

Marco AVANZINI

## NEW ANISIAN VERTEBRATE TRACKS FROM THE SOUTHERN ALPS (VAL D'ADIGE AND VALLE DI NON - ITALY).

The discovery of Anisian tetrapod footprints is not a novelty for the Southern Alps. Several ichnoassociations, some of which are still under study, have been found in the Dolomites and surrounding areas (Abel, 1926; Brandner 1973; Mietto, 1987; Sirna et al., 1994; Mietto, pers.comm.). However, the consistence of the ichnocenosis, the frequency of the trampled layers and the excellent preservation of the footprints, which often show details of the scaly plantar surfaces, makes the new Anisian sites located in the upper Val di Non and in Val d'Adige (Bolzano, Northern Italy) a unique study-case for the Early Triassic ichnocenosis in the Southern Alps (Avanzini & Neri, 1998).

### AGE AND GEOLOGICAL SETTING

The trampled layers consist of red, grey and yellow sandy to marly dolomites and marly-sandstones. This mixed carbonate and terrigenous succession overlies the top of the Anisian carbonate platform (Lower Serla Dolomite) and is overlain by the lower beds of the Upper Anisian-Ladinian Carbonate Platform (Mendola Dolomite). Conglomerate beds which intercalate within the sandy and marly dolomites, can be correlated with Anisian continental units outcropping in the Eastern Dolomites (cfr. Voltago -Pelsonian- and Richthofen -Illirian- Conglomerates) (De Zanche et al., 1993). The Anisian units of Valle di Non and eastern Val d'Adige, identifies a transitional continental to marine environments, characterized by terrigenous and carbonate platforms and coastal delta mouth bars deposited under relatively arid conditions.

### THE ICHNOFAUNA

The revision in progress of the Anisian stratigraphy of the area, carried out by the national geological cartographic body (C.A.R.G. - P.A.B.), has led to the identification of overlying stratigraphic units which preserve tracks of continental vertebrates.

Most of the isolated footprints or trackways pertain to Lepidosauria of the *Rhynchosauroides* ichnogenus and, subordinately, to Archosauria. In particular, *Synaptichnium*, *Parasynaptichnium*, *Chiroterium*, *Brachichiroterium*, and *Isochiroterium* have been recognised (Fig.1). The sites also yielded isolated footprints or tracks which can be ascribed to amphibia, therapsida and arthropods. Many tracks are at present unidentified.

Subclass: Lepidosauria Dumeril and Bibbon, 1939

Form-family: Rhynchosauroidea Haubold, 1966

Ichnogenus: *Rhynchosauroides* Maidwell, 1911

A lizard-like trackway. Pace angulation of the pes varies from  $70^\circ$  to  $125^\circ$  depending on the speed of quadrupedal locomotion. Pes plantigrade to digitigrade, pentadactyl. Digits slender and increase in length from I to IV, with the distal phalanges curved towards the midline. Digit V short. Manus similar to the pes, but smaller and plantigrade. The manus is sometimes overstepped by the pes. Most specimens have a distinct tail drag.

Several ichnospecies can be identified. Among them, in the middle to upper part of the sedimentary succession, appears the typical *Rhynchosauroides tirolicus* (Abel, 1926) (Fig.1d).

Well preserved footprints show that in *Rhynchosauroides* pes the axis of digits is characterized by a row of enlarged, transversally elongate scales. Distally on digits of manus the elongate scales seem to be replaced by smaller polygonal scales.

Subclass: Archosauria Cope, 1891

Form-family: Chirotheriidae Abel, 1935

Relatively narrow, quadrupedal trackways indicating the normal tetrapod walking gait. In the walking gait a small pentadactyl manus impression regularly occurs immediately in front of, but never overlapped by, a much larger pentadactyl pes which resembles a reversed human hand. Manus and pes are digitigrade. In large forms the pes tend to be plantigrade. Digits I-IV point more or less forward, digit IV is shorter than III, digit V is divergent. Strong claws are indicated on digits I-IV. Often the footprints show specialized metatarsal and phalangeal pads. In smallest species pes is only 3 cm long; in largest species pes exceeded 30 cm. Reptiles represented by these trackways are probably "Thecodontia".

Ichnogenus: *Synaptichnium* Nopcsa, 1923

Lizard-like chirotheriid. Pes only about 10 cm long. Digits nearly parallel, increase in length from I to IV. Digit V lateral. Pace angulation from  $140^\circ$  to  $160^\circ$ .

The most complete impressions pertain to some *Synaptichnium* sp. trackways coming from the middle (Gampenpass) and upper (Bad Gfrill) anisian succession. In these specimens, the size of the scales on the plantar surface as well as the position of the scales with respect to each other change in different areas of the foot (Avanzini, in press) (Fig.1a).

