Poster Session I

A CT SCAN OF A TITANOSAURIFORM SKULL (DINOSAURIA:SAUROPODA) FROM CENTRAL PATAGONIA, ARGENTINA

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We preliminarily report the results of a computed tomographic study of a titanosauriform skull from the Bajo Barreal Formation (Cenomanian-Turonian, early Late Cretaceous) of southern Chubut Province (central Patagonia, Argentina). For the study, we made a series of helical computed tomographies with a Multiple Slice System (MXTwin Multislice). Of the 281 images, 22 are three-dimensional reconstructions, 21 are sagittal, and 238 coronal. The slice thickness was two mm. The CT images allow the recognition of the olfactory bulb (CN I), the optic (CN II), trigeminal (CN V), and hypoglossal nerves (CN XII), the three subequal semicircular canals, middle and posterior cerebral veins, metotic fissure, and pituitary fossa. The latter is comparable in size to that in the endocranial mold of *Camarasaurus grandis*, although more rostrally oriented in the Chubut form. The exit points of the cranial nerves IX and X are tentatively identified. In the premaxillae, maxillae, and mandibles, the replacement teeth, adductor fossae and Meckelian grooves are visible. The latter are open medially as in *Brachiosaurus* and other forms. Other structures are more difficult to identify and will be the object of future studies. It is expected that the analysis of these images, and their comparison with related forms such as *Brachiosaurus* and more derived titanosauriforms, will allow to establish, in addition to the total encephalic volume of this dinosaur, characters and encephalic topographical features common to this sauropod lineage.

Wednesday 10:45

NEW MULTIPLE LATE JURASSIC DINOSAUR ICHNOCOENOSES OF SWITZERLAND: EVIDENCE FOR ENDURING DINOSAUR COMMUNITIES ON THE NORTHERN TETHYS PLATFORM

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Since 2002 dinosaur tracks are systematically excavated in Late Jurassic (Kimmeridgian) carbonate platform sediments (Canton Jura, Switzerland). This platform formed part of the Northern Tethys passive margin in Late Jurassic times. To date, over 55 essentially narrow-gauge trackways of sauropods, and over 90 trackways of bipedal, tridactyl dinosaurs chiefly attributed to theropods, have been excavated and documented on multiple (>15) track-bearing surfaces. This provides insight into track formation and taphonomy, in particular the distinction of true tracks from under- and overtracks, a key point for consistent ichnotaxonomical and paleoecological interpretations. Multiple ichnocoenoses (associations of true tracks on a single surface) include (1) trackways of tiny (FL (footprint length)<25 cm) and large (FL>100 cm) sauropods with trackways of small (10<FL<25 cm) theropods; (2) trackways of tiny and medium-sized (25<FL<40 cm) sauropods with trackways of minute (FL<10 cm), small and medium-sized (25<FL<30 cm) theropods; (3) trackways of tiny and medium-sized sauropods with trackways of medium-sized and large (FL up to 50 cm) theropods. These ichnocoenoses exhibit diverse trackway orientation patterns and trackways with changes in gauge and gait of both sauropods and theropods. Even if these ichnocoenoses only partially reflect the former terrestrial vertebrate ecosystem of the platform, they indicate a recurrent presence of diverse dinosaur communities, at least during periods with prolonged inter- to supratidal conditions. The repeated associations of trackways of similar patterns and track morphology of very small and medium or large sauropods give a hint for different age classes within a single species. Moreover, this suggests that—contrary to recent publications—stance and resulting trackway gauge of sauropods is not necessarily related to ontogeny. This might be corroborated by more ichnocoenoses obtained by ongoing excavations. Finally, the paleogeographic situation implies that the platform was frequently connected to continental landmasses. This probably prevented a development of insular, dwarfed faunas, as has been postulated for similar carbonate platform settings.

Vertebrate Development Symposium, Wednesday 10:45

EVALUATING CRANIAL DISPARITY, MORPHOLOGICAL INTEGRATION, AND MODULARITY OF THE ARCHOSAURIAN CRANIUM USING GEOMETRIC MORPHOMETRICS

