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Dinosauromorph tracks from the Middle Triassic (Anisian) of the Southern Alps (Valle di Non - Italy)

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KEY WORDS – Archosaurs, Dinosauromorpha, Tracks, Anisian, Middle Triassic, Southern Alps.

ABSTRACT – In Valle di Non (northern Italy), siltstones of Middle Triassic age (Anisian) yield archosaurian and other reptilian tracks. The ichnofauna includes the ichnogenera Rhynchosauroides, Chirotherium, Brachychirotherium, Isochirotherium *and* Synaptichnium. *Some isolated tracks show a tridactyl footprint that may be related to undetermined nondinosaurian archosaurs with a very dinosaur-like pes.*

RIASSUNTO – [Tracce di dinosauromorfi dell'Anisico (Trias Medio) delle Alpi meridionali (Valle di Non, Italia)] *– In alta Valle di Non (Italia settentrionale), tracce di arcosauri e altri rettili sono conservate in unità continentali di età medio triassica (Anisico). L'icnofauna comprende gli icnogeneri* Rhynchosauroides, Chirotherium, Brachychirotherium, Isochirotherium *e* Synaptichnium. *Alcune orme tridattile isolate possono essere attribuite ad arcosauri non dinosauriani con un piede funzionalmente evoluto e molto simile a quello dei dinosauri.*

INTRODUCTION AND GEOLOGICAL SETTING

Some Middle Triassic ichnosites has been recently found in the Italian Southern Alps and especially in upper Valle di Non (Trentino region). The main ichnoassociation has been discovered on a wall exposure near Passo Palade/Gampenpass and possibly dating from near the Pelsonian-Illyrian boundary (Anisian). The trampled layers consist of red marly sandstones, (Kreis, 1970; Avanzini & Neri, 1998) that can be correlated with middle Anisian continental units outcropping in the Eastern Dolomites (cf. Voltago Conglomerate) (Bechstadt & Brandner, 1970; De Zanche, 1990; De Zanche *et al.*, 1993). These Anisian continental units consist of sediments laid down from a continental to marine environment characterised by coastal delta mouth bars.

The Passo Palade/Gampenpass site revealed more than two hundred footprints or trackways. Among them, many of the tracks represent the well known ichnogenera *Rhynchosauroides* Maidwell 1911, *Chirotherium* Kaup 1835, *Brachychirotherium* Beurlen 1950, *Isochirotherium* Haubold 1971, *Rotodactylus* Peabody 1948, *Parasynaptichnium* Mietto 1986 and *Synaptichnium* Nopcsa 1923.

It is beyond the scope of this short note to provide details of this ichnofauna that is essentially the same in composition as those already reported from adjacent regions (Abel, 1926; Brandner, 1973; Mietto, 1987; Sirna *et al.*, 1994; Mietto, 1997, Avanzini & Neri, 1998; Avanzini, 1999; Avanzini *et al.*,1999; 2000; in press; Avanzini *et al.*, 2001, Ceoloni *et al.*, 2000). The main impetus for this report came from the discovery of two small tridactyl footprint that represents a novelty for the Middle Triassic ichnocoenoses of the Southern Alps.

PALAEOICHNOLOGIC DESCRIPTION

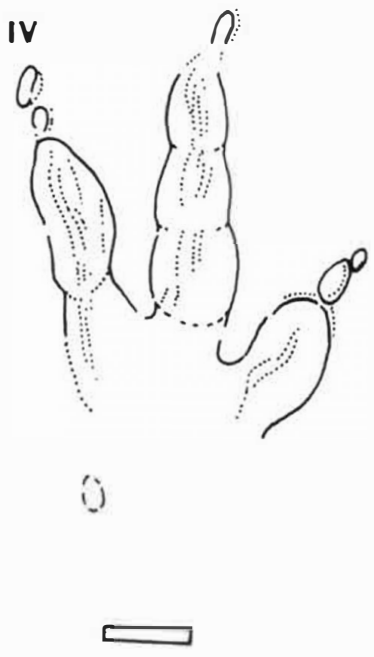
The best preserved specimen consists of a small functionally tridactyl left footprint (ULFIW46-Museo Tridentino di Scienze Naturali, Unsere Liebe Frau im Walde-Bolzano Province) which is longer (54 mm) than wide (42 mm) with a length (L) to width (W) ratio equal to 1.28. (Text-fig. 1).