Ichnogenus: *Parasynaptichnium* Mietto, 1987

Narrow footprints. Pes with slender and elongate digits curving inwards. Low I-IV interdigital angles.

Few of the footprints from the basal levels of the series refer to this ichnogenus, however the fragmented nature of the finds do not permit, for the time being, a better understanding of the relationship with finds from the nearby area of Recoaro (Vicenza) (Mietto, 1987). Clear impressions show a granular or beaded skin surface (Fig.1c).

Ichnogenus: *Chirotherium* Kaup, 1835

Digit III is the longest; digit IV longer than II; digit V lateral with respect to the I-IV group. Pace angulation varies from 160° to 170°.

Some large footprints are included in this group (exceeding 25 cm). Some of these can be compared to the similar forms of *Chirotherium rex* (Peabody, 1948) and *Chirotherium barthii* (Kaup, 1835). Chiroteriid pes and manus exhibit granular scales with polygonal or hexagonal borders, both in the finger and in the plantar surface footprints.

Ichnogenus: *Brachychirotherium* Beurlen, 1950

Short digits, as wide as they are long with rounded ends. Digits II and III strongly impressed. The base of digit V lies between digits II-IV. Digit V is short and sometimes not impressed.

Many prints have not yet been identified. Some are similar to *Brachychirotherium parvum* (Hitchock, 1889) and *Brachychirotherium*. aff. *parvum* (Bradner, 1973) (Fig. 1a).

Ichnogenus: *Isochirotherium* Haubold, 1971

Digits II and III are the longest. Digit IV shorter than I and often near to III. Phalangeal pad of digit V aligned with the phalangeal-metatarsal joints of digits I-IV. Pace angulation about 165°.

In this group *Isochirotherium delicatum* (Courel and Demathieu, 1976) is abundant with juveniles and adults specimen (Fig. 1b).

## CONCLUSION

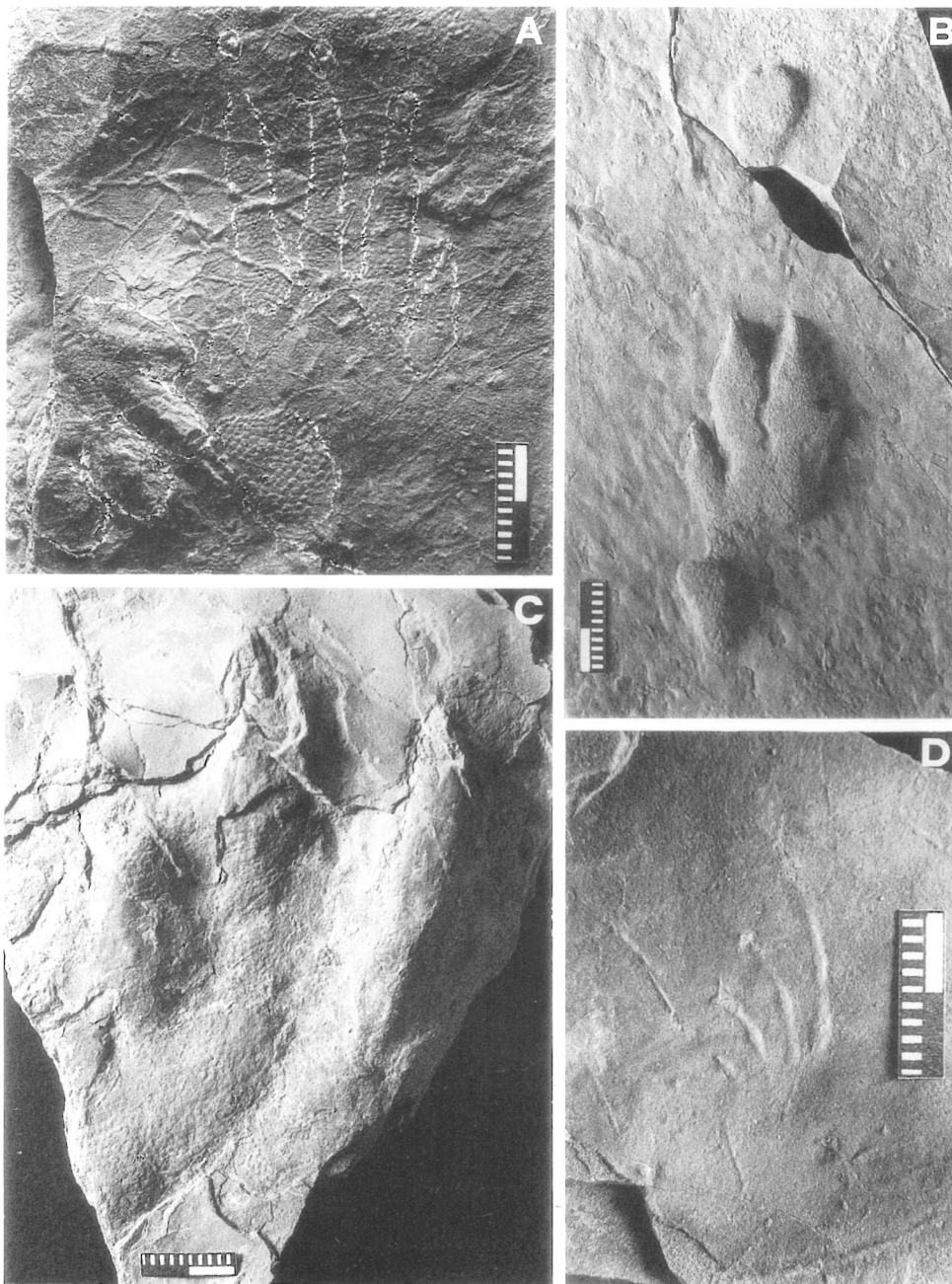
The discovery of these new Anisian ichnoassociations confirms the ichnological potential of the southern alpine continental formations. The material from the various sites will provide the opportunity to improve the definition of the faunistic associations of this sector of the Southern Alps and to further identify differences between the various chiroterian ichnogenus based on the epidermic configuration.

