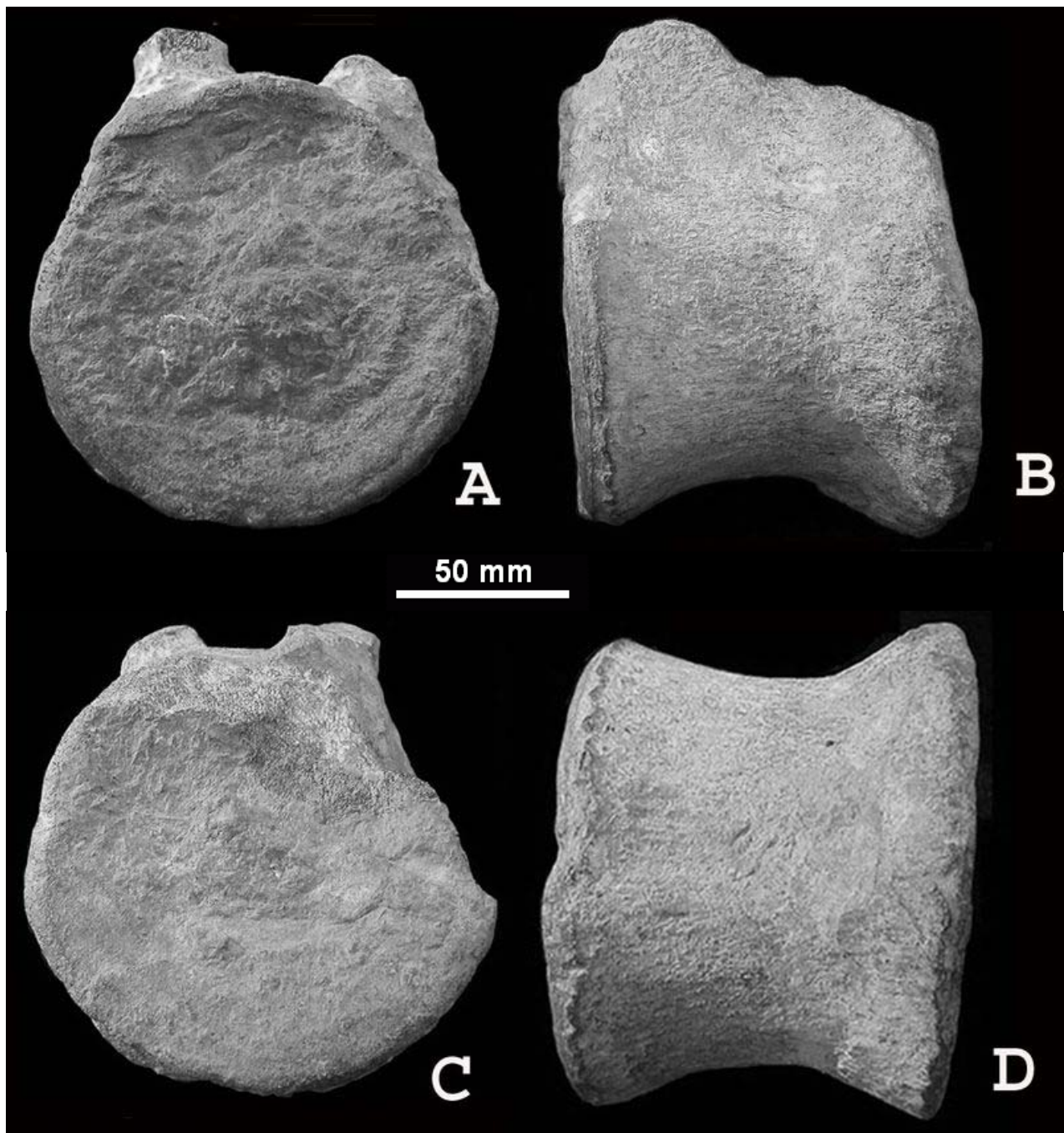


Figure 1: Dorsal vertebra of a large pliosaur from the Albian of Mesnil-Saint-Père, Aube (J.-L. PETIT collection, Troyes), in anterior (A), left lateral (B), posterior (C) and ventral (D, anterior end to the left) views.

developed transverse processes which extend over a large part of the lateral sides of the centrum (see, for instance, McINTOSH, 1990, Fig. 16.7, p. 363, and UPCHURCH *et alii*, 2004, Fig. 13.9, p. 286). Even if the neural arch was totally missing on the vertebra from Mesnil-Saint-Père, which is not the case, the inception of the transverse processes on the sides of the centrum would be visible. Instead, the lateral faces are smooth. According to KNOLL *et alii* (2000), the vertebra from Mesnil-Saint-Père shows very strong similarities with the first caudal of *Brachiosaurus brancai*. However, a comparison with JANENSCH's description and figures JANENSCH (1950) shows that this is inaccurate: in *Brachiosaurus brancai*, as in other sauropods, there are well-developed transverse processes, inserting on the lateral faces of the centrum, down to nearly mid-height. Nothing of the sort can be seen on the specimen from Mesnil-Saint-Père; its well-preserved left side clearly shows the absence of any process. Consequently, there can be no doubt that the identification of the vertebra from Mesnil-Saint-Père as a sauropod caudal is erroneous. The characters of this vertebra do not fit in a sauropod vertebral column.

