

Poster Session III, (Friday)

NEW ADAPISORICULID MAMMALS FROM THE EARLY PALEOCENE LOCALITY OF HAININ (BELGIUM)

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A recent study of the family Adapisoriculidae from the Early Paleocene deposits of Hainin has led to the description of two new species and four new morphotypes, as well as a more complete description of *Bustylus marandati*. The new species both belong to the pre-dilambdodont adapisoriculids, one to the genus *Afrodon* and one to the genus *Bustylus*. The newly identified morphotypes belong to both dilambdodont and pre-dilambdodont forms, with three morphotypes representing *Adapisoriculus*, *Remiculus* and *Afrodon*, and the fourth one probably belonging to a new genus. All known genera of adapisoriculids thus seem to be present in Hainin except the very particular African genus *Garatherium*.

The presence of several teeth with a robust morphology reminiscent of the dilambdodont *Remiculus*, but still close in other features to the most primitive genus *Afrodon*, suggests an evolution scenario different from those developed by previous authors. Dilambdodonty is commonly thought to have appeared only once, with the split between the two dilambdodont genera *Remiculus* and *Adapisoriculus* occurring later. The new material from Hainin shows that the evolution of adapisoriculids is probably more complex than expected, with dilambdodonty possibly evolving twice.

Poster Session II, (Thursday)

A COLLECTION OF MODELS OF MEXICAN LATE JURASSIC MARINE REPTILES AT A 1:10 SCALE

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Systematic investigation of Mexican Mesozoic marine reptiles began few years ago, financially supported by the German Science Foundation and Consejo Estatal de Ciencia y Tecnología, and yielded rich assemblages for both the Late Jurassic and Late Cretaceous. Many of these fossils are kept, prepared and studied at the Museo del Desierto, Saltillo, Coahuila (Mude), a large museum devoted to the deserts of north-east Mexico, their fauna and flora, geology, archaeology, ethnography, which includes areas for art exhibitions and wild living animals rescued from unwanted encounters with humans. The Mude was born from the stubborn vision of Lic. Magdalena Cardenas, who could convince political powers and assemble necessary competencies in the provincial-looking city of Saltillo, capital of Coahuila. The new Direction wished to mark the first decade of existence of the Mude by exhibiting exceptional fossils from the region. Among those are undoubtedly the marine reptiles that populated the Late Jurassic Mexican Gulf, encountered both in Nuevo León and Coahuila. It was decided to produce a diorama at a 1:10 scale. This comprises models of *Ophthalmosaurus* cf. *icenicus* adults (40 cm) and juveniles (7 cm), *Dakosaurus* sp. (40 cm), *Cricosaurus saltillense* (25 cm), cf. *Brachypterygius* sp. (80 cm), an indeterminate pliosaur representing 'The Monster of Aramberri' (150 cm) and a new cryptoelidid plesiosaur (30 cm).

The models were first sketched according to the fossil material and literature, and a silhouette cut out in Styrofoam; this prototype was then coated with epoxy plastilin and hand-finished, including details such as skin ornamentation, eyes and fins, painting and high-gloss varnish coating to suggest an aquatic atmosphere.

At Mude, the visitors view the paleontology laboratory through a window, where they can ask questions and be answered. Some of the models were exhibited in this window, and comments are unexpectedly gratifying, e.g. the ichthyosaurs are correctly depicted by the kids as 'looking like dolphins but still different', and in general, the models help the public connect the raw bones they see in preparation to real, living animals of the past.

Molecular Tools in Paleobiology: Trees, Clocks and linking Geno- with Phenotype, Friday 9:15

THE "TIME-DEPENDENCY OF MOLECULAR RATES OF EVOLUTION" REVISITED: HOW WELL-CALIBRATED PALEONTOLOGICAL EVIDENCE CAN CLEAR THE MESS IN THE BAYESIAN DEBATE GENERATED BY POORLY-CALIBRATED UNINFORMATIVE MOLECULAR DATA

