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A NEW PTEROSAUR (REPTILIA, PTEROSAURIA) FROM THE NORIAN
(LATE TRIASSIC) OF FRIULI (NORTHEASTERN ITALY). PRELIMINARY NOTE

UN NUOVO PTEROSAURO (REPTILIA, PTEROSAURIA) DAL NORICO
(TRIASSICO SUPERIORE) DEL FRIULI (NE ITALIA). NOTA PRELIMINARE

Abstract - *Eudimorphodon rosenfeldi* n. sp. a pterosaur from the Norian (Late Triassic) of northern Friuli (Northeastern Italy) is described. The features which distinguish *E. rosenfeldi* from *E. ranzii* are: hind-limbs proportionally longer (tibia is as long as ulna and much longer than humerus); different shape of the posterior part of the lower jaw, of the humerus, coracoid and pteroid; pterygoid without teeth; teeth surface smooth.

Key words: *Eudimorphodon*, Pterosauria, Late Triassic, Norian, Friuli.

Riassunto breve - Viene descritto *Eudimorphodon rosenfeldi* n. sp., uno pterosauro proveniente dal Norico (Triassico superiore) della Carnia (Friuli-Venezia Giulia). I caratteri che distinguono *E. rosenfeldi* da *E. ranzii* sono: arti posteriori in proporzione più lunghi (la tibia è lunga come l'ulna e molto più lunga dell'omero), differente forma della parte posteriore della mandibola, dell'omero, del coracoide e dello pterioide, pterigoideo senza denti, superficie dentale liscia.

Parole chiave: *Eudimorphodon*, Pterosauria, Triassico superiore, Norico, Friuli.

Introduction

The specimen on which this report is based was found casually in 1986 by dr. Corrado Rosenfeld. It was preserved on a slab of dolostone which split into two parts revealing the presence of a fossilized skeleton. The rocky fragment was exposed in the debris at the base of a rocky wall about 10 m thick in the narrow valley of Forchiar Creek (Enemonzo, Udine province, NE Italy). The specimen undoubtedly comes from the layers of the overhanging wall. Fish remains (*Pseudodalatias barnstonensis* (SYKES, 1971), *Sargodon tomicus* PLIENINGER, 1847 and *Saurichthys* sp.) and decapod crustaceans (*Dusa longipes* (PINNA, 1974)) were also found in the debris. Sampling for conodonts yielded an abundance of *Epigondolella slovakensis* (KOZUR, 1972) which was particularly important for dating purposes (for particulars see ROGHI et al., in press).

Systematic Paleontology

Class	Reptilia
Subclass	Archosauria
Order	Pterosauria
Suborder	Rhamphorhynchoidea
Family	Eudimorphodontidae WELLNHOFER, 1978
Genus	<i>Eudimorphodon</i> ZAMBELLI, 1973
Type species:	<i>Eudimorphodon ranzii</i> ZAMBELLI, 1973

Eudimorphodon rosenfeldi n. sp.

Synonymy: 1994 - Rhamphorhynchoidea indet., SIRNA, DALLA VECCHIA, MUSCIO & PICCOLI, p. 264.
1994 - *Eudimorphodon* sp. A. DALLA VECCHIA, p. 106.

Etymology: named in honour of the finder of the holotype, Dr. Corrado Rosenfeld, Udine.

Holotype and only specimen: n. 1797 MFSN (Museo Friulano di Storia Naturale of Udine).

Horizon: Lower part of the Dolomia di Forni Formation, *H. hogarti* Zone - *H. macer* Zone, Alauian 2-3, Middle Norian (ROGHI et al., in press).

Locus typicus: approximated 500 m a.s.l. along the Forchiar Creek, northern slope of Lovinzola Mt., Enemonzo, Carnia, Udine Province, Friuli-Venezia Giulia Region, Northeastern Italy.

Diagnosis: wing span of about 65-70 cm; the pentacuspide teeth present a smooth surface; the pterygoid lacks teeth; the posterior part of the lower jaw is very deep at the coronoid process; there seems to be a long diastema between the posteriormost tooth and the tip of the coronoid process; the shaft of the coracoid is short and wide; the humeral shaft is proportionally longer and slender than in *E. ranzii* and the deltopectoral crest is narrow and with a rectangular profile slightly different from that of the latter; the pteroid is rod-like with a characteristic angled shape; 25 carpals; wing phalanx 1 is the longest, and is slightly longer than wing phalanx 3; hind-limbs proportionally longer than *E. ranzii*; tibia very long (it is nearly as long as the ulna and decidedly longer than the humerus); probably 2 tarsals; sesamoid bone on the proximal part of the phalanx 1 of digit V of pes; phalangeal formula of the pes: 2 3 4 5 2.

Description of the holotype

The specimen is preserved on two thin slabs of black dolostone; one part (A) presents most of the bones, the counter-part (B) has some bone but mostly carries impressions of those on slab A. The specimen was completely prepared and partly freed from the enclosing matrix. X-ray photographs were made to identify skeletal elements covered by other bones. On slab A the specimen is exposed in lateral-ventral view, lying on the left side. The skeleton, if we exclude the neck, is quite articulated.

