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**A CRETACEOUS PLESIOSAUR REMAIN (REPTILIA, SAUROPTERYGIA)
FROM THE ARGILLE VARICOLORI OF VARZI
(PAVIA, LOMBARDY, NORTHERN ITALY)**

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Key-words: Plesiosauria (Reptilia, Sauropterygia), Santonian-Campanian (Upper Cretaceous), Varzi (Pavia, Northern Italy).

Riassunto. Si segnala il primo ritrovamento di resti di Plesiosauro in Italia. Il fossile, un omero destro isolato, è stato rinvenuto in un affioramento delle Argille Varicolori, presso Zavattarello (Pavia). La datazione mediante metodi micropaleontologici suggerisce un'età cretacea per il sedimento (Santoniano-Campaniano). Le dimensioni ed alcune caratteristiche morfologiche dell'osso fanno ritenere che questo appartenesse ad un esemplare giovanile, attribuibile all'ordine *Plesiosauria*. Il cattivo stato di conservazione impedisce una ulteriore classificazione più dettagliata. Si può tuttavia suggerire la probabile appartenenza alla superfamiglia *Pliosauroidae*.

Abstract. The first finding of a plesiosaur remain in Italy is reported. The specimen, a single humerus has been collected in the Argille Varicolori formation, in an outcrop close to the village of Zavattarello near Varzi (Pavia, Lombardy, Northern Italy). Micropaleontological dating by analysis of calcareous nanofossils indicates a Santonian-Campanian age for the sediment enclosing the fossil. The morphology of the bone is described: available characters allow to consider the bone as belonging to a juvenile specimen and to ascribe it to the *Plesiosauria* with confidence, but the poor preservation prevents further reliable taxonomic assignment at lower ranks; some clues however suggest that it may belong to the *Pliosauroidae*.

Introduction.

Plesiosaurs (Reptilia, Sauropterygia) were among the most successful and widespread groups of Mesozoic marine reptiles. Their remains have been collected in various Jurassic and Cretaceous localities around the world, but no plesiosaur finding in Italy has been reported so far. In spring 1992 an isolated bone has been collected by G. Bianchini, an undergraduate student in geology of the Università di Milano, during a survey on the area of his thesis. The fossil was collected from the Argille Varicolori

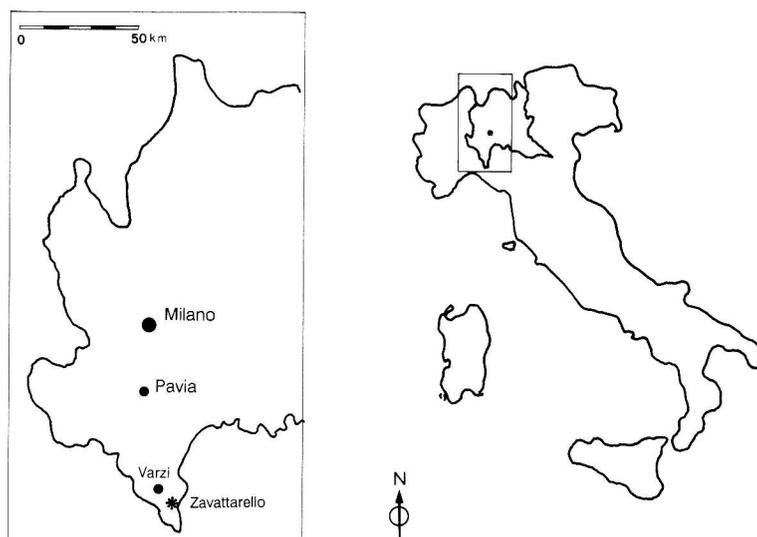


Fig. 1 - Index-map of the fossil locality (asterisk).

formation (Gelati et al., 1974) in an outcrop near the small village of Zavattarello (Fig. 1) in the Varzi district (Pavia, Lombardy, Northern Italy). The outcrop consists of silty and marly shales with red, violet or green bands, densely crumpled and fissured. No other macrofossil has been ever collected from this formation. The analysis of calcareous nannofossils by Dr. E. Erba of the Dipartimento di Scienze della Terra, Università degli Studi di Milano, suggests a Santonian-Campanian (Upper Cretaceous) age for the sediment in which the bone was included. The morphology of the bone allows to consider it as a plesiosaur humerus, probably belonging to a juvenile individual. Findings of Jurassic marine reptiles are scarce in Italy, consisting principally of a crocodylian and of some ichthyosaurian remains. Several cretaceous marine reptiles have been collected from many Italian localities, but findings consist of chelonians, mosasaurs, and aigialosaurids (Cigala Fulgosi et al., 1980; Leonardi, 1946; Carroll, 1992) whereas no plesiosaur remain has been recorded so far, thus the finding from Zavattarello becomes important, even if the poor preservation does not allow an accurate taxonomic assessment. On the basis of its general outline, the bone is tentatively considered as belonging to a member of the family *Pliosauridae*.

