

Messel Pit is an ancient open-cast mine in southern Germany, in which middle Eocene oil shales were quarried. Aside from a famous mammal fauna, there is an important record of fossil fishes.

Messel gars (*Arctosteus trausii*) were removed from the genus *Lepisosteus*, e.g., because of their reduced infraorbital enameloid, as well as the presence of enlarged dermopalatine fangs. Although there are characters that contradict this generic assignment and even their higher rank systematics, the previous classification is not put into question as of yet. There is a general need for a review of gar systematics and results of current research projects remain to be seen. There is one new Messel gar species, at least. It was first detected by its very short snout and a continuous enameloid covering on certain skull bones. In the meantime, additional diagnostic features were found, which characterize the new gar as a lepisosteid of uncertain relationships.

Thaumaturus intermedius, a primitive teleost, was recently classified as a member of the Ostariostomidae. Our investigations point out that this species cannot belong to the ostariostomids, notopteroids or osteoglossomorphs as defined in recent publications. Two characters contradict its classification as Ostariostomidae: five characters its classification as Notopteroidae, three characters its classification as Osteoglossiformes, and four characters (primary bite not between basihyal and parasphenoid, presence of a supraorbital, separate fourth and fifth infraorbitals, pu 1 without neural spine) contradict its classification as Osteoglossomorpha. Additional characters are present that also contradict an osteoglossomorph relationship. One unique character (posterior maxillary process) may be an autapomorphy of the Thaumaturidae.

MORPHOLOGICAL BASIS FOR HALLUCAL ORIENTATION IN FOSSIL BIRDS

MIDDLETON, Kevin M., Department of Ecology and Evolutionary Biology, Brown University, Box G-W, Providence RI 02912.

One of the salient features of most extant birds is a reversed (opposable) first digit, which is critical for perching and grasping. Studies of the diversity of extant bird feet reveal two morphological correlates of hallucal (digit I) reversion. 1. The shaft of metatarsal I exhibits a distinctive torsion, which reorients the distal condyles. 2. The fossa for metatarsal I lies more posteriorly on the tarsometatarsus, which reorients the digit as a whole. These two characteristics are easily identified among extant birds and should also be observable in fossil theropods. Thus, quantification of metatarsal I torsion and fossa position allows the hallucal orientation in fossil birds to be determined.

Since the discovery of the first specimen of *Archaeopteryx* almost 150 years ago, the life orientation of the hallux in Mesozoic birds has remained of significant interest. The presumed presence of a reversed hallux in *Archaeopteryx* has been used to infer a "trees-down" origin of flight. Traditionally, the preserved position of the hallux has been used as the lone measure of hallucal orientation in fossil birds. The preserved position of a fossil avian hallux is subject to potentially unknown biases in the taphonomy of three-dimensional structures. For example, it is possible that a digit which is partially reversed or unreversed could be preserved in an orientation identical to a fully reversed digit. An alternative method for determining hallucal orientation is necessary. The methodology presented here, based on the metatarsal morphology alone, avoids misinterpretations based on preserved position alone.

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POPULATION STRUCTURE AND IMPLICATIONS FOR SOCIAL BEHAVIOR IN MIOCENE FLORIDA RHINOCEROSSES

MIHLBACHLER, Matthew C., Dept. Zoology, Univ. Florida, Gainesville FL, 32611

The Florida Miocene fossil localities, Love Bone Bed (late Clarendonian) and Mixon's Bone Bed (early Hemphillian), contain large attritional samples of paleopopulations of two rhino genera, *Teleoceras* and *Aphelops*. Each *Teleoceras* population contains over 50 individuals. Measures of crown heights and wear stages of the deciduous and adult cheek teeth reveal discrete age categories indicating seasonality in births, and that deaths tend to be seasonal or that *Teleoceras* was migratory, only inhabiting these two localities during a certain portion of the year. Juveniles are well represented and the sample contains unerupted deciduous premolars with incompletely formed enamel crowns suggesting that birthing took place at these localities. There is a sharp increase in mortality during the sixth wear stage, or 6th year, that corresponds to the eruption of the lower tusks. Based on the sexually dimorphic tusks, males outnumber females 3/1 at Love and 4/1 at Mixon's. Nearly two thirds of the males are young adults or adolescents. Sexual maturity, thus, occurs at six years of age and intense inter-male competition and territoriality is probably the cause of the increased mortality. Because both Love and Mixon's were shallow water environments, the population structure of *Teleoceras* indicates that shallow bodies of water were the centers of social behavior for this genus, not unlike the living Indian rhino, *Rhinoceros unicornis*. The *Aphelops* samples are smaller but discrete wear categories seem to be absent. Sex ratios are nearly 1/1. Juveniles and young adults are rare while old adults are common, suggesting that *Aphelops* was less gregarious with reduced inter-male competition. Shallow water environments do not seem to be important centers of social behavior in this genus.

EARLY SOUTH AMERICAN IMMIGRANTS IN CENTRAL MEXICO, AND TIMES OF THEIR APPEARANCES

MILLER, Wade E., Dept. Geology, Brigham Young University, Provo, Utah, 84602;

CARRANZA CASTAÑEDA, Oscar, Instituto de Geología, Campus Juriquilla, C.P. 76230, Querétaro, Qro., Universidad Nacional Autónoma de México

The biotic interchange that occurred between North and South America via the Isthmus of Panama beginning in the late Tertiary has received considerable scientific attention since it was first recognized. While plants and invertebrates have been involved in this interchange, most scientific reports center on vertebrates, and more specifically on mammals. Of these

South American immigrants, edentate, are the first to appear. The earliest South American rodent immigrant, occurring a little later in the fossil record, is the capybara.