The head is incompletely preserved because of the breaking of the slab containing the specimen. Only the posterior part of the skull is present. The anterior segment of the right mandibular ramus is lost and the anterior part of the left ramus split away leaving only its impression. Only a partially preserved five-cusped posterior mandibular tooth and the shallow print of four others are recognizable. The head is separated from the neck but



Fig. 1 - *Eudimorphodon rosenfeldi* n. sp.; holotype, es. 1797 MFSN. Slab A, with most of the bones. Scale bar 3 cm.
- *Eudimorphodon rosenfeldi* n. sp.; olotipo, es. 1797 MFSN. Lastra A, contenente la maggior parte delle ossa.
La scala di riferimento è lunga 3 cm.

is not far from the rest of the body. The head is rotated, exposing the oto-occipital and sphenoidal regions, part of the palate and a small part of the right lateral side of the skull. The right and left ramus of the lower jaw are exposed respectively on lateral and medial view. An isolated and disarticulated cervical vertebra is exposed in ventral view above the base of the cranium. The other two or three cervical vertebrae are articulated and connected with the remaining part of the vertebral column. The atlas and axis are not visible and the missing cervical vertebrae (*Eudimorphodon ranzii* presents 8 cervical vertebrae) were probably lost due to the proximal disarticulation of the neck. Only two anterior dorsal vertebrae are identifiable and most of the dorsal segment and the entire sacral and caudal segments were contained on the missing part of the slab.

The proximal segments of many anterior dorsal ribs are exposed. The shafts of the ribs are covered by the right humerus and by the sternal plate, as shown by x-ray photography. Sternal ribs may be present in the sternal and ventral region. Several gastralia are evident in the ventral region. The coracoid part of the right scapulocoracoid is complete and well exposed while only a proximal fragment of the scapular part remains in the slab. The left scapulocoracoid is mostly covered by other bones. The coracoid shaft is short and wide; scapula and coracoid are fused. The sternum is a wide plate partly covered by other bones, still in its natural position. The right humerus is still articulated to the corresponding forearm and is covered proximally by the right coracoid; most of the deltopectoral crest is preserved on the slab B. Only the distal end of the left humerus is visible, still articulated to the corresponding forearm. The humeral shaft is relatively narrow and elongated; the deltopectoral crest is narrow and rectangular. The elements of the right forearm are complete while those of the left one are mostly preserved in impression. The right carpus is slightly detached from the forearm; the carpals are more or less articulated. The left carpus is more disarticulated and mostly preserved as an external mould. There are probably 5 carpals. Both pteroids are virtually complete; part of the right one is on the slab B. They are rod-like and with an angled shape. The bones of the right manus are preserved in natural articulation; parts of the distal phalanges of digits I-III are lost. Only part of the metacarpals of the left manus are testified by bone; the remaining part of the metacarpus is represented only by a shallow imprint. The distal part of the left manus is not on the slab. The phalanges of both wing fingers are articulated but slightly rotated; all wing phalanges are present but the wing phalanges 2, the right wing phalanx 3, and the left wing phalanx 4 are incomplete; left wing phalanx 1 is represented only by its print. Wing phalanx 1 is the longest, phalanx 3 is only slightly shorter, and phalanx 2 is longer than phalanx 4. Fragments of the wing patagium are preserved near the left wing phalanx 3, among the two pes and the left tibia, along this latter bone and in the space between the right tibia, the left femur and left wing phalanx 2. Thin, elongated «fibers» are evident in these fragments.

Little remains of the pelvic girdle. The bones of both hind limbs are almost perfectly articulated. The femora are partially preserved and partly covered by other bones; the length of the left femur can be measured comparing the preserved part on slab A and its impression of the proximal segment on slab B. Considering the two slabs, the two tibiae are nearly completely preserved; they present a well developed distal bicondylar trochlea. The tibia is particularly long with respect to the other limb bones. In particular, it is nearly as long as the ulna ($U/Ti = 1.02$). This is very different to other specimens of *Eudimorphodon* (1.30, 1.33, 1.40, 1.31, see WILD, 1978; 1994) and more like *Peteinosaurus zambellii* ($U/Ti = 0.98$). The tibia is also markedly longer than humerus ($H/Ti = 0.75$), even if the latter element is rather long with respect to the other limb elements. This ratio is substantially different from those of the specimens of *E. ranzii* (0.94, 0.98, 1.04, 1.02, see WILD, 1978; 1994) and, once more, nearer to that of *Peteinosaurus zambellii* ($H/Ti = 0.79$). The fibula does not reach the distal part of the tibia and is fused to it proximally. The tarsus is not very disarticulated but in both cases is partly covered by other bones; there are probably two large tarsals. Both pedes are completely preserved with all elements in articulation. Surprisingly there is a small cylindrical bone on the proximal part of the phalanx 1 of digit V of pes, near the articulation with the metatarsal. It is present on both pedes in the same place. It is probably a sesamoid bone, like those present on the distal end of antungual phalanges of the manus of *Eudimorphodon ranzii*, *Peteinosaurus zambellii* and *Dimorphodon macronyx* (PADIAN, 1980; WILD, 1978) and on the distal end of antungual phalanges of the pes of *Dimorphodon macronyx* (UNWIN, 1988). All the phalanges of the pes are ossified. The phalangeal formula of the pes is 2 3 4 5 2.

