OSTEODERMS OF THE TITANOSAUR SAUROPOD DINOSAUR \textit{ALAMOSAURUS SANJUANENSIS} GILMORE, 1922

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The presence of osteoderms in titanosaur sauropods has been well accepted for several decades, following the conclusive discovery of skeletal material associated with dermal plates and ossicles in \textit{Saltasaurus loricatus} (Bonaparte and Powell, 1980). This effectively ended the debate and misidentification that had surrounded the concept of sauropod osteoderms for nearly a century (Depéret, 1896; D'Emic et al., 2009). Since that time, at least 10 titanosaur taxa have been discovered with associated osteoderms (D'Emic et al., 2009). Although most titanosaur taxa are thought to have been “unarmored,” it has been difficult to definitively assert that particular species lacked osteoderms based on absence alone. Several practical problems attend this determination: the uncertain in vivo placement of sauropod osteoderms, their lack of connection to other bony structures, and their rarity even in taxa that are known to possess them. Nonetheless, a few titanosaur taxa have been more confidently interpreted as “unarmored” based on the existence of sufficiently complete and/or articulated materials (e.g., \textit{Epachthosaurus}; Martínez et al., 2004) from multiple horizons and geographic areas. These include \textit{Opisthocoelicaudia skarzynskii} and \textit{Alamosaurus sanjuanensis}, whose purported lack of osteoderms has been proposed as a synapomorphy linking the two (Wilson, 2002).

\textit{Alamosaurus} is unusual among titanosaur taxa in several respects. It is the last known sauropod in North America, present in the southern United States during the Maastrichtian but not venturing north of central Utah (Williamson and Hunt, 1989; D'Emic et al., 2010, 2011). The absence of any Campanian titanosaur in North America implies that \textit{Alamosaurus} was a Maastrichtian immigrant (Lucas and Hunt, 1989; Wilson and Serena, 1998; D'Emic et al., 2011). The taxon is known from a large number of isolated or disassociated elements as well as a few partially articulated specimens. Although many of the isolated specimens do not bear diagnostic features of \textit{Alamosaurus} (see list in Jasinski et al., 2011), there is no decisive evidence of a second sauropod in North America at that time, and where multiple exemplars overlap anatomically, morphological disparity is low (D'Emic et al., 2011; Jasinski et al., 2011). Finally, \textit{Alamosaurus} has had a long history of ongoing discovery since its initial description (Gilmore, 1922), but not a single specimen of definitive \textit{Alamosaurus} “armor” has been reported during that time, although a possibly referable isolated specimen was reported from the Javelina Formation (Fronimos, 2010). As a result, the absence of osteoderms in \textit{Alamosaurus} has been considered genuine (e.g., Wilson, 2002).

In light of this, the recent identification of an osteoderm that has clear associations with skeletal material of \textit{Alamosaurus sanjuanensis} is significant. Unearthed in 1937 but only recognized recently, this specimen provides important new data for understanding the anatomy and relationships of this taxon, as well as the distribution of osteoderms within Titanosauria.

\textbf{Systematic Paleontology—} \textit{DINOSAURIA} Owen, 1842

\textit{Saurischia} Seeley, 1887

\textit{SAUROPODA} Marsh, 1878

\textit{TITANOSAURIA} Bonaparte and Coria, 1993

\textit{ALAMOSAURUS} Gilmore, 1922

\textit{ALAMOSAURUS SANJUANENSIS} Gilmore, 1922

(Figs. 1–3, 4A)

\textbf{Referred Specimen—}USNM 15660, an articulated partial skeleton discovered near North Horn Mountain, Utah, in 1937 (Gilmore, 1938; 1946). Previously the skeleton has been described as an articulated individual composed of some dorsal vertebrae, a sacrum, a complete caudal vertebra series with chevrons, several dorsal ribs, a complete pectoral girdle, a nearly complete forelimb, and ischia, to which the presently described osteoderm material can now be added. The poorly preserved sacrum and dorsal vertebrae were not collected (Gilmore, 1946:30, 40).

\textbf{History of Discovery—}The osteoderm described herein was discovered in the collections of the USNM by Michael Brett-Surman in 2009. At the time it included two related sediment blocks with a small amount of visible bone at the surface. These were labeled ‘USNM 15660,’ a number that also pertains to a well-studied specimen of \textit{Alamosaurus sanjuanensis} (Gilmore, 1946), in the same style and hand as the remainder of the specimen, indicating it had been cataloged by the same person (and probably at the same time). One block also contained bone impressions in the sediment, indicating the close proximity of the new material to the previously prepared skeletal elements. Preparation revealed three separate pieces of osteoderm, but their precise relationships cannot be established. The largest piece appears to be its own ossification; the smaller two may represent one or two separate elements.