The specimen from Mesnil-Saint-Père can be identified as a dorsal vertebra of a large sauropterygian. The fact that there are no insertion facets for ribs on the lateral faces shows that it must have been located far posteriorly in the dorsal series, so that the rib facets were located on the now missing parts of the neural arch. The more or less cylindrical, although constricted, shape of the centrum is also in agreement with its identification as a sauropterygian vertebra. Well-marked central papillae on the articular surfaces, bearing or not a notochordal pit, are a very frequent feature of sauropterygian vertebrae, whereas they are not common in sauropods. On the whole, the vertebra from Mesnil-Saint-Père closely resembles the dorsal vertebrae of large Cretaceous representatives of the Plesiosauria. In size and shape, for instance, it compares well with a large vertebra from the Upper Cretaceous of Elbing, Prussia (today Elblag, Poland) described by SCHRÖDER (1885) as *Pliosaurus ? gigas* (referred to as Plesiosauria indet. by BARDET & GODEFROIT, 1995).

One unusual feature of the vertebra from Mesnil-Saint-Père is the lack of large foramina on the ventral or lateral surfaces of the centrum. These "foramina subcentralia" (STORRS, 1991) are very common in the Plesiosauria, and their absence in the specimen from Aube may at first sight seem surprising. However, in some pliosaur taxa the foramina subcentralia are reduced or missing altogether. As noted by WILLISTON (1903, p. 62), in the Late Cretaceous *Brachauchenius lucasii*, "the ventral vascular foramina, so characteristic of plesiosaur vertebrae, appear to be wanting throughout the whole series". SCHUMACHER &

EVERHART (2005) report the same lack of ventral vascular foramina in a pliosaurid from the Turonian of Kansas. According to O'KEEFE (2001), reduction of the foramina subcentralia is a derived character found, in the family Pliosauridae, in the genera *Liopleurodon*, *Pliosaurus* and *Brachauchenius*. The lack of such foramina in the specimen from Mesnil-Saint-Père is therefore not a sufficient reason to exclude it from the Plesiosauria, and may suggest that it belongs to a member of the family Pliosauridae (a conclusion also supported by the large size of the vertebra).

Measurements:

Height of anterior articular face of centrum: 137 mm

Width of anterior articular face of centrum: 140 mm

Ventral length of centrum: 108 mm

Estimating the total length of a pliosaur on the basis of an isolated vertebra is fraught with difficulties. On the basis of the proportions of the mounted skeleton of *Kronosaurus queenslandicus*, from the Lower Cretaceous of Australia, described by ROMER & LEWIS (1959) as being 12.80 m long, the pliosaur from Mesnil-Saint-Père may have been about 10 metres long. However, the total number of vertebrae in that specimen of *Kronosaurus queenslandicus* is uncertain and its total length may have been overestimated. KEAR (2003, p. 291) describes *Kronosaurus* as a "large-bodied pliosaurid up to and probably in excess of 9 m". This would suggest an approximate length of 7 metres for the pliosaur from Mesnil-Saint-Père. Moreover, the proportions of the pliosaur from Aube may have been different from those of *Kronosaurus*, so the above estimates must be considered as very rough approximations. Be that as it may, the pliosaur vertebra from Mesnil-Saint-Père clearly belonged to a very large animal.

Remarks on the pliosaurs from the "Sables verts" of the eastern Paris Basin

The vertebra from Mesnil-Saint-Père is not the first pliosaur specimen to be reported from the Albian Greensand of the eastern Paris Basin. BARROIS (1875) noted the occurrence of *Polyptychodon* teeth at Grandpré (Ardennes) and Louppy (Meuse). SAUVAGE (1882) described and illustrated teeth from Grandpré, and in 1903 described a tooth and eight vertebrae from Varennes-en-Argonne (Meuse). CORROY (1922) also mentioned *Polyptychodon* in the Albian of the Paris Basin and noted that the fossils from Varennes indicated an individual of an enormous size.

Polyptychodon was erected by OWEN (1841) on the basis of isolated teeth, with two species, *P. interruptus* and *P. continuus*, which may in fact correspond to teeth from different positions in the tooth row (SAUVAGE, 1903). Teeth and

other remains from many mid-Cretaceous formations, ranging in age from Albian to Turonian, in Europe and North America (WELLES & SLAUGHTER, 1963), have been referred to that genus. Although BARDET and GODEFROIT (1995, p. 182) considered it as "systematically well defined", *Polyptychodon* remains a relatively poorly known taxon. O'KEEFE (2001) did not include it in his phylogenetic analysis and classification of the Plesiosauria. Nevertheless, and although they did not redefine the taxon, BARDET's and GODEFROIT's conclusion (BARDET & GODEFROIT, 1995, p. 183) that it is a "valid genus of Pliosauridae" is probably well-founded.