Due to the fact that between the Permian and the Triassic the reptile foot shows considerable variation and a fairly high rate of modification (Demathieu and Haubold 1974), it seems likely that the use of these ichnoassociations could represent a useful instrument for the definition of continental chrono-stratigraphic units which do not have elements traditionally used for dating.

## REFERENCES

- ABEL O., 1926 - Der erste Fund einer Tetrapodenfährte in den unteren alpinen Trias. *Paläontologische Zeitschrift*, 7: 22-24.
- AVANZINI M., (in press) - *Synaptichnium* tracks with skin impressions from the Anisia (middle Triassic) of the Southern Alps (Val di Non - Italy). *Ichnos*.
- AVANZINI M. & NERI C., 1998 - Impronte di tetrapodi da sedimenti anisici della Valle di Non (Trentino occidentale - Italia): nota preliminare. *Annali Museo civico Storia Naturale Ferrara*, 1: 5-19.

- BRANDNER R., 1973 - Tetrapodenfahrten aus der unteren Mitteltrias der Südalpen. *Festschrift Heissel, Veröffentlichungen. Universität Innsbruck*, 86: 57-71.
- COUREL L. & DEMATHIEU G., 1976 - Une ichnofaune reptilienne remarquable dans les grès triasiques de Largentière (Ardèche, France). *Palaeontographica. A, Paläontologie* 151, 4/6: 194-216.
- DEMATHIEU G. & HAUBOLD H., 1974 - Evolution und Lebensgemeinschaft terrestrischer Tetrapoden nach ihren Fahrten in der Trias. *Freiberg Forschungshefte, C* 298: 51-72.
- DE ZANCHE V., GIANOLLA P., MIETTO P., SIORPAES C. & VAIL P.R. 1993. Triassic Sequence Stratigraphy in the Dolomites (Italy). *Memorie Scienze Geologiche*, 45: 1-27.
- KAUP J. J., 1835 - Über Tierfahrten bei Hildburghausen. *Neues Jahrbuch für Mineralogie, Geologie und Paläontologie*, 1835: 327-328.
- MIETTO P., 1987 - *Parasynaptichnium gracilis* nov. ichnogen., nov. sp.. (Reptilia: Archosauria Pseudosuchia) nell'Anisico inferiore di Recoaro (Prealpi vicentine - Italia). *Memorie Scienze Geologiche*, 39: 37-47.
- PEABODY F.E., 1948 - Reptile and Amphibian Trackways from the Lower Triassic Moenkopi Formation of Arizona and Utah. *Bulletin of the Department of Geological Science*, 27/8: 295-468.
- SIRNA G., DALLA VECCHIA F.M., MUSCIO G. & PICCOLI G., 1994. Catalogue of Paleozoic and Mesozoic Vertebrates and vertebrate localities of Tre Venezie area (North Eastern Italy). *Memorie Scienze Geologiche*, 46: 255-281.



Tetrapod footprints from the Anisian of the Valle di Non and Valle dell'Adige (Southern Alps). Footprints commonly show the impressions of the skin surface, and, in particular, of the arrangement of the scales. A) Right pes of *Synaptichnium* sp., from the Gampenpass site. On the left, a small *Brachychirotherium* sp. pes. B) *Isochirotherium delicatum* right manus-pes couple. C) *Parasynaptichnium* sp. left pes D) *Rynchosaurooides tirolicus* pes. (scale: 2 cm).