Palaeontological description

Class **Reptilia**

Subclass **Sauropterygia** Owen, 1860

Order **Plesiosauria** de Blainville, 1835

Superfamily *Pliosauroidae* (Seeley, 1874) Welles, 1943

Family *Pliosauridae* Seeley, 1874

Pliosauridae indet.

Text-fig. 2-4

Material. A single humerus (Fig. 2, 3) signed as 6765 MPUM of the catalogue of the Museo Paleontologico Università di Milano, Dipartimento di Scienze della Terra, where the fossil is stored.

Horizon and locality. Santonian-Campanian (Upper Cretaceous); Argille Varicolori (Gelati et al., 1974) near the small village of Zavattarello (Varzi, Pavia, Lombardy, Northern Italy).

Description.

The humerus (Fig. 2, 3) is thick and heavy in its proximal portion, becoming flattened and expanded distally; the anterior outline is gently convex, while the posterior one is concave. The bone is better preserved in its proximal portion, while the more distal one is fractured and eroded, specially at its margin. The proximal head of the bone shows a rounded, hemispherical articular surface for the glenoid, the capitulum, and a stout dorsal tubercle, pierced by many foramina for blood vessels and nerves. The dorsal tubercle is separated from the capitulum only by an embayment of the margin of the proximal head of the humerus (Fig. 3a). According to Brown (1981), this latter character is an indicator of juvenile stage, since in adult plesiosaurs the two structures are more distinctly divided and sometimes separated by a strip of periosteal bone. Well developed foramina are present in both the anterior and posterior margins of the bone. On the proximal third of the ventral surface of the bone, some rugosities are visible, testifying the insertion of the stout pectoral muscles. Two fractures cross the shaft of the bone and the distal portion is heavily eroded, mainly in its posterior region, so that the distal outline of the bone cannot be restored.

Systematic discussion.

The taxonomic assignment of this fossil is difficult, owing both to the juvenile condition of the specimen and to the poor preservation. The general outline of the bone and the morphology of the proximal head allow to consider this specimen as belonging to the *Plesiosauria* (Brown, 1981; Romer, 1956), any further assignment to lower rank taxa is tentative however. In fact the morphology of the distal portion of the humerus is among the main diagnostic elements in the plesiosaur forelimb (Brown, 1981).

According to Brown (1981) and Carroll (1988) the *Plesiosauria* are divided in two main superfamilies: the short-necked, large-skulled *Pliosauroidae* and the long-necked, small-skulled *Plesiosauroidae*. The humerus of the *Pliosauroidae* is more elongated and slender than that of most *Plesiosauroidae*, which is frequently as large as deep. The morphology of 6765 MPUM is more similar to that of the plesiosaur humeri (Fig. 4).

