

and Lucas (2002c) consider the aetosaur *Acaenasuchus* to be a junior subjective synonym of *Desmotosuchus*, as the former appears to represent a juvenile of the latter, increasing the observed number of specimens of *Desmotosuchus* known from these quarries by as many as 30 additional osteoderms (Long and Murry, 1995). Even if *Acaenasuchus* is a valid taxon, it is only known from deposits of Adamanian age (Heckert and Lucas, 2002c). The Adamanian phytosaur *Rutiodon* (*Leptosuchus* of some authors) also occurs in the *Placerias*/Downs' quarries as several squamosals representing at least three individuals (Long and Murry, 1995). In contrast, *Parasuchus* is known from the same quarries by only a partial skull of a subadult phytosaur discussed previously.

These facts, when corroborated with the low stratigraphic position of the *Placerias*/Downs' quarry complex, suggest that these quarries were deposited very early in Adamanian time, shortly after the first occurrence of *Stagonolepis* and *Rutiodon*. These taxa, combined with abundant *Desmotosuchus*, are all hallmarks of the Adamanian (Lucas and Hunt, 1993; Lucas, 1997, 1998), and the occurrence of comparatively rare *Parasuchus* indicates holdover of that particular taxon into the earliest Adamanian.

Therefore, despite the presence of *Parasuchus* at the *Placerias*/Downs' quarries, we assign them an Adamanian age, as did Lucas (1993b), Lucas and Hunt (1993), Lucas and Heckert (1996a), Lucas et al. (1997c), and Heckert and Lucas (1997, 2001, 2003a). This means that (1) the Downs' quarry *Parasuchus* fossil is apparently younger than most other records of the genus (2) the lower Bluewater Creek Formation is Adamanian, and that Otischalkian time, if it is represented by Chinle Group strata in eastern Arizona, is only represented by the Zuni Mountains and Shinarump formations.

Other St. Johnsian Vertebrates from Arizona

As noted above, the fossil assemblage typical of the Adamanian lvf comes from the Blue Mesa Member of the Petrified Forest Formation in the PFP. First collected and studied by Charles Camp, this is the best known Adamanian assemblage from the Chinle Group (e.g., Camp, 1930; Murry and Long, 1989; Murry, 1990; Hunt and Lucas, 1993, 1995; Long and Murry, 1995). The assemblage comes from a narrow stratigraphic interval 5-10 m thick in the upper part of the Blue Mesa Member (Lucas, 1993b; Heckert and Lucas, 2002).

Typical Adamanian vertebrates of this assemblage (Table 2) include the aetosaurs *Stagonolepis wellesi* and *Desmotosuchus haplocerus* and numerous specimens of the phytosaur *Rutiodon*, whose taxonomic status remains in flux (Ballew, 1989; Hunt, 1994; Long and Murry, 1995; Hungerbühler, 2002). The larger metoposaur *Buettneria* is considerably more common than its smaller counterpart *Apachesaurus* throughout Adamanian strata, particularly in the PFP (Hunt and Lucas, 1993).

Smaller late Adamanian vertebrate assemblages are known from the upper Bluewater Creek Formation and Blue Mesa Member near St. Johns, including both the Blue Hills (Lucas and Heckert, 1996a; Heckert and Lucas, 1997, 2001, 2003) and Stinking Springs Mountain (Polcyn et al., 2002). The St. Johns assemblage is particularly important because it can easily be shown, on a lithostratigraphic basis, to be above the early Adamanian *Placerias*-Downs' quarry assemblage (Fig. 12). Thus, the stratigraphic superposition of the earliest and later Adamanian (St. Johnsian) vertebrate fossil assemblages can be demonstrated in the St. Johns area.

