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**A POSSIBLE RAUISUCHID (REPTILIA, ARCHOSAURIA)  
TOOTH FROM THE CARNIAN (LATE TRIASSIC)  
OF LOMBARDY (ITALY)**

**RIASSUNTO** - Viene descritto un dente isolato ritrovato in un affioramento della Formazione di Gorno, presso la località di Zambra Alta nelle Prealpi Bergamasche. La struttura zifodonte e le caratteristiche della denticolazione delle carene consentono di considerarlo come appartenente ad un rettile arcosauro, probabilmente un rauisuchide.

**ABSTRACT** - An isolated tooth found in an outcrop of the Gorno Formation (Carnian, Late Triassic) in the locality of Zambra Alta (Bergamo, Lombardy, Italy) is described. The ziphodont morphology and the characters of the serrations allow to consider it as belonging to an archosaur, possibly a rauisuchian.

**KEY WORDS:** Ziphodont tooth, Rauisuchia (Reptilia Archosauria), Middle Carnian (Late Triassic), Bergamasche Prealps - Lombardy (Italy), description.

## **INTRODUCTION**

In 1978, during a survey led by Rocco Zambelli, Curator of Paleontology of the Museo Civico di Scienze Naturali di Bergamo (Lombardy, Italy), Mr. Mario Gervasutti, a collaborator of the same museum, found an isolated tooth in a marly limestone of Carnian Age belonging to the Gorno Formation, which cropped out in a small impluvium lateral to Parina Valley, in the locality of Zambra Alta. The specimen was found in a mound of debris due to construction of a dirt road branched off S.P. 27 southwards Zambra and Crocette Passes (Fig. 1) in the municipality of Oltre il Colle, (Bergamo, Lombardy, Italy). During a close look to museum Triassic vertebrate collections (1983/1985), Dr. Rupert Wild (Stuttgart Museum, Germany) hypothetically attributed this tooth to "Thecodontia, Fam.? Rauisuchidae".

In 2003, during a new review of collections, the specimen was carefully cleaned from matrix on one side by using steel needles under a binocular microscope. Once prepared, it revealed to be a triangular blade-like ziphodont tooth. In the present paper the specimen is described and a tentative systematic attribution is proposed.

## **GEOLOGICAL SETTING**

During the Carnian Age, the rise and subsequent dismantling of a volcanic system located South to the Orobian Basin, influenced the evolution of depositional systems in the Bergamasche Prealps (Jadoul et Al., 1992; Jadoul & Gnaccolini, 1992; Jadoul & Rossi, 1982; Jadoul, 1994).

During the Lower-Middle Carnian, in Lombard area, deltaic fluvial systems, which deposits formed the Arenaria di Val Sabbia (Gnaccolini, 1988; Gnaccolini & Jadoul, 1988, 1990) ended in shallow lagoons where the Gorno Formation was deposited

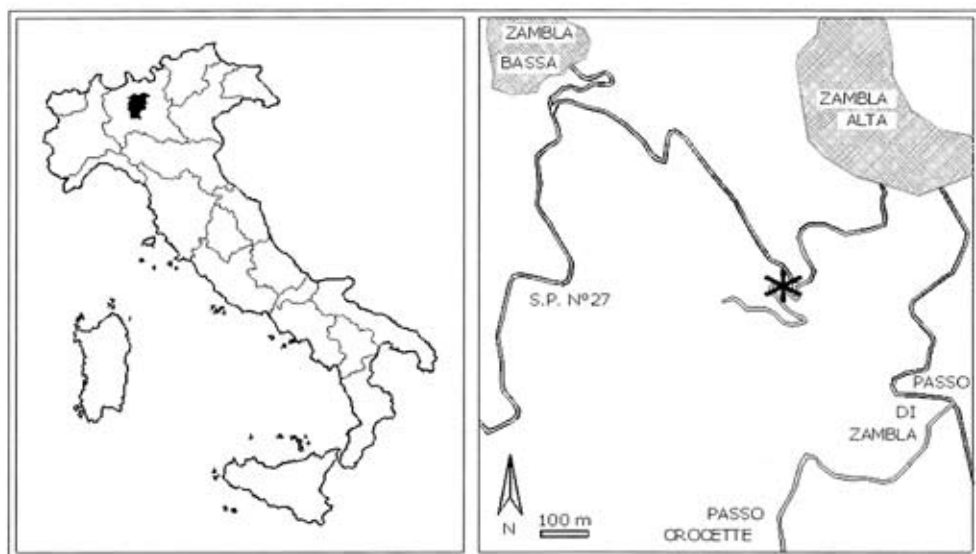


Fig. 1. Location map; the asterisk indicates the locality in which the specimen was found.

