LATE TRIASSIC VERTEBRATE TRACKS FROM PETRIFIED FOREST NATIONAL PARK

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ABSTRACT

The first documented vertebrate tracks from Upper Triassic rocks of the Petrified Forest National Park represent three morphotypes. Elongate parallel grooves are "swim tracks" and two morphologies of small pentadactyl tracks represent *Rhynchosauroides* sp. These are some of the few vertebrate tracks from the Carnian of the Chinle Group. *Rhynchosauroides* sp. are known from several Rhaetian units in the Chinle.

INTRODUCTION

Petrified Forest National Park (PEFO) in northeastern Arizona is one of the most fossiliferous areas for Late Triassic fossils in North America. The range of fossils is also very large and includes petrified wood, plant compressions, bivalves, gastropods, crustaceans, invertebrate trace fossils, fish, amphibians and reptiles. However, until recently virtually nothing was published about vertebrate trace fossils other than coprolites. Caster (1944, p. 82) noted that tracks "apparently of vertebrate origin" were found in the Newspaper sandstone (sensu Billingsley, 1985). These will not be discussed further. Unpublished notes of a National Park Service Naturalist on file at PEFO also mention the discovery of vertebrate tracks (Appendix). None of these specimens are apparently extant, but this occurrence is discussed further below. The first published documentation of tracks from PEFO was by Santucci and Hunt (1993). The purpose of this paper is to evaluate the previous records of vertebrate tracks, to provide descriptions of recently collected specimens and to briefly comment on their importance of vertebrate tracks from PEFO.

WALKER'S VERTEBRATE TRACKS

Myrl V. Walker, former Naturalist at PEFO made detailed notes on tracks from the park which were never published (Appendix). Copies of these notes were sent to several geologists including E. D. McKee. These notes describe the tracks in great technical detail (Appendix) and appear to have been intended to be the draft of a formal description which was never published. Unfortunately, no photographs or drawings accompany this description.

Several points of Walker's description suggest that some or all of these supposed vertebrate tracks actually pertain to limuloids. In the early part of the century this misidentification was relatively common until the seminal paper of Caster (1938). These points are: (1) many trackways are present at one locality; (2) tail drags (caudal traces) are straight not sinuous; (3) first digit of pedal impression is directed posteriorly; (4) tracks occur on sloping beds in Sec. 22, T. 18N., R. 24E) from the Blue Mesa Member of the Petrified Forest Formation; and (5) manual impressions are placed markedly medial to the pedal impressions. These facts all suggest that the tracks, at least in part, do not represent vertebrates because: (1) Carnian vertebrate tracks are rare in western North America (see below) and it would be unusual in find them in abundance, whereas limuloid tracks are commonly found in abundance (Caster, 1938; Hunt et al., 1993a) and have been reported as locally common at PEFO (Caster, 1944); (2) Vertebrate tail drags are almost always sinuous whereas limuloid tail drags are usually straight (Caster, 1938); (3) not many vertebrate tracks have a posteriorly directed digit, an exception being the Early-Middle Triassic *Rotodactylus* (Peabody, 1948), whereas the ectognathic feet of limuloids have a prominent "toe" directed posteriorly (Caster, 1938, fig. 1c); (4) Caster's (1944) limuloid tracks and Walker's specimens both come from sloping beds of the Blue Mesa Member in the same Section (Caster 1944: Appendix); and (5) it would be rare for a vertebrate trackway to have the manual impressions markedly medial to the pedal impressions. In addition, Carnian limuloid trackways have been reported from PEFO (Caster, 1944; Hunt et al., 1993a), limuloid tracks were preserved in the PEFO collection in the middle part of the century (Caster, 1944) and limuloid tracks have frequently misidentified as pertaining to vertebrates (Caster, 1938, 1944). Thus, it appears that some, if not all, of Walker's specimens pertain to limuloids. Caster (1944) notes that vertebrate tracks occur in the same stratigraphic unit in the same area as the limuloid trackways (see also below) and thus it is possible that some of Walker's specimens are vertebrate in origin. Finally, it is worth noting that if it were not for the detail of Walker's descriptions, we would not be able to reevaluate his specimens and also that it has been a common mistake for limuloid tracks to be misinterpreted as vertebrate in origin. Of Walker's and Caster's specimens, only the holotype of the limuloid *Kouphichnium arizonae* is extant at the National Museum of Natural History with a mold at the University of Cincinnati and a cast at the University of Colorado at Denver. Other specimens were misplaced or discarded.