Our research shows that deposits in central Mexico contain the earliest records of several South American immigrants that came into North America through the Isthmus of Panama. These have been located in the states of Hidalgo, Guanajuato and Jalisco, and include the taxa *Megalonyx*, *Paramylodon* (= *Glossotherium*), *Pampatherium* and *Neohoerius*. Although no radiometric date is yet available for the earliest record of *Megalonyx*, associated taxa indicate a late early Hemphillian age. An ⁴⁰Ar/³⁹Ar age for *Paramylodon* of 4.7 ± 0.07 Ma has been determined, as well as a 3.9 ± 0.3 Ma for both *Glyptotherium* and *Pampatherium* based on fission-track dating. Sanidine grains were used for the single crystal ⁴⁰Ar/³⁹Ar age and zircon grains for the fission-track ages. The earliest rodent immigrant is a primitive species of *Neohoerius*. A fission-track age corresponding to the bed yielding this taxon is 3.9 ± 0.3 Ma.

Earlier reports on the timing of the late Cenozoic faunal interchange between North America and South America generally give this event as commencing about 3.0 Ma. Our findings establish initial immigrations at 4.7 Ma. It should be noted that the late Tertiary taxa thus far discovered are all large forms. Planned extensive screen washing of fossiliferous sediments of this age in central Mexico should reveal smaller immigrants taxa.

NEW BASAL ANOMODONT THERAPSID FROM THE UPPER PERMIAN OF SOUTH AFRICA: PHYLOGENETIC IMPLICATIONS

MODESTO, S.P., and RUBIDGE, B.S., Bernard Price Institute for Palaeontology, University of the Witwatersrand, Johannesburg, WITS 2050, South Africa.

Systematic prospecting of the lowermost sediments of the Permo-Triassic Beaufort Group, South Africa has resulted in the collection of several specimens of new anomodont therapsids. The first was described earlier this year as *Anomocephalus africanus* and heralded as the most basal anomodont. Dicyonodonts comprise the remaining materials. Two well preserved skulls represent forms that are intermediate in cranial morphology between the basalmost dicyonodont *Eodicynodon* on one hand and all other dicyonodonts on the other. A fourth skull is that of a diictodont distinguishable from *Diictodon* and *Robertia* by the presence of maxillary post-canine tooth rows. These specimens are from localities in the Northern and Western Cape provinces that are probably positioned in lower-to-middle horizons of the *Tapinocephalus* Assemblage Zone. Two partial skulls are from a locality in the Eastern Cape that is currently of uncertain biozone affiliation; they represent a medium-sized species that may be allied with the endothiodonts *Endothiodon* and *Chelydantops*.

Minimum divergence times indicate that basal anomodonts were more diverse in southern Africa during the Kazanian than implied by group diversity (3 spp. have been described from the *Eodicynodon* Assemblage Zone). This observation is consonant with the hypothesis that anomodonts diversified initially in Gondwanan Pangaea rather than Euramerica, as thought previously for this and other major therapsid groups.

WEAR SURFACES AND BREAKAGE PATTERNS OF TYRANNOSAURID (THEROPODA: COELUROSAURIA) TEETH

MONGELLI, Anthony, Jr., VARRICCHIO, David J., Dept. of Vertebrate Paleontology, Museum of the Rockies, Montana State University, 600 W. Kagy Blvd., Bozeman, MT 59715; BORKOWSKI, John J., Dept. of Mathematical Sciences, Montana State University, Bozeman, MT 59715.

Isolated tyrannosaurid teeth (n = 386) from the Campanian Two Medicine and Judith River Formations of Montana were examined for wear and breakage. Damage to premaxillary and lateral teeth were compared. The teeth studied fell into three subjective wear classes: class 1 (little or no wear), class 2 (slight to moderate wear), and class 3 (heavy wear). The latter class also contained teeth displaying smooth, nearly flat wear facets; such teeth broke while in the animal's mouth and post-break usage flattened and smoothed them. Observed tooth damage was also compared to observations of tooth wear and breakage reported for extant carnivores. Tyrannosaurid premaxillary teeth most frequently exhibited heavy wear (class 3), while slight to moderate wear (class 2) was the most common type among lateral teeth. Interestingly, 47% (n = 24) of the premaxillary teeth examined displayed smooth, nearly flat wear facets (indicative of post-break usage), while only 8.4% (n = 28) of the lateral teeth examined displayed this type of breakage. Several hypotheses may be advanced to explain the much greater frequency of this breakage type amid premaxillary teeth, including taphonomic processes, differential rates of tooth replacement, greater stresses and/or usage than lateral teeth, and less resistance to torsional forces than lateral teeth. Among these, the latter two are the best supported.

A NEW LATE CENOZOIC LOCAL MAMMALIAN FAUNA FROM THE MIXTECA ALTA, PUEBLA, MÉXICO.

MONTELLANO-BALLESTEROS, Marisol, Dept. Paleo., Intituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Deleg. Coyoacán, 04510 D.F. México

In the State of Puebla, two kilometers north of the well known fossiliferous Albian fish and reptile locality of Tlayua Quarry, a sequence of gravels and sands out crops along the Axamilpa River. A number of sites yielding small associations of mammalian remains are located. In one of the sites, a partial carapace of a glyptodont was recovered and referred to *Glyptotherium* cf. *G. mexicanum*; also remains of *Equus conversidens*, and undeterminate antilocaprid, and *Mammuthus* sp. were present. This faunal association suggests a Rancholabrean age, but *Bison* is absent.

Recently, in another site called 'Rancho Gerardo' lower jaws and postcranial elements of *Equus conversidens* were collected; also skeletal and tooth remains of two proboscideans

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