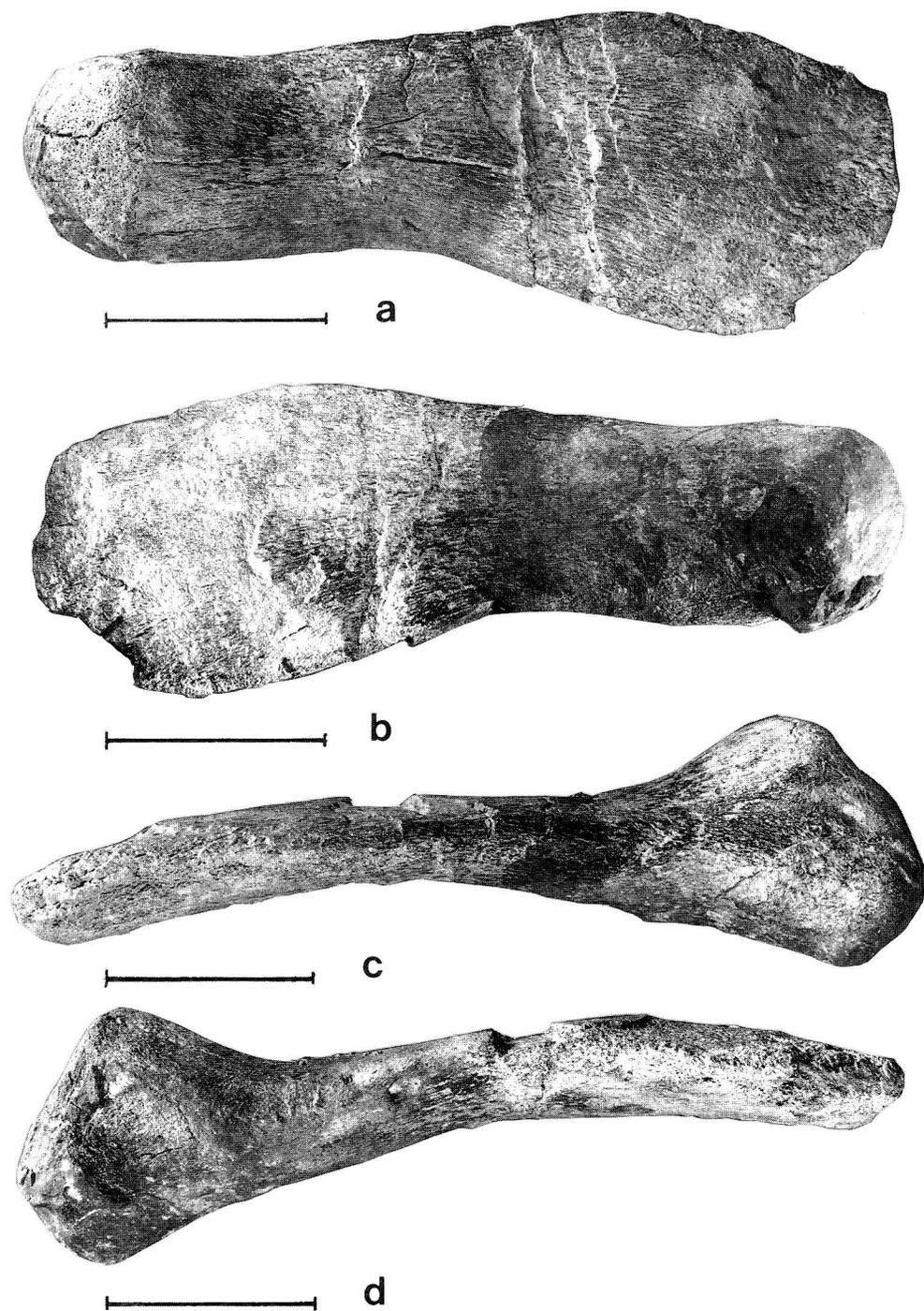


Fig. 2 - The humerus signed as 6765 MPUM. a) Dorsal; b) ventral; c) anterior (preaxial); d) posterior (postaxial) views. Scale bar equals 5 cm.



Fig. 3 - 6765 MPUM, proximal (a) and distal (b) head. Scale bar equals 5 cm.

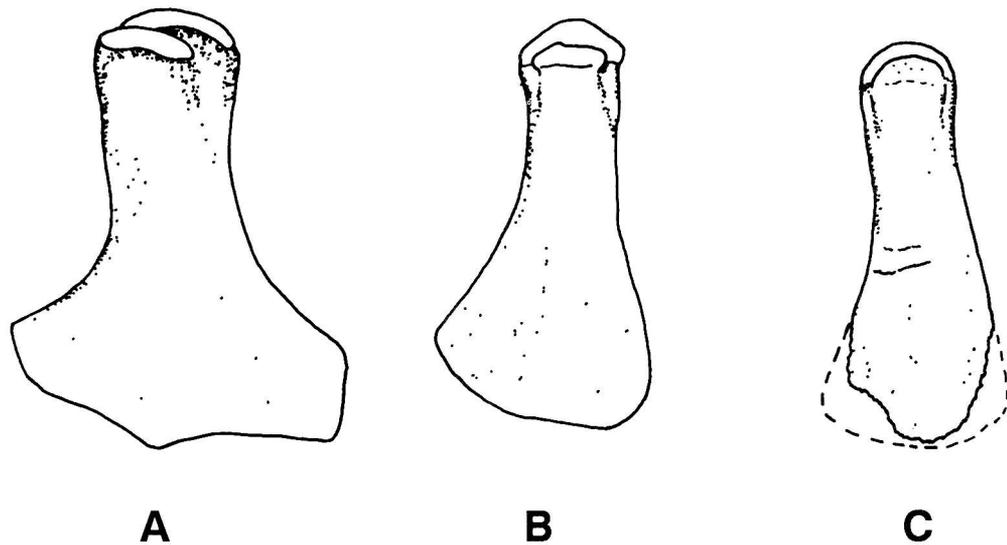


Fig. 4 - Comparison among the outlines of the humeri of a plesiosauroid (A), of a pliosauroid (B), and of specimen 6765 MPUM (C), from dorsal view. A and B redrawn from Robinson (1975). Drawings not to scale.

The outline of the preserved portion of the anterior margin of the bone suggests that this latter was not so expanded in its distal portion as can be observed in most cretaceous and jurassic *Plesiosauroidea*. The *Plesiosauroidea* consist of only one family, the *Pliosauridae*, with several genera both from United States and Europe (Brown, 1981; Carroll, 1988; Tarlo, 1960). Attempts to ascribe specimen 6765 MPUM to any pliosaur genera will be not reliable however, and the best thing to do is to consider it tentatively as *Pliosauridae* indetermined.

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