(Brusca et Al., 1981; Garzanti, 1985; Garzanti & Jadoul, 1985). In The Middle-Late Carnian the lagoonal environment was replaced by continental/marine alluvial plains which formed the San Giovanni Bianco Formation.

The litofacies in the locality where the specimen was found is the typical one for the Gorno Formation, and consists of marly micritic and marly-sandstone limestones with thin dark grey laminations, in decimeter thick beds alternated with lighter pelitic beds. The upper part of the sequence, shows abundance of plant remains and a gradual transition to thin grey/greenish sandstone levels in alternation with green pelites. This testifies the transition to the overlying San Giovanni Bianco Formation, allowing to place the outcrop at the top of the Gorno Formation.

## PALAEONTOLOGICAL DESCRIPTION

Reptilia

Archosauria

Rauisuchia

Rauisuchia indet.

**MATERIAL:** Specimen MCSNB 6167 of the collection of the Museo Civico di Scienze Naturali "E. Caffi" Bergamo, consisting in an isolated crown of a ziphodont tooth (Fig. 2).

**HORIZON AGE AND LOCALITY:** Uppermost level of the Gorno Formation, Middle Carnian (Late Triassic), Zambla Alta (Bergamo, Lombardy, Northern Italy).

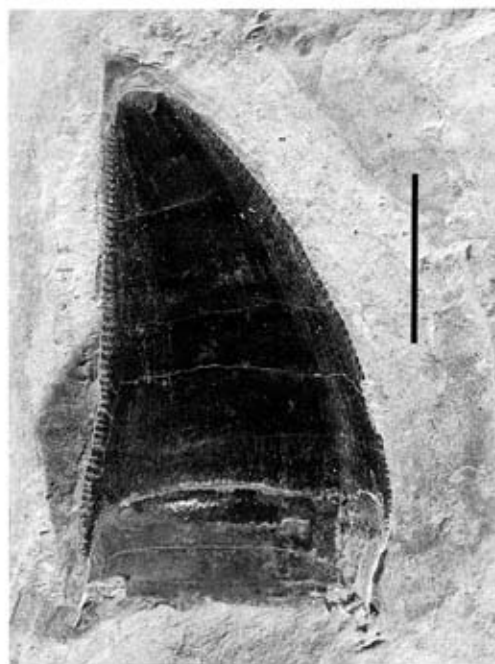


Fig. 2. Specimen MCSNB 6167 lingual view. Scale bar equals 5 mm.

**MEASUREMENTS:** The following measurements have been taken: maximum height of the crown 15mm; anteroposterior width at the crown base 9 mm.

**DESCRIPTION AND COMPARISONS:** The specimen consists of an isolated tooth crown exposed in lingual view, while the labial side is embedded in the matrix (Fig 2-3). The crown has the apex broken, only a small part of its base is missing. The crown itself shows a triangular shape with the mesial (anterior) margin more developed and inclined toward the apex with respect to the distal (posterior) one. The main axis of the tooth is slightly inclined thus the tip of the tooth points somewhat posteriorly. The most apical part of the crown is also inclined lingually. The crown surface is only slightly ornamented by faint striae, nearly smooth.

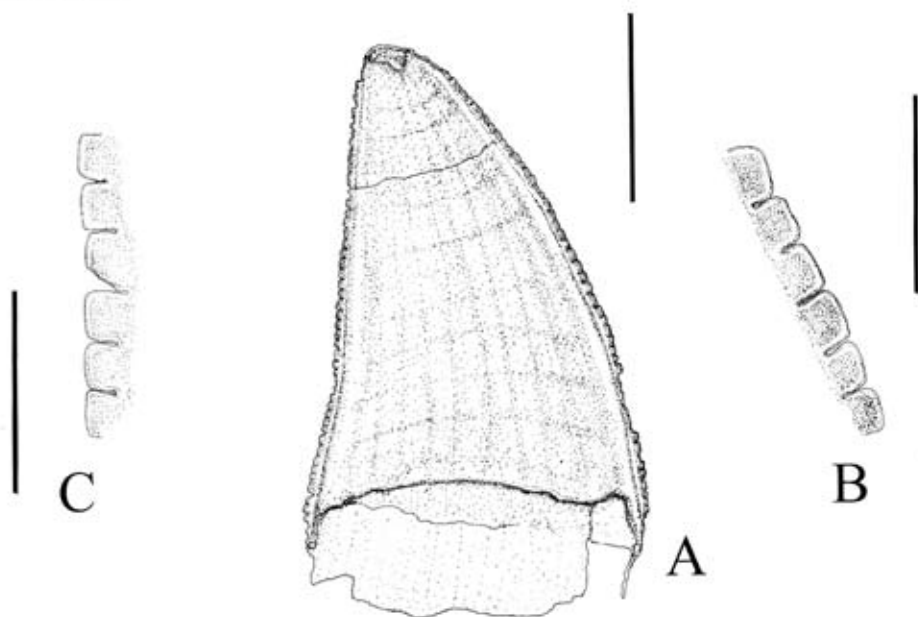


Fig. 3. Drawing of Specimen MCSNB 6167 (A), particular of anterior (B) and posterior (C) serrations; scale bars equal 5mm for A and 1 mm for B and C.