Near Ward's Terrace another small vertebrate assemblage in the Blue Mesa Member is of some importance to understanding regional litho- and biostratigraphy. These outcrops of the Blue Mesa Member contain a typical Adamanian fossil assemblage, including the highest occurrence of the dicynodont *Placerias*. This demon-

strates the utility of the Adamanian lvf throughout the Bluewater Creek Formation-Blue Mesa Member lithostratigraphic section. Further, the Ward's Terrace localities are important to understanding Late Triassic tetrapod biochronology as they are clearly in the Blue Mesa Member and therefore also demonstrably above the *Placerias*-Downs' quarry fauna. The result of this combination of robust lithostratigraphy with accurate stratigraphic placement of fossil occurrences means that the stratigraphic position of the assemblages shown in Figure 12 are well-documented throughout the Upper Triassic section in Arizona.

Lamyian (late Adamanian) Vertebrates

It has long been thought that the Sonsela Member is depauperate in vertebrates (e.g., Long and Padian, 1986; Long and Murry, 1995; Hunt and Lucas, 1995), and as recently as 2002 any record from the unit was thought to be exceptionally rare (Hunt et al., 2002a). It is now apparent, with a better understanding of the Sonsela lithosome (Heckert and Lucas, 2002a; Woody, 2003), that tetrapods are actually a common component of the Sonsela, and that many localities long thought to be in either the Blue Mesa Member or the Painted Desert Member in fact lie in the Jim Camp Wash beds of the Sonsela Member (Heckert and Lucas, 2002a; Parker and Irmis, 2005). Hunt et al. (2005a) considered this fauna equivalent to the type Lamyian (late Adamanian) fauna, based on the shared occurrence of the phytosaur *Pseudopalatus* and the aetosaur *Typothorax antiquum*. Other tetrapods known from this interval include the aetosaur *Paratypothorax* (including the specimen described by Hunt and Lucas, 1992), and the holotype and some referred material of *Pseudopalatus mccauleyi*. Low in this interval the Adamanian index taxon *Stagonolepis* is known, and *Typothorax coccinarum* has also been recorded from the unit (Parker and Irmis, 2005).

Much work is underway by several parties to try to better delineate the actual stratigraphic ranges of individual vertebrate taxa (e.g., Heckert and Lucas, 2002a; Hunt et al., 2005a; Parker and Irmis, 2005). This is especially the case in the Sonsela Member of the Petrified Forest National Park and vicinity, as the obvious implication of numerous Sonsela localities is that the turnover from the type Adamanian assemblage to a Revueltian assemblage must occur somewhere within the Sonsela Member. It is extremely important to note that the type Adamanian assemblage, that is the classic collecting localities of "Dying Grounds," "Crocodile Hill," and "Phytosaur Basin," among others (Parker, 2002), are all still within the Blue Mesa Member. Therefore, the fauna of the Blue Mesa Member remains largely unchanged in spite of this stratigraphic revision. What does change dramatically is the vertebrate fauna of the Sonsela Member, which goes from being exceedingly sparse (e.g., Hunt et al., 2002a), to rather rich, including both Adamanian and Revueltian faunal elements (Heckert and Lucas, 2002a; Hunt et al., 2005a; Parker and Irmis, 2005).

Early Revueltian Vertebrates

An extensive vertebrate fossil assemblage of early Revueltian age is known from the lower part of the Painted Desert Member of the Petrified Forest Formation in the PFP (e.g., Camp, 1930; Long and Padian, 1986; Padian, 1986, 1990; Murry and Long, 1989; Murry, 1990; Hunt and Lucas, 1993a, 1995; Long and Murry, 1995). The Painted Desert Member assemblage (Table 3) is significant in that the large metoposaurs are much less common, but the smaller genus *Apachesaurus* is considerably more abundant than in the Adamanian faunas. As documented by Hunt and Lucas (1995), other faunal elements include the phytosaurs *Pseudopalatus*, the aetosaurs *Typothorax coccinarum* and *Desmotosuchus chamaensis* ("*D.*" *chamaensis* of Parker and Irmis, 2005), the raiusuchians *Postosuchus*, and *Chatterjeea elegans* (Long and Murry,