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F.M. DALLA VECCHIA, G. MUSCIO & R. WILD

PTEROSAUR REMAINS IN A GASTRIC PELLET FROM THE UPPER TRIASSIC (NORIAN) OF RIO SEAZZA VALLEY (UDINE, ITALY)*

*RESTI DI PTEROSAURO IN UN RIGURGITO GASTRICO
PROVENIENTE DAL TRIASSICO SUPERIORE DELLA VALLE
DEL RIO SEAZZA (UDINE, ITALIA NORDORIENTALE)*

*Dedicated to Prof. Dr. E. Kuhn-Schnyder
on his 85th birthday*

Abstract — A gastric pellet containing an incomplete disarticulated skeleton of cf. *Preondactylus buffarinii* WILD, 1984 is described from the Upper Triassic (Norian) of Rio Seazza valley, province of Udine, Italy. Speculation is made concerning the origin of the pellet. The stratigraphical age of the find and the sedimentology, palaeoenvironment and palaeogeography of the "dolomia di Forni" are discussed.

Key words: Pterosauria, *Preondactylus buffarinii* WILD 1984, Upper Triassic (Norian), Carnic Prealps.

Riassunto breve — Viene descritto un rigurgito gastrico contenente uno scheletro incompleto e disarticolato di cfr. *Preondactylus buffarinii* WILD, 1984 proveniente dal Triassico superiore (Norico) della Valle del Rio Seazza in provincia di Udine. Viene presentata una ipotesi sull'origine del rigurgito gastrico. Vengono inoltre discusse l'età del reperto e le caratteristiche sedimentologiche, paleoambientali e paleogeografiche della "dolomia di Forni".

Parole chiave: Pterosauria, *Preondactylus buffarinii* WILD 1984, Triassico Superiore (Norico), Prealpi Carniche.

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Introduction

In 1984 one of the authors (F.M. Dalla Vecchia) discovered a small slab of dolostone about 13x7x2 cm containing some small fossil bones. The bones were largely obscured by sediment. The specimen was found amongst broken material taken from a cut of the Preone - Valle di Preone road, north of the little church of Madonna Peraries, near the bridge marked by the 552 m sign in the Carta Tecnica Regionale 1:10.000 on the left side of the Rio Seazza valley, Province of Udine, NE Italy.

During preliminary cleaning of the specimen, an accumulation of additional small bones, which were hidden for the most part by sediment, was exposed.

The specimen is housed in the Museo Friulano di Storia Naturale in Udine (MFSN), under catalogue number 1891.

During a visit to Udine, the senior author (R. Wild), examined the specimen and considered the bones to be those of a pterosaur. He further prepared the specimen by the method described in WILD (1978, p. 178) to reveal a ball-like accumulation of many different, partly broken bones of a mostly disarticulated pterosaur skeleton (figs. 2 and 3).

Systematic Palaeontology

Class *Reptilia* LAURENTI, 1768
 Subclass *Archosauria* COPE, 1869
 Order *Pterosauria* KAUP, 1834
 Suborder *Rhamphorhynchoidea* PLIENINGER, 1901
 Family *Rhamphorhynchidae* SEELY, 1870
 Genus *Preondactylus* WILD, 1984.

Type species: *Preondactylus buffarinii* WILD, 1984.
 Diagnosis: see WILD (1984).
 Distribution: Upper Triassic, Norian; Rio Seazza Valley (Preone, Udine) and Endenna (Zogno, Bergamo), N Italy.

Synonymy: *Preondactylus buffarinii* WILD, 1984
 1984 "Neuer, noch unbekannter Flugsaurier" - WILD, Naturwiss., 71: 1; Fig. 4.

1984 *Preondactylus buffarinii* sp. nov. - WILD, Gortania - Atti del Mus. Friul. St. Nat., 5: 45; Fig. 1-3.

Holotype: MFSN no. 1770, complete skeleton preserved as a natural mould.
 Horizon: "dolomia di Forni", Lower Norian, Late Triassic (see page 126).
 Locality: About 200 m south of the little church of Madonna Peraries, Rio Seazza valley (Preone), Province of Udine.

cfr. *Preondactylus buffarinii* WILD, 1984

Referred specimen: MFSN no. 1891, incomplete, mostly disarticulated specimen preserved as a gastric pellet ejected by an unknown predatory fish.

