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### Technical Session 3: Terrestrial Ecosystems – Late Jurassic (Friday, June 9, 2023, 2:00 PM)

#### NEW MATERIAL OF *HAPLOCANTHOSAURUS* (HATCHER 1903) FROM THE DRY MESA DINOSAUR QUARRY AND A COMMENT ON SAUROPOD DIVERSITY

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*Haplocanthosaurus priscus* (Hatcher, 1903), “simple-spined lizard,” was named from partial skeletons collected from the Marsh-Felch Quarry near Cañon City, Colorado. Another species, *H. delfsi*, was named from a partial skeleton collected from the Cleveland Delfs Quarry, also in Colorado (McIntosh and Williams, 1988). To these specimens, fragmentary remains from several other localities have been assigned to the genus (Foster, 2020), and a nearly complete skeleton that may represent a new species awaits publication (Bilbey et al., 2000).

Brigham Young University Museum of Paleontology houses five *Haplocanthosaurus* dorsal vertebrae (BYU 9194, 11506, 17530 (Figure 1), 17531, 17689) and a tibia (BYU 12865, Figure 1) from the Late Jurassic Dry Mesa Dinosaur Quarry (DMDQ). The dorsal vertebrae possess diagnostic *Haplocanthosaurus* characters, including tall neural arch peduncles, dorsally-angled transverse processes, and parapophyses placed well below the diapophyses even on posterior dorsal vertebrae (Figure 1). The right tibia is identified as *Haplocanthosaurus* based on the robust nature of the element and the general morphology of a greatly expanded distal end and small cnemial crest. The least breadth/length (LB/L) measurement of 0.21 is greater than any other known sauropod taxa from DMDQ and compares well with USNM 4275, which includes a left tibia assigned to *H. priscus* (LB/L 0.23). While the left tibia of USNM 4275 has an articulated astragalus on its distal end, the morphology matches well with BYU 12865.

The primary importance of the new specimens is stratigraphic rather than morphological. *Haplocanthosaurus* is not abundant at any locality in the Morrison Formation, and the Marsh-Felch Quarry in Colorado is the only quarry to definitively produce more than one individual of *Haplocanthosaurus* (CM 572, CM 879, and USNM 4275). Despite its numerical scarcity, *Haplocanthosaurus* persisted through much of the deposition of the Morrison Fm. Dorsal vertebrae referable to *Haplocanthosaurus* are present low in the Salt Wash Member of the Morrison Fm. in central Utah (MJW pers. obs., Figure 1), and other *Haplocanthosaurus* localities are in the upper Salt Wash, lower Brushy Basin, and upper Brushy Basin members of the Morrison Fm. (Turner & Peterson, 1999). The DMDQ *Haplocanthosaurus* material confirms the presence of this long-lived genus in the upper Brushy Basin (Britt, 1991). The *Haplocanthosaurus* elements reported herein from DMDQ do not help resolve the phylogenetic position of this enigmatic genus.

Hatcher (1903) considered *Haplocanthosaurus* to be “... the most generalized member of the Sauropoda yet

discovered in America”, with the species name *priscus* meaning “first.” Historically the phylogenetic relationships of *Haplocanthosaurus* have been uncertain. Various analyses have found it to be a derived eusauropod just outside of Neosauropoda, a basal macronarian alongside *Camarasaurus* and *Brachiosaurus*, or the most basal diplodocoid, with more recent analyses tending to support the diplodocoid hypothesis (see Foster & Wedel, 2014 for a brief review; Foster, 2020).

The Dry Mesa Dinosaur Quarry has produced the most diverse assemblage of sauropod dinosaurs in any one locality in the world. The quarry, opened in 1972, was excavated for the better part of two decades and, at over 120m long, it is one of the larger Morrison Formation localities. Unfortunately, the majority of the nearly 5,000 elements prepared are disarticulated.

Six sauropod genera from four families are positively identified based on remains found at the quarry. The diplodocids are represented by at least three species. Most of the *Diplodocus* remains from the quarry belong to adults, as defined by complete neurocentral fusion. However, they are smaller than all other adult *Diplodocus*. Characters in the DMDQ *Diplodocus* and *Brachiosaurus* vertebrae suggest they may be new species.