Although the type species of *Polyptychodon* was based on teeth, isolated vertebrae from

deposits where such teeth have been found have been referred to this genus. Thus, SEELEY (1876) described several vertebrae from the Cambridge Greensand as belonging to *Polyptychodon*. The Cambridge Greensand vertebrates are considered as Late Albian, reworked into the basal Cenomanian (UNWIN, 2001). Photographs of a dorsal vertebra (Sedgwick Museum, CAMSM B57396) from that collection kindly provided by Dr Leslie Noë (Sedgwick Museum, Cambridge) show considerable similarities with the specimen from Mesnil-Saint-Père, both in the shape of the centrum and in the absence of large foramina subcentralia (Fig. 2).

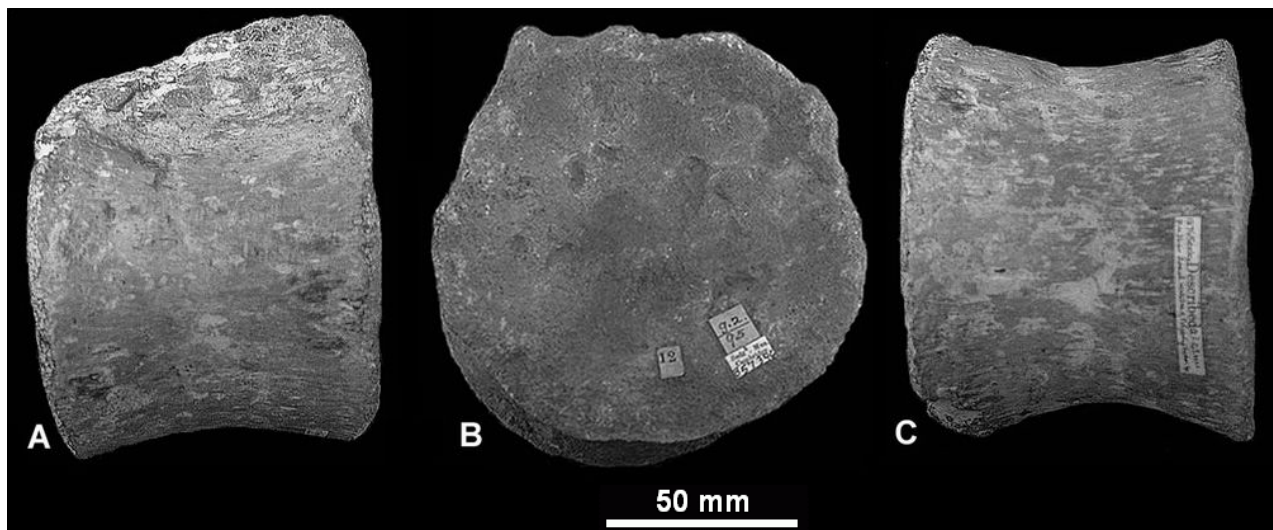


Figure 2: Dorsal vertebra referred by SEELEY (1876) to *Polyptychodon*, from the Cambridge Greensand (Sedgwick Museum, Cambridge, CAMSM B57396), in right lateral (A), anterior (B) and ventral (C, anterior end to the left) views. Photos courtesy of Dr Leslie Noë (Sedgwick Museum).

The vertebrae from Varennes-en-Argonne referred by SAUVAGE (1903) to *Polyptychodon* are of particular interest because they appear to be reminiscent of the specimen from Mesnil-Saint-Père both in their morphology (most of them are described as having more or less concave articular faces with a strong central papilla) and in their size (vertebra "8" is described as being 140 mm high, 115 mm long and 135 mm wide), although most of them show costal facets on the sides of the centrum and must have come from more anterior parts of the vertebral column. However, whether the vertebrae described by SAUVAGE (1903) can safely be referred to *Polyptychodon* is uncertain; there is no clear evidence that the tooth and the vertebrae he mentioned were from a single individual (associated skeletal elements seem to be rare in the Sables verts, although SAUVAGE (1882) did describe a partly articulated theropod skeleton). This applies even more to the isolated vertebra from Mesnil-Saint-Père: pending a revision of *Polyptychodon* in general, and of the pliosaur remains from the Sables verts in particular, it seems safer to refer to it as Pliosauridae indet. The coexistence

of large teeth referable to *Polyptychodon* and of large pliosaur vertebrae in the Albian Sables verts of the eastern Paris Basin does suggest, however, that they may belong to the same taxon.

Conclusions

Although sauropod remains do occur in the Albian of the eastern Paris Basin (see BUFFETAUT, 1995, for a review), and have recently been reported from the Sables verts (BUFFETAUT, 2002), the vertebra from Mesnil-Saint-Père clearly does not belong to a dinosaur, and it obviously cannot be used to support the conclusions of KNOLL *et alii* (2000) on the possible occurrence of brachiosaurids in the Albian of Europe. However, its identification as a dorsal vertebra of a large pliosaurid raises the question of the plesiosaurs and pliosaurs from the Sables verts of the eastern Paris Basin. A certain amount of material is present in the collections of various museums (notably in Lille, Nancy and Charleville-Mézières), but has received little attention since the beginning of the 20th century. A revision of these marine reptiles is clearly needed.

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