Description

The gastric pellet consists of an accumulation of pterosaur bones from a single skeleton. Most of them are lying one upon another, so that a few bones can be clearly defined (fig. 2).

In an assemblage of procoelus vertebrae, including cervicals, dorsals and elongated caudals, both ulnae and radii can be recognized, apparently in natural articulation. One pair seems to be preserved completely intact, although the epiphyses are

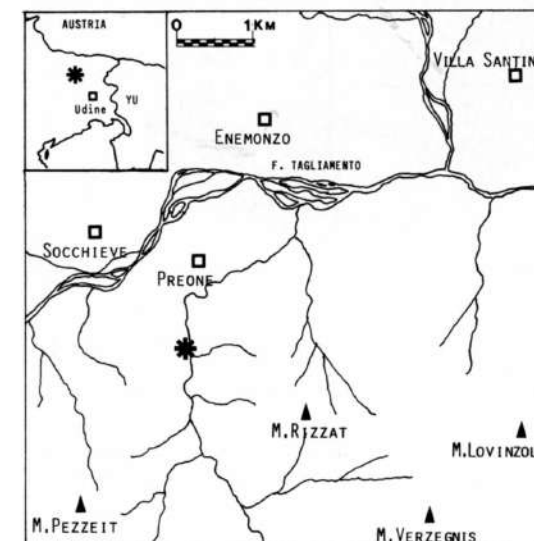


Fig. 1 - Location of Preone and Rio Seazza valley where the described specimen was found.
 - L'area di Preone e la valle del Rio Seazza da cui proviene l'esemplare descritto.

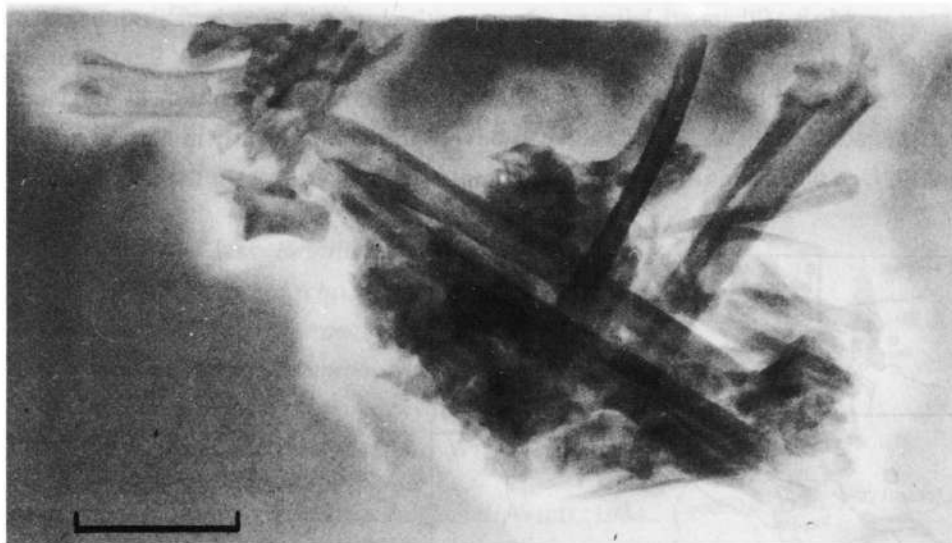
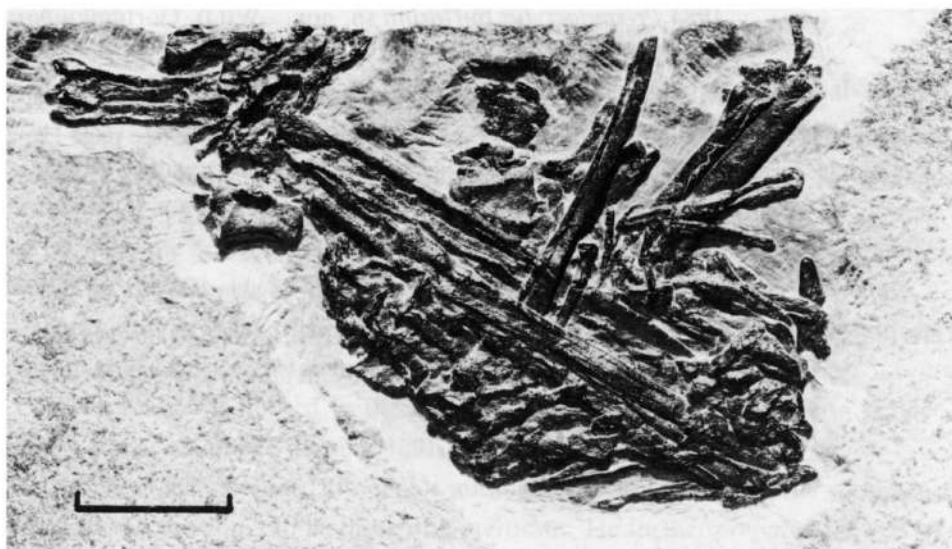


