Fronimos and Wilson (2017) suggested that the complex interdigitations of the neurocentral joints in sauropods were an adaptation for resisting biomechanical stresses associated with large body size and long necks. Shifting the position of the neurocentral joint dorsal or ventral to the neural canal may have served a similar function, by essentially merging the left and right halves of each joint into one and thereby increasing the surface area of the joint. Even if some other adaptive or developmental cause provided the impetus for such change, these shifts would at least have had the exaptive effect of increasing the surface area available for the joints.

Sauropods therefore increased the surface area of the neurocentral joints in all available directions: cranio-caudally and dorso-ventrally by increasing the height and complexity of the interdigitations, and medio-laterally by shifting the joints dorsally or ventrally to eliminate the gap created by the neural canal.

This leaves the question of why neurocentral joints are shifted dorsally in some vertebrae and ventrally in others. To date, all examples we have found of dorsally-shifted neurocentral joints occur in dorsal vertebrae, and all ventrally-shifted joints occur in caudal vertebrae. The dorsal centra of most sauropods are deeply excavated by lateral pneumatic fossae or foramina, even in very young individuals (Wedel et al., 2000: Figure 14), and shifting the joint ventrally might have either reduced the surface area available for the joint, or interfered with the process of pneumatization. In sauropod caudal vertebrae, the neural arches become narrower dorsally, so shifting the neurocentral joint dorsally would have expanded the surface area of the joint little, if at all. Shifting the joint ventrally not only widened the contact between the neural arch and the centrum, but also allowed the arch to be partially morticed between the caudal ribs, which probably strengthened the joint even further.

Alternatively, the direction of the shift in the position of the joint may have been influenced more by a need to protect the spinal cord from trauma. Perhaps the caudal centra of sauropods were more susceptible to injury than the neural arches, although this is neither obvious *a priori* nor backed up by data. A global survey of vertebral pathologies in sauropods is outside the scope of this work, but it could provide useful insights. Furthermore, as we have only described herein a handful of examples of shifted neurocentral joints, a more comprehensive survey in other sauropods, in basal sauropodomorphs, and indeed in other dinosaurs would also be most welcome.

In conclusion, dorsal and ventral shifts in the positions of the neurocentral joints in many sauropods could plausibly have strengthened the vertebrae, improved protection for the spinal cord, or both. These hypotheses await testing by further paleontological discoveries, and by biomechanical modeling.

Institutional Abbreviations: BIBE, Big Bend National Park, Texas; CM, Carnegie Museum, Pittsburgh, Pennsylvania; MB.R., Museum für Naturkunde Berlin, Berlin, Germany; YPM, Yale Peabody Museum, New Haven, Connecticut.

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Technical Session 3: Terrestrial Ecosystems – Late Jurassic (Friday, June 9, 2023, 2:15 PM)

MICROVERTEBRATE EXPANSION OF KNOWN FAUNA OF THE MORRISON FORMATION OF OKLAHOMA WILL ENABLE MORE MEANINGFUL COMPARISONS WITH OTHER REGIONS

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The vertebrate fauna of the Jurassic Morrison Formation as it crops out in the valley of the Cimarron River near Kenton, Oklahoma, USA was discovered in 1931 and worked 1935 - 1942 under the direction of Dr. Willis Stovall. The fossil-bearing exposures lie near the eastern edge of the Upper Jurassic Morrison Basin, where the formation is about 60m thick and thins to the East (Richmond et al., 2020). Analysis of pedogenic calcite

suggests that there was not significant rainfall seasonality (Myers et al., 2018), which may differentiate the region from the more intensively studied central basin (Turner & Peterson, 2004).
In 2012 a new site, OMNH V1694, was discovered. In the interim some collections had been made in adjacent Union County, New Mexico, but no further extensive collection in Oklahoma had been done and a comprehensive faunal study of the Stovall localities is lacking, although some individual taxa have been published. V1694 is being worked with the advantage of more advanced techniques of quarrying and preparation. Significantly, this includes underwater screening, and one result has been the recovery of many small elements of the Jurassic paleocommunity.
The new site has thus far produced fruiting bodies of charophyte algae, ostracods, several types of snails, teeth and vertebrae of actinopterygian fish, an anuran distal humerus, and mammalian teeth, in addition to small crocodilian teeth and fragments of large animals. Larger elements of the community include the turtle *Glyptops*, crocodylians, teeth of an allosaurid, and diplodocid sauropod skeletal elements, some of which are attributable to *Barosaurus*. *Glyptops* is the most common vertebrate from the site on the basis of MNI, although crocodylian teeth are common. There are probably both strong environmental and taphonomic signals in the composition of the assemblage; the richest parts of the site were deposited in a high-energy current.
Faunal comparisons across the Morrison Formation have tended to focus on dinosaurs (e.g., Whitlock et al., 2018) in part because of historical collecting bias. Increasing recovery and recognition of small-bodied vertebrates allows more nuanced ecological comparisons (e.g., Foster, 2020) and will likely facilitate more exact biogeographic divisions and characterizations of habitats. Whitlock et al. (2018) found low endemicity of the southern dinosaur assemblage, but this could change with the inclusion of microvertebrates if smaller animals have smaller or habitat-specific ranges. While microvertebrates from V1694 will be useful, age constraint is currently lacking in the Oklahoma outcrops, making temporal correlation to sites in other regions difficult. V1694 has been interpreted as lower in the section than Stovall's sites (Richmond et al., 2020) although nothing identified from the macrofauna is not also present in those sites. It is not easy to compare V1694 to Stovall's sites; even factoring out collecting bias, sedimentary facies indicate somewhat different taphonomy. Future work should include both ostracod biostratigraphy from the vertebrate-bearing sites themselves, if possible, and magnetostratigraphy.

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Technical Session 3: Terrestrial Ecosystems – Triassic – Middle Jurassic (Friday, June 9, 2023, 11:45 AM)

HIGH DIVERSITY MIDDLE JURASSIC DINOSAUR FAUNAS REVEALED THROUGH MICROVERTEBRATE ANALYSIS

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