DESCRIPTION OF NEW TRACKS

In 1993, vertebrate tracks were observed at two localities in sandstones of the Blue Mesa Member of the Petrified Forest Formation (sensu Lucas, 1993) in the southern portion of PEFO. These specimens are from Sec. 22, T. 18N., R. 24E (the same Section as Walker's and Caster's specimens) from the Newspaper sandstone or its equivalents (exact locality information on file at PEFO). One specimen was collected (Santucci and Hunt, 1993, unnumbered fig.). Three morphologies of tracks are present.

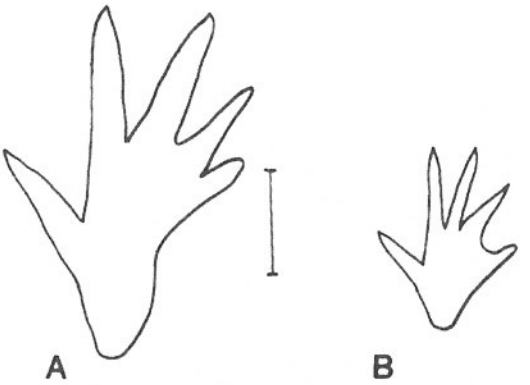


Figure 1. Two specimens of Rhynchosauroides *sp. from the Blue Mesa Member of the Petrified Forest Formation (Late Carnian), Petrified Forest National Park. Scale bar is 1 cm.*

At one locality there are elongate parallel depressions which are similar to others attributed to the toe-drag marks of swimming tetrapods. Such "swim traces" are common in the Early-Middle Triassic Moenkopi Formation in Arizona and Utah (Lockley et al., 1994) but are rare in the Chinle Group (Lockley, 1986).

The second type of track is known from an isolated pedal impression which is slightly weathered. This track is 3 cm long and pentadactyl (Fig. 1A: Santucci and Hunt, 1993, unnumbered fig.). This print represents the impression of a left pes. The impression of digit V diverges from the others. Digit impressions IV-I showing decreasing length. The heel impression is narrow and elongate. In overall morphology this track is similar to ichnospecies referred to *Rhynchosauroides* which probably represents the track of a sphenodontid (e. g., Haubold, 1971, fig. 28).

The third type of track is represented by isolated pentadactyl pedal impressions which are quite small (1.5 cm in length). The best print is a left (Fig. 1B). Digit impression V diverges from the others. Digit impressions IV and III are subequal in length with II being slightly shorter. The impression of digit I diverges from that of digit II. The heel impression is more indistinct than for the above morphotype but appears relatively shorter and wider. This specimen also falls within the range of *Rhynchosauroides* (Haubold, 1971, fig. 28).



Figure 2. Photograph of the left pes of Rhynchosauroides *sp. from the Blue Mesa Member of the Petrified Forest Formation (Late Carnian), Petrified Forest National Park.*

DISTRIBUTION OF TRACKS IN THE CHINLE GROUP

Hunt and Lucas (1992) noted that vertebrate tracks are nonrandomly distributed stratigraphically within the Chinle Group. Most Chinle tracks are Rhaetian in age (e. g., Lockley, 1986; Conrad et al., 1987; Lockley et al., 1992). Few tracks are known from Norian units (e. g., Hunt et al., 1993b) and even less from late Carnian ones. In fact the only other Carnian tracks from the Chinle Group

are undescribed tracks from the Bluewater Creek Formation in eastern New Mexico (Dubiel et al., in prep.)

