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ABSTRACTS VOLUME

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A mechanical approach to sauropod neck mechanics

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The Finite element analysis (FEA) is a computer simulation technique used in engineering analysis that allows determination of stresses and displacements in mechanical objects and systems. FEA was carried out on a cervical vertebra of the sauropod dinosaur *Brachiosaurus brancai* in order to study the vertebral design in context with biomechanical behaviour of the long neck. Specifically, the FEA was applied to

- explain the distribution and geometry of pneumatic spaces in the vertebra by determining the distribution and direction of maximum and minimum stresses in the vertebra,
- clarify if the long, overlapping cervical ribs of *Brachiosaurus* were a ventral elastic support device for the neck, and
- study the load cases during movement of the neck in context with the vertebral morphology.

The FEA was carried out for dorsal and lateral movement of the neck, as well as for a neutral (resting) pose. Because of only rough calculations of the involved masses, uncertainties in soft-tissue reconstructions and an oversimplified geometry of the studied vertebra, absolute values obtained are rather imprecise, whereas distribution and direction of stresses are correct.

In all load cases, the vertebra was mainly compression loaded. Mainly the vertebral bodies were loaded, with stresses occurring especially in the outer layer of the vertebra, leaving its internal space nearly unloaded. As it was assumed before, the pneumatic cavities within the vertebra lie in these regions of low stress, without peak stresses occurring at their margins. This corroborates the idea that the existent vertebral shape forms a framework between which pneumatisation can take place. The FEA explains the distribution of the pneumatic diverticula, but not their size or geometry, which is possibly a factor of other biological demands. The FEA shows furthermore an important role of the zygapophyseal articulations for limiting the lateral excursion of the neck and guiding it in controlled movements. During neck movement, high forces are generated by the contracting axial muscles that make the neck prone to torsion and lateral buckling. The zygapophyses form a “dovetail”-guidance in the neck, which counteracts this tendency. If the cervical ribs were elastically interconnected by ligaments as it was assumed in our reconstructions, they serve as a flexible abutment for the neck, relieving the intervertebral articulations. Thus, the biomechanical role of the long, overlapping cervical ribs of *Brachiosaurus* for neck support can be verified by this analysis.

The results of the FEA are consistent with our model for neck support in a sauropod with long cervical ribs, combining osteological (zygapophyses, cervical ribs) and soft-tissue (ligaments, pneumatic diverticula) structures to brace the neck. Thus, with the help of FEA, the mechanics of the neck of sauropods is better understood, and our biomechanical model is proofed by an engineering approach.

Revision of *Cetiosauriscus greppini* – new results and perspectives

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Cetiosauriscus greppini Huene, 1922 represents the only skeletal find of a sauropod from Switzerland and ranges among the few well-preserved European sauropod skeletons (Meyer and Thüring, 2003). The remains of *C. greppini* were found in the 1870's at the "Basse Montagne" quarry near Moutier, Switzerland. The bones were extracted from a greenish lens of marls and limestone, indicating deposition in an ephemeral lake. The sediments belong to the lower part of the Reuchenette Formation, and of Early Kimmeridgian (*sensu gallico*) age. The material of *C. greppini* can be assigned to at least three individuals of different size, of which the holotype is the most complete specimen. The preserved bones comprise skull fragments, a cervical vertebra, several tail vertebrae and isolated neural spines, and many appendicular bones, such as scapula and coracoid, humerus, femur and tibia.
The material of *Cetiosauriscus greppini* was originally described as *Ornithopsis greppini* by Huene (1922), but later, in combination with the British skeleton BMNH R3078 (= *Cetiosaurus leedsi*, Woodward, 1905) from England, included in the new genus *Cetiosauriscus* Huene, 1927. BMNH R3078 was re-named as *Cetiosauriscus stewarti* Charig, 1980 and established as the type specimen of *Cetiosauriscus* (Charig, 1993). The material of *C. greppini* has received very little attention since Huene's (1922; 1927) work, and is either considered a nomen dubium or completely ignored. Nevertheless, a revision of the taxon revealed significant characters allowing its taxonomic and systematic assignment. Because of its position among basal Eusauropoda, *C. greppini* contributes to our knowledge on sauropod evolution, especially in Europe.
In comparison to *Cetiosauriscus stewarti*, the holotype specimen of *C. greppini* is remarkably smaller, but represents an adult, probably even an old individual. Several characters clearly distinguish *C. greppini* from *C. stewarti*, such as caudal transverse processes that are anteroposteriorly flat and bear a distinct dorsal wing-like expansion, anterior and posterior centrodiapophyseal laminae situated ventrally to the anterior caudal transverse processes, a coracoid with a rounded square outline and with a notch ventrally to the glenoid articular surface, remarkably straight shafts of humerus and femur, a distal end of the humerus with a higher medial than lateral hemicondyle, a more proximally positioned 4th trochanter, and a longer and straighter shaft of the ischium. These characters certify that both taxa are distinctive at the generic level. Phylogenetically, *Cetiosauriscus greppini* is most probably a non-neosauropodian eusauropod basal to Turiasauria. A detailed redescription of this taxon, including a phylogenetic analysis, in currently in progress.

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