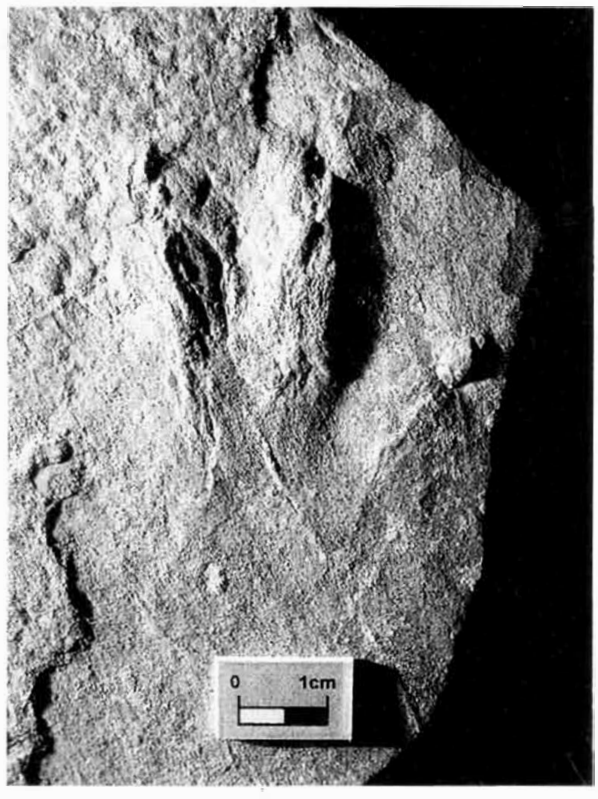
Digit III is sigmoid with tree preserved phalangeal pads and has a triangular point with a narrow claw mark; the free digit III length is 36 mm. Digits II and IV are shorter (free digit length is 20 mm and 30 mm respectively). Length of the rear of print is 35 mm and the length of the projecting part of digit III is 18 mm. Clear claw impressions occur on all digits. A possible claw trace of the digit I is preserved in a proximal area of the footprint, but the position not seem right and this could be an artefact. The angle between digit II and IV is 58°. The angle between II and III is 33°, those between III and IV is 25°.

DISCUSSION

The most recent studies indicate that the oldest skeletal evidence of dinosaurs dates from the Late Triassic (Early, Late Carnian) (Sereno *et al.*, 1993; Novas, 1996; Arcucci, 1997; Farlow & Brett Surnam, 1997).

However there are several reports of supposed dinosaur or dinosauroid footprints from the Lower and Middle Triassic (Sarjeant, 1967; Wills & Sa-



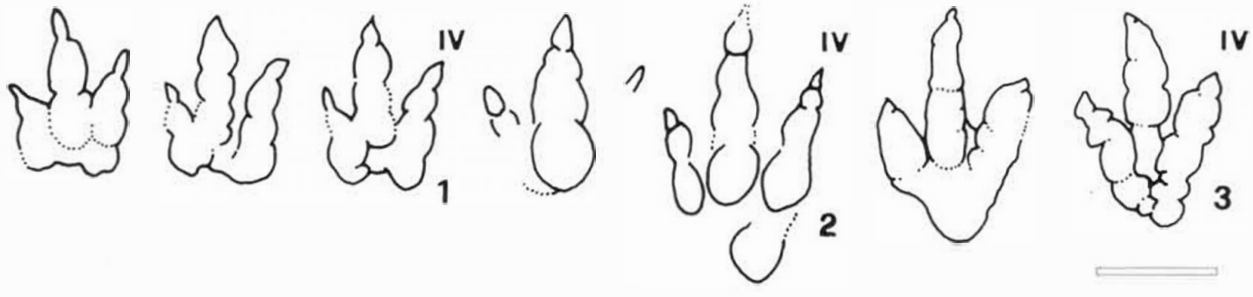


Text-fig. 1 – Tridactyl footprint from the Middle Triassic of Valle di Non (Italian Alps) that may have been made by nondinosaurian archosaurs with very dinosaur-like feet. (Scale: 1cm).

rjeant, 1970; Demathieu, 1970; 1989; Courel & Demathieu, 1973; 1976; Sarjeant, 1996). Some of these have beeen reinterpreted as ripple marks, mud rip-up clast, possible limulid prints and as partial specimens of *Chirotherium* footprints (King & Benton, 1994). Other are so well preserved that there can be no doubt that they are vertebrate footprints similar to *Grallator* trackways from late Triassic and Jurassic deposits (Demathieu, 1989; Lockley & Meyer, 2000). Haubold (1999) and Lockley & Meyer (2000) suggest that the Lower to Middle Triassic tridactyl tracks may have been made by nondinosaurian archosaurs with very dinosaur-like feet and that "animals like *Lagosucus* or *Lagerpeton* known from the Middle Triassic of South America make very suitable candidates" (Lockley & Meyer, 2000).

Tridactyl tracks from Passo Palade/Gampenpass are wider and sturdier than those illustrated by Demathieu (1984; 1989) as *Anchisauripus bibractensis* Demathieu 1971. Closer comparison can be made with *Coelurosaurichnus perriauxi* Demathieu & Gand, 1972 and *Coelurosaurichnus largentierensis* Courel and Demathieu 1976 (Text-fig. 2).

The digits of the tridactyl prints at Passo Palade, are less parallel than the typical small theropodan tracks (Olsen *et al.*, 1998). The angle of divarication between digit II and III is larger than the same angle of dinosaurian footprints and is quite similar to that



Text-fig. 2 – Middle Triassic dinosauroid footprints. 1) *Anchisauripus bibractensis* Demathieu 1971. 2) *Coelurosaurichnus largentierensis* Courel & Demathieu 1976. 3) *Coelurosaurichnus perriauxi* Demathieu & Gand 1972. (Scale: 5 cm).

of chirotherian tracks. Nevertheless, these prints do not seem to be chirotherian underprints as evidenced by primary structures on the trace (small striations and ridges created by direct contact of the sediment by the slipping tracemaker and by the lifting of the foot). It seems, therefore, that these tracks provide further evidence of the presence during the Middle Anisian, of small bipedal archosaurs with a primitive functionally tridactyl pes (Demathieu, 1989).

These footprints increase the diversity of the ichnofaunas of the Southern Alps and make them more similar to the other Middle Triassic ichnoassociations of Eastern and Central Europe, especially those of the Triassic Eastern border of the French Massif Central.

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