Rhynchosauroides has been reported from several Rhaetian units of the Chinle Group including the Rock Point Formation in Utah, Bell Springs Formation in Utah and Colorado and the Sloan Canyon Formation in New Mexico (Lockley, 1986; Conrad et al., 1987; Lockley et al., 1992). It is also known from the Early and Middle Triassic portions of the Moenkopi Formation (Peabody, 1948; Hunt et al., 1993c, table 2). Thus, at the generic level *Rhynchosauroides* is of no biochronologic utility.

ACKNOWLEDGMENTS

We thank Bill and Jenny Cotton for assistance with fieldwork.

APPENDIX

The following document is preserved on file at PEFO and was retrieved by VLS and independently MGL obtained a copy from the papers of the late E. D. McKee. The document is undated and typed throughout (including signature) and is reproduced without corrections (e. g., typographical errors).

NOTES ON FOSSIL TRACES IN THE PETRIFIED FOREST NATIONAL MONUMENT, ARIZONA

Although a variety of animals and plant fossils have been reported from the Triassic beds (Chinle) of the Petrified Forest National Monument area, no report has as yet recorded the presence of tracks of animals. A few forms of tracks and trails have been known for some time, but they were so poorly preserved that no attempt was made to describe them. Recently, however, the writers attention was called to an area where a few tracks were discovered. Since that time quite a number of slabs of sandstone which carry trackways have been collected and placed in our study collections.

These recently discovered trackways are small and delicate, but very well preserved. They were apparently made by some small quadrupedal reptile or amphibian whose skeletal parts are as yet unknown from the Triassic of this region. The Triassic rocks of the Connecticut valley are of course noted for the wonderful series of trackways which have been described from that region, and it is very interesting to now record the existence of tracks and trackways in the upper Triassic (Chinle) of the western interior basin area. (See Lull's "Triassic Life of the Connecticut Valley").

At the present time no attempt is being made to refer these specimens to any known or described Triassic trackways. These tracks and trackways are found on the fine-grained sandstones (often ripple marked and mud cracked) which occur between a series of even bedded shales and clays in the lower Blue Forest area. The clays and shales produce impressions of Cycads, Ferns, and

the side branches of the Giant Neocalamites casts and the tracks and trackways of animals. Fossil vertebrate bones have not as yet been found in this series of alternating shales and sandstones, but they do occur in shales not more than a half mile from this area.

It is clearly evident that we have here discovered some of the old land surfaces of Triassic time. These land surfaces were apparently bordered by streams or lakes which frequently flooded the low-lying areas. Once more the Blue Forest region becomes a field laboratory of great interest, for it has told, through its tracks and trackways, of forms of animal life not previously known to have existed in this region in Triassic time, and has provided material for another scene in the picture of the old Triassic Forest.

DESCRIPTION OF FOSSIL TRACKWAY

Type -Catalogue number 190, Petrified Forest National Monument. This specimen consists of a slab of sandstone about 14" x 10" x 1" which carries a consecutive series of tracks and evidently made on a sloping "dune or ripple of sand". Collected by Mr. Clare Hepworth, B. P. R. Engineer.

Referred specimens -Numbers 192, 193, 195 and 196, Petrified Forest National Monument.

Type locality -Petrified Forest National Monument, Arizona. In the Blue Forest, 200 yards south of the road which runs west by northwest in the NW1/4 of Sec. 22, Twn. 18 N., R. 24 E.

Geological occurrence - Triassic (Chinle) about 150 to 200 feet above the Moenkopi contact.

Description -Small quadrupedal form of animal. Stride about 27 mm.; width of trackway--manus 30 mm., pes 55 mm. Three digits in manus. Five digits in pes. Manus digitigrade; pes slightly plantigrade. caudal trace straight, not undulating.

Manus -The impression of the manus is composed of three slender depressions. It appears that the three digits were made on a sloping surface and the manus was turned in or rotated, causing the digits to leave three impressions in a semi-circle. The claws were pointed in toward the body. Another specimen which has a trackway on a smooth surface shows the three digits making three parallel impressions paralleling the body, with the inner digit the longest.