Fig. 2 - Cf. *Preondactylus buffarinii* WILD, 1984, no. 1891 MFSN. Incomplete, mostly disarticulated skeleton preserved as a gastric pellet; Lower Norian, Preone - Rio Seazza valley, province of Udine, Italy. Above: normal light photograph, below: X-ray photograph. Scale: 1 cm.

- Cfr. *Preondactylus buffarinii* WILD, 1984, n. 1891 MFSN. Scheletro incompleto ed in gran parte disarticolato conservato come rigurgito gastrico: Norico inferiore, Preone - valle del Rio Seazza, provincia di Udine. Sopra: fotografia a luce naturale, sotto: fotografia ai raggi X. Scala: 1 cm.

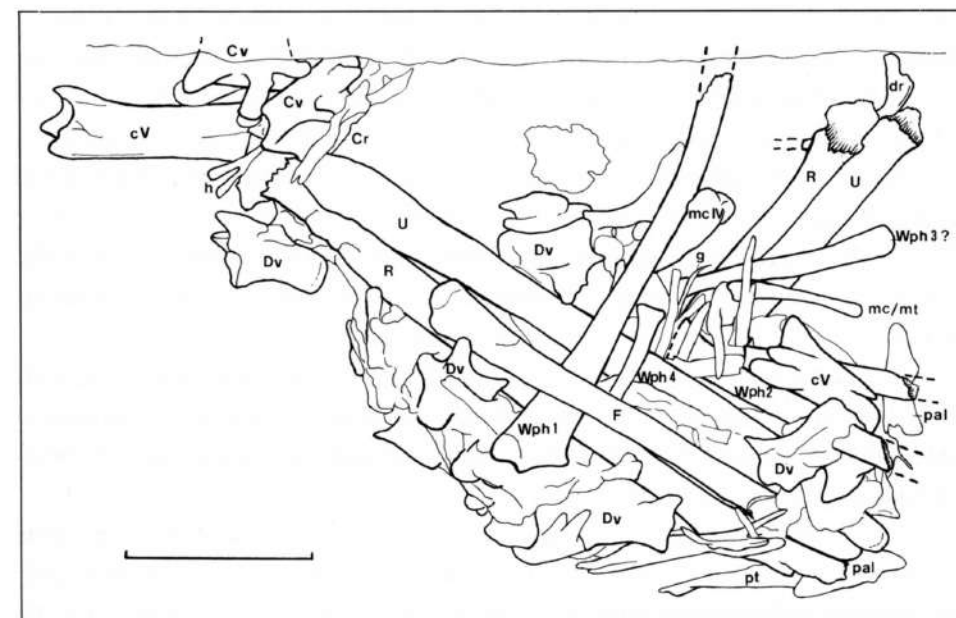


Fig. 3 - Cf. *Preondactylus buffarinii* WILD, 1984, no. 1891 MFSN. Drawing of the accumulated bones of the skeleton. Abbreviations: Cr = cervical rib; Cv = cervical vertebra; cV = caudal vertebra; dr = dorsal rib; Dv = dorsal vertebra; F = femur; g = gastral rib; h = haemapophysis; mc IV = wing-metacarpal; mt = metatarsal; pal = palatine; pt = pterygoid; R = radius; U = ulna; Wph1-4 = wing-phalanges 1-4. Scale: 1 cm.