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One of the predictions of the neutral theory of molecular evolution is that the long-term rate of substitution between two lineages can only be inferior to their instantaneous rate of mutation, due to the fixation of transient polymorphisms through time. Accordingly, some recent work supports that a drastic acceleration in the molecular rates as divergence time approaches zero is a general and predictable feature. It has become since then a hotly debated topic in both systematics and evolutionary biology. Although, observations of such 'accelerations' in the molecular rates within recent evolutionary time have been documented, some recent models describe a phenomenon an order of magnitude beyond them. Indeed, it allows a variation within a wide range of rates (beyond 20 fold) during an extended period of time (up to two million years). Although intuitively appealing and explaining well the original data, this model supports a serious and prolonged impact of deleterious mutations

and would thus require large adjustments in the current evolutionary paradigm of genomes. Recently, both the model of the time-dependency and the significance of the rate acceleration phenomenon have been put in question. In this communication, our primary objective is to re-address the nature of the causal factor(s) of the rate acceleration described by previous models, as well as their biological meaning. Based on previously published material, we suggest that the emphasis placed upon the divergence time in the current explanation of this phenomenon has hidden other relevant factors such as the information content of the datasets. In order to compare the performance of the strict "time-dependency" model with a more inclusive "signal-dependency" hypothesis, we examine both the impact of sequence length and the relative advantages & disadvantages of alternative calibration methods over the estimates of the rates. We illustrate the theoretical benefits of well-documented paleontological evidence on the inference of the rates through a case-study of modern and extinct Elephantoids. We thus conclude that the hypothesis for a signal-dependent artifact appears to model the data more accurately and explains some inconsistencies between published reports on evolutionary rates and paleontological data.

Poster Session IV, (Saturday)

UP IN ARMS: AN ANALYSIS OF EVOLUTIONARY TRENDS WITHIN THE MANIRAPTORAN APPENDICULAR SKELETON USING ALLOMETRIC AND BAYESIAN PHYLOGENETIC APPROACHES.

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Elongation of the coelurosaurian forelimb is a well accepted trend within theropod dinosaurs. The level of elongation is usually measured by an increase in the relative increase in the humerus to the femur that culminates at a 1:1 ratio at node Aves. However, the use of ratio data without explicit context masks the independent trends in each measurement. This leads to an incomplete picture and possibly misleading assessment of actual morphological change. The implicit assumption in humeral to femora analysis is that the femur length is not under positive selection, and length differences between taxa are caused solely by body mass. Recent analysis in extant avians shows this assumption to be invalid. Using regression analysis we show that although femur length is closely related to snout to vent (SVL) and trunk (dorsal and sacral series) lengths in most theropods, basal deinonychosaurs show significantly longer femora than would be expected. We also find that the humeral to femur ratio, previously designated as a critical character in the diagnosis of Aves, is size dependent. Standardized for size and based on long term trends in maniraptoran, the "critical" ratio of 1:1 is actually the expected value for a SVL of less than 250mm. *Archaeopteryx*, *Microraptor* and *Epidexipteryx* are all within this size range and show a variety of levels of both forelimb and hindlimb elongation relative to body length. Femur length elongation in basal paravians has led researchers to overestimate body mass in these taxa, perhaps by more than 200% in some deinonychosaurs including critical taxa such as *Microraptor*, *Buitreraptor* and *Rahonavis*. Using allometric equations based on body length, (either SVL or trunk) and body mass, (derived from mid-shaft width or whole body silhouette methods) we examine where and to what extent there exist larger than expected deviations in fore- and hindlimb proportions within maniraptorans. Using Bayesian analysis, we further examine the implications for the reconstructions of ancestral states of appendicular morphology and re-evaluate currently proposed paravian behavioral hypotheses, including the origin of powered flight.

Poster Session IV, (Saturday)

THE CHEWING BIOMECHANICS OF DEER ANALYZED BY FINITE ELEMENT METHOD (FEM)

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The highly complex geometry of mammalian teeth, and also the diverse material they are made up of, restricts our knowledge of chewing biomechanics. Here we propose that a better understanding of dental morphology may be reached by objectifying the studies using the engineering technique of finite-element (FE) analysis. We advance the results obtained on creating two complex 3D FE upper molar models of extinct (*Procervulus ginsburgi*) and extant (*Cervus elaphus*) deer (Cervidae) in order to reconstruct chewing biomechanics. Evaluating the stress and strain fields in their teeth structures allows us to investigate how teeth respond to mechanical loading. FE models were generated from white light 3D and micro computed tomography (micro CT) scans and then physical-chemical properties of extant ruminant teeth were applied to the models. When bite force was applied by FEM, some unexpected patterns of distribution were seen among the models examined, as a result of differences in dental shape. To obtain more reliable interpretations, a comparison between the stress and strain maps obtained and the dental wear patterns of the molars was realized. The extinct deer model is more extensively strained and stressed, which is particularly notable in the dental cones. In contrast, both strains and stresses are highly restricted on the dental crests for the extant. The models behave differently because the general morphology of molars is much lower, wider and shorter in *Procervulus* than in *Cervus*, and also because there are some significant differences concerning the crescentic-shaped cusps. Our modeling reveals that such differences act by reducing the surface involved in strain and stress distribution in the extant deer model. It was found, however, that regions for both models