DMDQ sauropods with representative diagnostic specimen numbers:

*Apatosaurus* sp. - putative caudal #1 (BYU 5065), rt. fibula (BYU 11420)

*Brachiosaurus* sp. - rt. scapulocoracoid (BYU 9462), sacral complex with three articulated caudal vertebrae (BYU 11434)

*Camarasaurus* sp. - caudal vertebrae (BYU 12852, 12853, 13286), rt. tibia (BYU 17352)

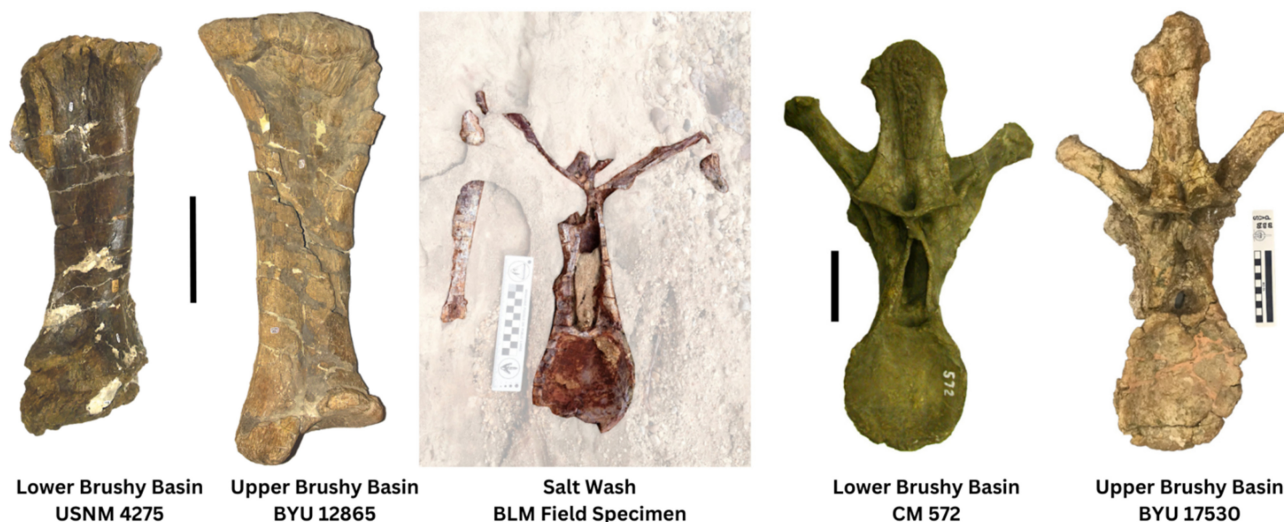
*Diplodocus* sp. - articulated skeleton from presacral 3 to caudal 15+ (BYU 12155), rt. tibia (BYU 12604)

*Haplocanthosaurus* sp. - dorsal vertebrae (BYU 9194, 11506, 17530, 17531, 17689, 17530), rt. tibia (BYU 12865)

*Supersaurus* - caudal vertebra (BYU 9044), holotype scapulocoracoid (BYU 12962)

Additionally, a cervical vertebra (BYU 11617) may belong to *Barosaurus*. If so, this would make a seventh sauropod genus present.

With the recognition that the specimens described herein are referable to *Haplocanthosaurus*, DMDQ is the first – and so far only – known quarry in the world with at least six distinct, valid genera of sauropods present. The quarry is hypothesized to represent a faunal assemblage that was first concentrated and then killed by a severe drought (Richmond and Morris, 1998), so the six sauropod genera might have originally been segregated among different nearby habitats during favorable, non-drought conditions. Still, the presence of at least six sauropod genera within the area that could be concentrated



**Figure 1.** *Haplocanthosaurus* tibiae and dorsal vertebrae

during a severe drought emphasizes the high site-level diversity of Morrison sauropods.

Is DMDQ unique in the Morrison in supporting so many dinosaur taxa? At least nineteen dinosaur genera (six sauropods, eight theropods, and five ornithischians) are currently recognized. Is it a “disaster quarry,” the bone salad resulting from a massive drought drawing all of the surrounding taxa into close quarters? Was it a crossroads site, occupying a migration path, or situated on the boundary between two ecosystems? Evidence from Whitlock et al. indicates this quarry was part of the western region of the Morrison Formation, and DMDQ's sauropod assemblage provides further evidence for the high diversity across the Western and Eastern regions of the Morrison (Whitlock et al., 2018).

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## Technical Session 3: Terrestrial Ecosystems – Triassic – Middle Jurassic (Friday, June 9, 2023, 9:45 AM)

### GEOLOGY AND PALEONTOLOGY OF THE UPPER TRIASSIC CHINLE FORMATION IN THE NORTHERN PARADOX BASIN OF SOUTHEASTERN UTAH: COMPARING SURVEYS FROM CANYONLANDS NATIONAL PARK AND INDIAN CREEK IN BEARS EARS NATIONAL MONUMENT

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