- Cfr. *Preondactylus buffarinii* WILD, 1984, n. 1891 MFSN. Disegno delle ossa accumulate dello scheletro. Abbreviazioni: Cr = costola cervicale; Cv = vertebra cervicale; cV = vertebra caudale; dr = costola dorsale; Dv = vertebra dorsale; F = femore; g = costola gastrale; h = emiapofisi anteriore; mc IV = metacarpo alare; mt = metatarso; pal = palatino; pt = pterigoide; R = radio; U = ulna; Wph1-4 = falangi alari 1-4. Scala: 1 cm.

damaged, possibly as a result of the predator's bite. The X-ray photograph (fig. 2) shows that the other pair of forelimb epipodials lack their epiphyseal ends. The left (?) ulna and radius are approximately 4 cm long and the complete (?) femur, which runs parallel to and overlies these elements, is 2.9 cm long. These proportions are consistent with the type of *Preondactylus buffarinii* where the ratio of length of ulna/femur is about 1.39.

The left (?) ulna and radius are crossed by wing-phalanx 1 which is lacking its distal end. At the fracture, the shaft measures 1.4 mm across, while the minimum

width of the bone is some 7 mm wide. This suggests that only a small portion of the distal end is missing, and when complete it is estimated to have been between 2.8 and 3.0 mm long. This compares closely with the corresponding bone in other Triassic and Liassic pterosaurs. The wing-phalanx 1 is slightly bent posteriorly at its distal end, a condition also observed in a specimen of *Peteinosaurus* (WILD, 1978: page 225, figs. 13 and 14) and in the type of *Preondactylus buffarinii* (op. cit. page 47, figs. 2 and 3). The length ratio of wing-phalanx 1/femur is about unity, while that of wing-phalanx 1/ulna is approximately 0.7. These calculated values approximate most closely to those of *Preondactylus buffarinii*.

The new material can be designated to cf. *Preondactylus buffarinii* on the basis of the characteristics of the bones, including the absolute size and the stratigraphical and local distribution of the material when compared with the type specimen of *Preondactylus buffarinii*.

From the orientation of the material it might be suggested that it represents a coprolite. However bones extracted from coprolites always show traces of digestive corrosion and this is not present in the material described here. Neither are the bones embedded in an organic or phosphatic matrix as would be expected in a coprolite. It is therefore concluded that the specimen is a gastric pellet and the breakage of the long bones together with the lack of symphyseal ends can be attributed to the biting action of the predator.

Gastric pellets consisting of vertebrate remains are rare in the fossil record. WEIGELT (1927: page 145, pl. 17, fig. 1) described a rolled up specimen of *Stenopterygius* from the Liassic Posidonienschiefer of Holzmaden, as a mummified carcass, but this was reinterpreted by KELLER (1977: page 128, fig. 6) as a gastric pellet. In addition JANICKE (1970) described a gastric pellet consisting of the fish *Strobilodus* from the Upper Jurassic shaly limestones of Solnhofen-Eichstätt. In all cases preservation of gastric pellets depends upon the presence of anaerobic depositional conditions (see page 128).

Age

The formation where the gastric eject was found was informally named "dolomia di Forni" by MATTAVELLI & RIZZINI (1974) and it is also known as the "calcare di Caprizzi" (FERASIN et al., 1969). It extends east-west for approximately 30 Km

from Tolmezzo to Forni di Sopra, and it is considered as a heteropic facies of the Dolomia Principale Formation (SELLI, 1963; PISA, 1971). According to these authors the "dolomia di Forni" overlaps the "Rauhacken" of the Raibl Group called the "dolomie cariate", which is dated as Upper Carnian, and it is covered by the upper part of the Dolomia Principale Formation.