Pes -The impression of the pes is composed of five depressions. The digits were long and slender and had sharp pointed claws. The first digit is directed backward, the other forward, but diverging from the center of the pes. The impression of the fourth digit is the longest. Where the trackway is made on a sloping surface, the pes is rotated and the four forward digits are pointed toward the body.

General -The position of the front feet, that is, close together and directed straight forward, would tend to indicate that the forward part of the body was carried well off the ground. The sharp pointed manus impressions indicate something of a digitigrade condition. It is impossible to determine which digits are present, but probably those represented are the 2nd, 3rd and 4th.

The slender, long, but diverging digits of the hind foot, and the well spread trackway, might indicate that the hind legs were considerably longer than the front legs. The peci\uliar rotation of the hindfoot when walking on a sloping surface, indicates a very flexible condition in these parts.

M. V. Walker.
Park Naturalist.

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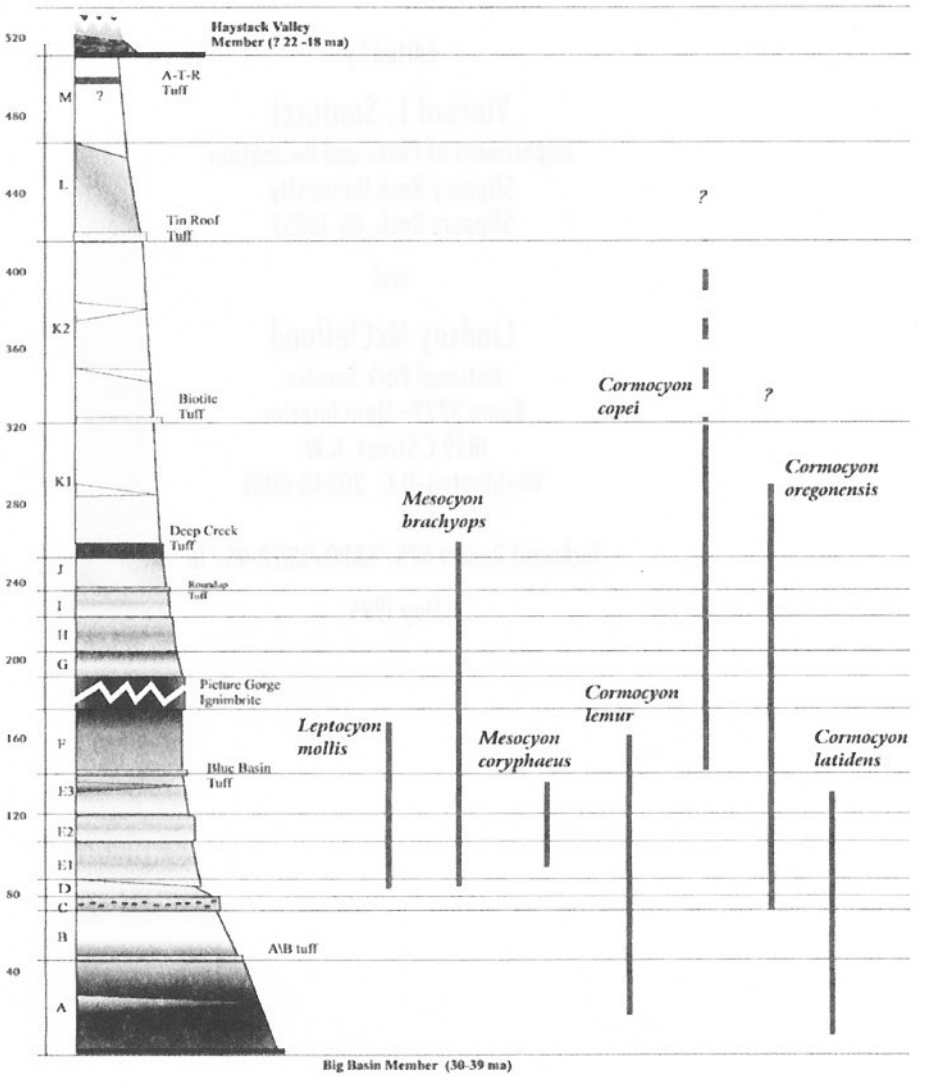
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