

Pneumatic diverticula associated with the spinal cord in birds, sauropod dinosaurs, and other ornithodiran archosaurs

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By the dawn of the 20th century, palaeontologists had realized that sauropod dinosaurs have small neural canals relative to their large size, and therefore their spinal cords must have been small as well. The neural canals of sauropods are also unusual in that they are often taller than wide. This is shown by the fact that the spinal cords of vertebrates are highly constrained in cross-sectional shape, and almost always slightly wider than tall. Therefore not only are the neural canals of sauropods oddly small, it would appear that the meningeal sac containing the spinal cord almost certainly did not fill the entire space. In extant birds, much of the cross-sectional area of the neural canal is occupied by the canalis supramedullaris, a pneumatic diverticulum derived from the lungs and air sacs. The canalis supramedullaris is present in hummingbirds and ostriches and in most size-intermediate taxa where it has been surveyed, so its presence is likely ancestral for birds. It probably evolved much earlier, however. We have identified supramedullary pneumatic foramina in unfused neural arches of a juvenile titanosauriform from the Cloverly Formation (Lower Cretaceous, Aptian-Albian) of Montana, and juvenile *Alamosaurus* from Javelina Formation of Texas (Upper Cretaceous, Maastrichtian). Furthermore, pneumatic features on the vertebrae tend to cluster around the neural canals in both saurischian dinosaurs and pterosaurs. Although the function of supramedullary diverticula is unknown, such diverticula are probably primitive for saurischian dinosaurs, and may have been present in most ornithodiran archosaurs.