However in the Rio Seazza valley, where the gastric pellet was found, and also to the east, the "dolomia di Forni" is covered by well-bedded black, sometimes cherty, limestones dated as Rhaethian p.p. - Lias p.p. on the basis of poor foraminifers associations and lateral transitions into other formations (GNACCOLINI & MARTINIS, 1974; COUSIN, 1981).

Therefore the time span for deposition of the "dolomia di Forni" extends from the Upper Carnian (see CARULLI et al., 1982) to the Upper Norian or Rhaetian. This dating is supported by the age of the basal part of the Dolomia Principale Formation in the Vicentinian Prealps determined as Upper Carnian by DE ZANCHE & MIETTO (1977).

In the Rio Seazza valley the sediments of the "dolomia di Forni" are more than 800 m thick, but the fossil flora and fauna are only found in the middle to lower parts.

From the top of the Upper Norian Calcare di Zorzino Formation of Lombardy a rich fauna has been collected (PINNA, 1987). By comparison with this fauna the fossiliferous zone of the "dolomia di Forni" seems to contain primitive vertebrates (WILD 1984; TINTORI et al., 1985; Tintori, pers. comm.). So it is most likely that the fossiliferous zone of the "dolomia di Forni" in the Rio Seazza valley is Lower Norian.

Until now the oldest geological record of a pterosaur was that of *Preondactylus buffarinii* which was collected from the same valley in 1982. However, those remains were found at a stratigraphical level about 150-200 m higher than that of the new specimen. The new find is therefore the oldest pterosaur found to date.

Sedimentology

During the building of the Preone-Valle di Preone road, the stratigraphical section where the new specimen was found revealed about 35 m of well-bedded dolostones. They consist mainly of thin (5-100 mm), slightly graded beds, alternating with sets of very thin plane-parallel lamina (fig. 4). They are completely recrystallized and,

in particular the sets of lamina, are rich of organic material, optical opaque pyrite and perhaps clay minerals. The colours of the rocks are generally black or dark grey. These alternating thin beds and sets of lamina are interrupted by slump-bedding (10-120 cm thick), and black chert nodules or bands. The facies closely resembles the D facies of the Norian Dolomie Zonate Formation of Lombardy, described by JADOUL (1986) and interpreted as tectonically inactive slope deposits. In particular the sets of lamina represents the "normal" hemipelagic sedimentation and the slightly graded strata are considered as microturbidites. According to BOSELLINI & HARDIE (1988) the latter may be considered as decantation deposits in water rich in fine sediments suspended under storm conditions.

The basin depth was more than 30 m because no normal wave or storm wave-structures are present in the outcrop and in the whole "dolomia di Forni".

Palaeoenvironment

Benthic organisms such as bivalves, gastropods and echinoderms have not been described from the outcrops in Rio Seazza valley. Bioturbation horizons or trace fossils are completely absent. In addition there are undisturbed laminated sediments and organic material is preserved. These characteristics are all consistent with sedimentation in a depositional basin under anoxic conditions.

The anoxic milieu is also the reason for the preservation of the pterosaur skeleton in the gastric pellet (JANICKE, 1970; KELLER, 1977). Under aerobic conditions the bones would have been scattered.

It is difficult to determine what predatory animal could have fed on the pterosaur and thereby produced the pellet. The Lombardy vertebrate fauna is devoid of marine reptiles large enough to have been capable of feeding on pterosaurs (PINNA, 1987). It is possible that the gastric pellet came from a terrestrial reptile (e.g. a parasuchian) which captured the pterosaur on land. However, this must be considered highly improbable since it is very unlikely that the pellet could have been transported from land and washed into the sea without disintegrating entirely. We are therefore inclined to believe that the pterosaur was caught by a large fish, either when the pterosaur plunged into the sea whilst pursuing fish (WILD, 1978) or as a result of falling onto the surface waters after an aerial accident. *Saurichthys*, *Birgeria* and coelacanths are known from the Rio Seazza valley, and their remains are indicative