On both the anterior and posterior margins the tooth bears a distinct carina with serrated edges (Fig. 3). The denticles are subrectangular in shape and their axis is perpendicular to the main axis of the tooth.

The overall morphology of the crown permits its recognition as a ziphodont tooth, adapted for slicing and cutting flesh. Ziphodont teeth are typical of the lateral tooth row of carnivorous archosaurs, (Farlow et al. 1991, Sander 1997). During the Carnian, Three main groups of archosaurs had a ziphodont dentition, the eterodont phytosaurs, raiusuchians and basal theropods. A comparison among the morphologies of the teeth of these three groups allows to attempt a tentative systematic assessment of specimen MCSNB 6167.

In stout snouted phytosaurs, such as *Nicrosaurus* (Hunt 1989, Hungerbühler 2000) the teeth of the posterior region of the maxilla and of the dentary are strongly etherodont. The morphology of the lateral teeth of these phytosaurs is similar to that of MCSNB 6167 in fact they are smooth, they have an anterior portion which is more developed than the posterior one and serrated edges. Other characters, however, clearly distinguish specimen MCSNB 6167 from phytosaur teeth: these latter in fact show a more convex labial portion with respect to the lingual one, giving a typical "D" shape to the cross section of the tooth. Specimen MCSNB 6167 shows instead a symmetrical sub elliptical cross section, labiolingually compressed. The serration is also coarser in phytosaurs, which have a value of the SD (serration density: the number of denticles per mm) around 2.8-3 or even less (Hungerbühler 2000).

All raiusuchian teeth are ziphodont, sometimes with a "D" shaped cross section (Abler 1997), but more often they show an elliptical cross section and are compressed labiolingually (Benton 1986, Farlow et al. 1991), showing a morphology which is very similar to that of specimen MCSNB 6167. The SD for raiusuchian is known only in few taxa, its value ranging from 2.4 to 3 for some Carnian taxa like *Saurosuchus galilei* and *Tikisuchus romeri* (Sill 1974; Chatterjee and Majumdar 1987); also *Ticinosuchus*, known from the Anisian/Ladinian boundary of Northern Italy and Switzerland (Krebs 1965) has a SD around 3-3.5 (SR pers.obs.). In specimen MCSNB 6167 the SD reaches 4 for the posterior carina and 3.5 for the anterior one (Fig. 3 B-C). Thus it is slightly higher with respect to data reported in literature for other raiusuchid taxa.

The teeth morphology of many theropod taxa is very similar to that of raiusuchians, and also the SD values overlap for some extent. For some Triassic theropods however, it is possible to point out differences: in the Norian coelophysids, the SD is much higher than in raiusuchids, reaching 8 denticles per mm (Farlow et al. 1991). Little is known about Carnian theropods, however Sereno et al (1993) state that *Eoraptor* has lateral teeth in which only the posterior edges are serrated, while the anterior ones are smooth; Anterior teeth in *Eoraptor* are leaf-shaped, similar to those of prosauropod dinosaurs. The morphology of the teeth of *Eoraptor* is thus quite different to that of specimen MCSNB 6167.

## CONCLUSIONS

Available data allow to exclude the belonging of MCSNB 6167 to phytosaurs with some confidence, due to the labiolingually flattened crown and its sub-elliptical cross section. It is much more difficult to attribute the specimen with some confidence either to rautisuchian or to theropods, given also the scarcity of available data. Its morphology, however, is different from the one of the teeth of the basal theropod *Eoraptor* which is Middle Carnian in age, and SD is much lower than in later coelophysids. Taking also into account that theropods were a minor element in the Carnian faunas, while rautisuchians were abundant and diversified (Benton 1997, Sennikov 1996), it may be more probable that specimen MCSNB 6167 belonged to a rautisuchian, being also more probable that isolated rautisuchid material was washed out in the basin much more frequently than dinosaur material. All the above considerations, however, are far from being conclusive evidences, thus the attribution has to be considered only as tentative.

## ACKNOWLEDGEMENTS

True thanks are due to Mario Gervasutti and Rocco Zambelli for field work.

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