Observations

The shape of deltopectoral crest, which gives a hatchet-shape to the proximal part of

Coracoid:	23	Wing phalanx 2:	58.2
Humerus:	40.5	Wing phalanx 3:	63.2
Ulna:	55	Wing phalanx 4:	51.5
Pteroid:	14.5	Femur:	37
Wing metacarpal:	21	Tibia:	54.2
Wing phalanx 1:	64	Metatarsal III:	21

Tab. I - Length (in mm) of the main bones of the holotype (es. 1797 MFSN) of *Eudimorphodon rosenfeldi* n. sp..
- Lunghezza (in mm) delle ossa principali dell'olotipo (es. 1797 MFSN) di *Eudimorphodon rosenfeldi* n. sp..

the humerus, the presence of pentacused teeth and the fact that the forearm is shorter than the wing phalanx 1 are the main characters which permit attribution of the specimen to the genus *Eudimorphodon* (see the diagnosis of *E. ranzii* in WILD, 1978).

The features which distinguish the only known specimen of *E. rosenfeldi* nov. sp. from *E. ranzii* as described by WILD (1978) are summarized in the diagnosis of the new species. Of course, the wing span reported in the diagnosis is not actually indicating the average size of the individuals belonging to this species since it is based only on a single individual. The presence of the sesamoid bone on the proximal part of the phalanx 1 of digit V of the pes cannot be verified on the specimens of *E. ranzii* described by WILD (1978); it has never been observed, however, in any other rhamphorhynchoid pterosaur (PADIAN, 1980; WELLNHOFER, 1978; WILD, 1978; pers. obs.). The phalangeal formula of the pes is that characteristic of rhamphorhynchoid pterosaurs.

If we assume that «the elongated hind-limb is a primitive character, derived from their [the pterosaurs] ancestors» (WILD, 1984, p. 58), *E. rosenfeldi* nov. sp. is more primitive than *E. ranzii*. The slightly different ages of the two species - the stratigraphic position of the specimen 1797MFSN is probably lower with respect to that of the Cene specimens of *E. ranzii* (DALLA VECCHIA, 1994; JADOUL et al., 1994) - is in agreement with this assumption.

Conclusions

A detailed description of the osteology of *E. rosenfeldi* nov. sp. is in progress and will be published at a future date; a more exhaustive examination of its relations with other pterosaurs and, particularly, with other specimens of *Eudimorphodon* will be given then. This is a preliminary note to communicate that a second species of *Eudimorphodon* different from *E. ranzii*, lived on the carbonate platforms of the present Northern Italy during Norian times.

E. ranzii was found together with another pterosaur, *Peteinosaurus zambellii* WILD 1978, in the uppermost part of the Calcare di Zorzino Formation (Latest Middle Norian) of Lombardy. In the Dolomia di Forni Formation (Middle Norian) of Friuli, which yielded *E. rosenfeldi* nov. sp., another pterosaur, *Preondactylus buffarini* WILD 1984 was discovered (DALLA VECCHIA et al., 1989; WILD, 1984). The latter, in my opinion, is more strictly related to *Peteinosaurus zambellii* than previously supposed. A fragmentary specimen of *Eudimorphodon* was collected in the Dolomia di Forni along the Purone Creek (DALLA VECCHIA 1994). *Eudimorphodon* is also recorded from the lower part of Argilliti di Riva di Solto Formation (Earliest Late Norian) of Lombardy (WILD, 1994), which lies above the Calcare di Zorzino Formation. Recently, a very strange crested rhamphorhynchoid ptero-

saur has been discovered in the Norian (Seefeld Schichten) of Austria (Wild pers. comm.). This Austrian pterosaur seems to be roughly coeval with those of the Dolomia di Forni Formation (DALLA VECCHIA, 1994). A possible *Eudimorphodon* specimen was collected in the Norian of Greenland (DALLA VECCHIA, 1994; JENKINS et al., 1993). Teeth supposed to belong to *Eudimorphodon*, were found in a «Rhaetian» bonebed of north-eastern Switzerland (CLEMENS, 1980), in a «Middle» Norian bonebed of Luxembourg (HAHN et al., 1984), in the Dockum Group (Carnian ?) and Chinle Formation (Late Carnian) of south-western U. S. A. (MURRY, 1986). However, the attribution of these isolated teeth to pterosaurs appears doubtful (DALLA VECCHIA, 1994). Recently FRASER & UNWIN (1990) described as pterosaurian wing metacarpals two small bones from the «fissure infillings» (Norian ?) of Gloucestershire (England). Finally, HUNT & LUCAS (1993) report the discovery of an humerus belonging to «Pterosauria gen. et sp. nov.» (p. 55, tab. 5) from the Los Esteros Member of Santa Rosa Formation (Late Carnian) of New Mexico.

This brief overview demonstrates that pterosaurs were well differentiated by the Norian and that *Eudimorphodon* was the most common pterosaur and a relatively widespread genus.

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