

members of the Thelodonti, a group that has been suggested to be close to the ancestry of several major clades of early vertebrates.

We present here the preliminary results of our examination of thousands of specimens of *Phlebolepis elegans* from the collections of Tartu Univ., Estonia. Collected in 1929 by Artur Luha from the Himmiste quarry on the island of Saaremaa (formerly known as Oesel), the specimens are arranged by the dozens in part and counterpart on thick slabs of dolostone. The corresponding sediments were deposited during the Ludlovian Age in a shallow marine environment.

Study of the specimens confirms that the mouth was somewhat ventral, rather than terminal, that the pectoral fin originated close behind the orbit, that the dorsal fin is slightly in advance of the anal fin, and that the dorsal lobe of the caudal fin is more extensive than previously thought, although the ventral lobe contains the body axis. Scale patterns on the head show the probable location of the pineal macula. The arrangement of the branchial openings remains somewhat doubtful, but new evidence on this point has also come to light. Of the previous reconstructions, that by Ritchie is the most faithful to the evidence, although several details can now be improved upon.

Saturday 1:45

TAPHONOMY, GASTROLITHS, AND THE LITHOPHAGIC BEHAVIOR OF SAUROPODOMORPH DINOSAURS

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Gastroliths (stomach stones) have been traditionally interpreted as essential for the trituration of ingesta in prosauropod and sauropod dinosaurs. While recent research has shown that the amounts of gastroliths in sauropods do not correspond to the amounts within avian gastric mills, a patchy occurrence of gastroliths within the fossil record of sauropodomorphs may give further evidence.

Occurrences of suspected sauropod gastroliths and exotic clasts (exoliths) in several Upper Jurassic sauropod localities from western USA are compared with authentic finds of sauropod gastroliths (e.g., *Cedarosaurus*, *Seismosaurus*) as well as with other Mesozoic dinosaur sites. As taphonomic experiments with ostrich chick carcasses have demonstrated, the release of gastroliths from the body cavity can occur within a few days and is likely to happen in an aquatic environment because of prolonged floating of the carcass. This may be an explanation for the absence of gastroliths from most sauropodomorph carcasses in fluvial depositional environments, but not for their absence within autochthonous finds. Other reasons for post-mortem separation of bones and gastroliths, such as scavenging, also cannot explain the frequent absence of gastroliths satisfactorily.

The results of this investigation show that there are indeed very few prosauropod and sauropod finds with unambiguous gastroliths. The scarcity of pebbles in the fine-grained sediments of most fossil localities indicates that only a small number of sauropodomorphs possessed gastroliths. The existence of a gastric mill in all sauropodomorphs is not supported by the taphonomic evidence. Exoliths, which are abundant in the Lower Cretaceous of the western USA, are virtually absent in Upper Jurassic sediments. Without association with fossil bone, there is no convincing evidence that these exoliths represent former gastroliths. It is more plausible that most of the surface-collected stones are weathering relicts of former conglomerate layers or represent clasts associated with hyperconcentrated-flow deposits.

Poster Session A

PLIOCENE LAGOMORPHS AND MACROSCOLIDIDS RECENTLY RECOVERED FROM LAETOLI, NORTHERN TANZANIA

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Laetoli (circa 4.5-2.6 Ma) is one of the most important paleontological and paleoanthropological localities in Africa. The Laetoli sites were first worked in the 1930s, and they continue to produce a spectacular fauna including mammals, birds, reptiles, invertebrates, plants, and ichnofossils. Collections from 1998-2004 include more than 15,000 specimens, of which about 27% are lagomorphs. As from prior collecting, macroscelidids are extremely rare. Only four specimens, an isolated P4 and three incomplete mandibles of *Rhynchocyon plicicaenicus* were recovered. The lagomorph remains are isolated crania and postcrania, as well as partial skeletons, of the extinct taxon *Serengetilagus praecapensis*. The specimens of *Serengetilagus* from Laetoli are the most numerous and complete of any known fossil lagomorph from Africa. The large sample of *Serengetilagus* from Laetoli documents the range of morphological variation within this genus. This clarifies the taxonomic assignment of other poorly represented African and Asian specimens that have been assigned to *Serengetilagus*. It also clarifies the relationship between *Serengetilagus* and the contemporaneous morphologically similar primarily European fossil taxon *Trischizolagus*.