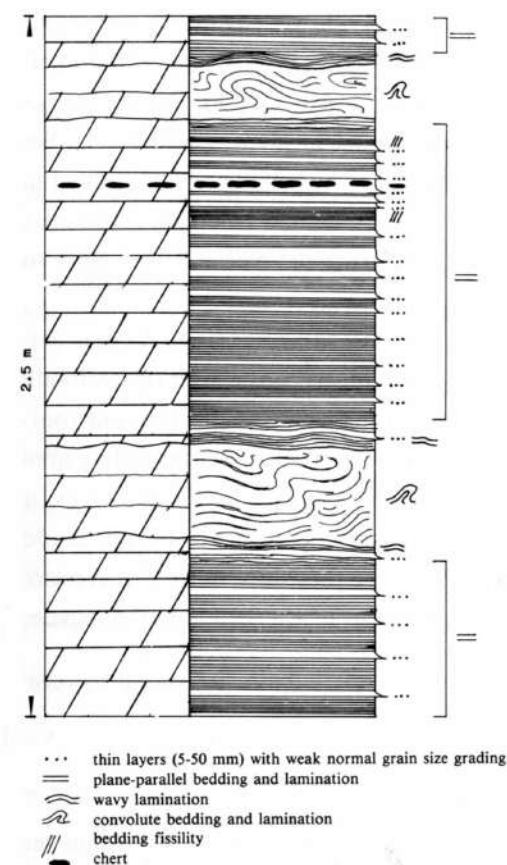


Fig. 4 - Stratigraphical column of a section from the Lower Norian dolostones of the "dolomia di Forni" at the outcrop north of Madonna Peraries, Preone - Rio Seazza valley, province of Udine, Italy, where the pterosaur was found.

- Sezione stratigrafica della "dolomia di Forni" nell'affioramento a nord di Madonna Peraries. Preone - valle del Rio Seazza, Udine, da cui proviene lo pterosauro descritto.

of specimens up to 1.0 m long. Any of these forms would have been potential predators of a pigeon-sized pterosaur. The indigestible pterosaur bones were presumably vomited as a pellet by the predator, and subsequently sank to the bottom of the basin. Undisturbed by scavenging benthonic organisms, the pellet was covered by sediment and preserved intact.

Palaeogeography

It is assumed that the "dolomia di Forni" basin ("bassin Carnique" in COUSIN, 1981) was surrounded by the peritidal platform of the Dolomia Principale Formation. Evidence for this can be found west, south and east of the outcropping area

of the "dolomia di Forni" (AA.VV., 1971; COUSIN, 1981). The Dolomia Principale consists of repeated subtidal-intertidal-supratidal cyclical deposits with repeated emersions of part of the peritidal platform (BOSELLINI & HARDIE, 1985). During the periods of emersion, island areas were probably inhabited by plants and animals. We believe that the area of provenance of the pterosaur (whose bones are preserved in the described pellet), was this emerged part of the Dolomia Principale Formation since there is no evidence for large areas of land during the Norian times close to the basin of "dolomia di Forni".

According to DE ZANCHE & MIETTO (1984) and MIETTO (1988) there is evidence of landmass south of the Alps also during the Upper Triassic after the Dolomia Principale tidal-flat was established. MIETTO (1985) suggests that the dinosaur footprints found in the Dolomia Principale 50 km west of the Rio Seazza valley area may have been produced by animals which come from this landmass. However, it is difficult to imagine that the pterosaurs found in the "dolomia di Forni" could have flown hundreds of kilometres to the place where they have buried. It is more likely that they lived in nearby areas, on the platform of the Dolomia Principale.

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Indirizzi degli Autori - Authors' addresses:

- Fabio Marco DALLA VECCHIA
— Dr. Giuseppe MUSCIO
Museo Friulano di Storia Naturale
Via Grazzano 1, I-33100 UDINE
- Dr. Rupert WILD
Staatliches Museum für Naturkunde Stuttgart
Rosenstein 1, D-7000 STUTTGART

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Indirizzi degli Autori - Authors' addresses:

- Fabio Marco DALLA VECCHIA
— Dr. Giuseppe MUSCIO
Museo Friulano di Storia Naturale
Via Grazzano 1, I-33100 UDINE
- Dr. Rupert WILD
Staatliches Museum für Naturkunde Stuttgart
Rosenstein 1, D-7000 STUTTGART