Thursday 1:30

TYRANNOSAUR BRAIN AND EAR STRUCTURE: ONTOGENY AND IMPLICATIONS FOR SENSORY FUNCTION AND BEHAVIOR

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The ear regions and cerebral endocasts of tyrannosaurids were investigated using CT scanning of the bony braincase and 3D visualization. Adult and subadult specimens of *Tyrannosaurus rex* included AMNH 5029, AMNH 5117, FMNH PR 2081, among others. The

controversial juvenile Cleveland skull (CMNH 7541) was also scanned. CMNH 7541 has been regarded as representing either a separate taxon (*Nanotyrannus*) or a juvenile *T. rex*. The braincase of the Cleveland skull was digitally extracted for more direct comparisons with more mature specimens. Pneumaticity of the braincase is extensive in all specimens, with clear communications among the caudal tympanic, basisphenoid, and subcondylar recesses. Most of the pneumatic features can be attributed to pneumatization from diverticula from the middle ear, but some may derive from a median pharyngeal diverticulum and others from the pulmonary system associated with the cervical air sacs. The cerebral endocasts of adult specimens are grossly similar to those of other large-bodied theropods, but that of the Cleveland skull is different in that the cerebral region is relatively more rounded and the dural pineal peak observed in adults is almost absent, suggesting potentially considerable ontogenetic changes in brain structure or at least endocranial cavity structure. The identification of presumptive olfactory turbinates in the Cleveland skull allows discrimination of neural components (olfactory bulb) from sensory epithelial components; the olfactory apparatus is well developed. The osseous labyrinth of the inner ear is organized much like that of other nonavian coelurosaurs but has particularly long delicate canals consistent with a well developed vestibulo-ocular reflex and reliance on the visual system. Moreover, the structure housing the cochlear duct is long, consistent with reliance on auditory cues and perhaps even emphasis on low frequencies given the effects of extensive tympanic pneumaticity on middle ear impedance. Orientation of the head when alert can be reconstructed based on labyrinth orientation, and the alert posture of the juvenile was strongly down-turned.

Friday 8:30

MANIPULATING DINOSAURIAN SOFT TISSUE: METHODS FOR HANDLING SOFT TISSUES, VESSELS AND CELLS IN FOSSIL SPECIMENS

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We previously announced the discovery of vessels and microstructures with cell-like morphology preserved in hindlimb elements of *Tyrannosaurus rex* (MOR 1125), showing that soft tissues could be preserved in the fossil record, not just by replacement or replication, but as intact structures retaining flexibility and resilience. Investigation of additional fossil material, including other tyrannosaurs, hadrosaurs, and more recent specimens, indicates that this is not an isolated phenomenon.

The challenge of trying to manipulate, process and analyze vessels and cellular structures millions of years old is not a minor one. Applying techniques designed for modern tissues to fossils has serious limitations, as methodologies for handling extant bone-derived vessels and cells are not well defined. We have tested a variety of methods for isolating, imaging, fixing, embedding and extracting soft tissue and cellular structures, to gain the greatest quantity of information from limited fossil materials in order to characterize preservation at cellular and sub-cellular levels.

Here, we detail methodologies designed to isolate these components from fossil bone and prepare them for detailed microscopic and molecular analyses. We discuss methods for removal of mineral matrix, isolation and preparation of microscopic structures, fixation and TEM preparation; and various means of molecular analyses.

Poster Session B

ZOOLOGICAL PALEOPATHOLOGY AND THE CASE OF THE TYRANNOSAURUS JAW: INTEGRATING PHYLOGENY AND THE STUDY OF ANCIENT DISEASE

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The analysis of diseases by veterinary pathologists relies on gross observation, serology, bacteriology, histopathology and clinical history. Paleopathologists are left with a fraction of that information from which to draw conclusions. Paleopathology has disregarded microbial evolution, and falls within the Victorian mindset that views the human model of disease as the arbiter of diagnosis. Although human pathology research is extensive, disease comparisons taken outside of phylogenetic context must be questioned. Therefore, the author proposes a new approach, here termed *zoological paleopathology*, that allies this field with zoological medicine. Zoological paleopathology accepts that pathogens evolve, and that susceptibility to non-transmissible conditions may also evolve, such that patterns can only be distinguished by inter-clade investigation. This method draws upon a history of zoological pathology research on numerous taxa, deferring to human pathology only in those mammalian cases that justify direct comparison. It is also pattern-based, preferring differential diagnosis of well-defined broad-scale trends to peremptory diagnosis of individuals.

As a test case for zoological paleopathology, the author studied oral pathology in tyrannosaurids. Of fifty-six individuals examined, one fourth of the mandibles displayed some form of anomaly, typically of the surangular or dentary. The dentaries had abnormalities classified as tooth traces from scavenging, an isolated bite wound, and idiopathic periosteal reactive ridges, which are observed on some specimens to display cranial curvature and overlap between the lingual and labial aspects. The surangulars often display resorptive fenestrae that are random in distribution. The fenestrae are ovate, ringed by normal periosteum, and generally lie proximal to other abnormal fenestrae. The tentative differentials for this condition are developmental abnormality, bite trauma, osteomyelitis, fibrosarcoma, idiopathic neoplasia and metastatic carcinoma. Preliminary results indicate that these abnormalities more closely resemble those found in crocodylians than rats.