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Shape analysis via Landmark-based Geometric Morphometrics is currently one of the best suited methodologies for the study of the organization and evolution of the phenotype, hence its usefulness in Paleobiology. While the multivariate statistical apparatus of geometric morphometrics is readily set, for instance, for the exploration of allometry, other conceptual proxies such as morphological integration and modularity are becoming prevalent among morphologists, mostly among those interested in the role of and mechanisms by which the developmental program might bias the direction of evolution. Evolutionary developmental biology research is making giant steps into unveiling the mechanisms underlying such phenomena, thus providing the experimental basis upon which to interpret morphological integration and modularity at a phenotypic level. We have explored the major patterns of endocranial shape variation and integration at a macroevolutionary scale across modern avian and some fossil Theropod dinosaurs by means of geometric morphometric procedures. Interlacing our morphological observations and the statistical accounts of the analyses with current developmental proceedings in experimental biology carried out in modern birds (i.e. chick and quail embryos), we render a hypothesis from which to propose the integrated and modular nature of the theropod skull, and possibly of representatives of the node Archosauria.

Preparators Symposium, Thursday 11:15

THE THRILL OF THE FRILL: WEAR AND TEAR DEMANDS RESTORATION OF A *DILOPHOSAURUS WETHERILLI* SKULL, UCMP 77270

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As the research interest in theropod dinosaurs has soared while museum budgets dwindle, the resulting wear-and-tear on fossil collections has been magnified by inexperienced researchers having fewer role models to follow in handling fossils as collection and preparation staff are also slashed.

Unique and key specimens, sometimes types, must bear the challenge of this intense interest and heavy traffic. Such a specimen is the double-crested *Dilophosaurus wetherilli*, UCMP 77270, used as a model for the “Spitter” in the movie Jurassic Park. The original preparation of UCMP 77270 was done before the presently available, more archival choices of glues, consolidants, and reconstructive mediums. These earlier materials did not offer the greater strength and flexibility tolerances of those now used by fossil preparators.

This charismatic theropod specimen has been stressed over time by a latex-lined jacket that abraded the transparently thin and topographically complex parts of the skull’s crest as the jacket cover was removed and replaced during study. Because access to this spectacular fossil is often sought, redesign of the clamshell jacket that will permanently house the specimen will be a crucial step in assuring the specimen’s future preservation.

The use of a custom-fitted sandbox has allowed placement of sculpted acrylic elements at key areas of structural stress. These supports have allowed further preparation of the ventral surface of the brain case, which was previously unknown, un-photographed and unstudied due to the specimen’s fragility; it could not have been turned upside down before.

To reduce unskilled handling in the future, as far as possible with visual clues, an archival graphic device that warns in the international signs and symbols code, “DO NOT TOUCH”, was developed and placed on key areas of weakness. Protection of other specimens in our collection with similar problems of fragility, combined with near universally comprehensible of warning labels, is also now addressed.

Poster Session II

NEW SPECIMEN OF *PROGNATHODON* (REPTILIA: MOSASAURIDAE) FROM THE BEARPAW FORMATION OF ALBERTA

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An exceptionally complete mosasaur was recovered from a mining operation on the Blood Nation Reservation near Lethbridge, Alberta. The *Prognathodon* specimen is from the lower Bearpaw Formation, approximately equivalent to the DeGrey Member of the Pierre Shale. It may be one of the best specimens of the genus from North America. The pectoral region and forelimbs were damaged by the mining operation, but the remainder of the skeleton was recovered. It includes a flattened skull that is missing parts of the posterior region, but has well preserved preorbital skull region, jaws, and teeth. The articulated vertebral column is nearly complete, missing only a few anterior vertebrae, and extending beyond the region of elongated neural arches, usually interpreted as a tail fluke. The hind limbs are fairly complete, as is the pelvis. The specimen is tentatively assigned to *P. rapax* on the basis of the shape of the quadrate, the dentary not projecting anterior to the first tooth, and the lack of a medial ridge on the frontal. If the tentative identification is correct, it expands the geographic range of *P. rapax* into the Western Interior Seaway. Moreover, this discovery provides new details about the morphology of this poorly known species.

Friday 9:30

THE CRETACEOUS OF ANGOLA

MATEUS, Octávio, Lourinhã, Portugal; MORAIS, Maria, Universidade Agostinho Neto, Luanda, Angola; SCHULP, Anne, Natuurhistorisch Museum Maastricht, Maastricht, Netherlands; JACOBS, Louis, POLCYN, Michael, Southern Methodist Univ., Dallas, TX

The coastal region of Angola has long been known to be richly fossiliferous, but until recently no continuous vertebrate paleontology and collecting has been undertaken there since the pioneering work of Miguel Telles Antunes in the early 1960’s. In May 2005, two of us (O.M. and L.L.J.) performed a short field reconnaissance in the Angolan provinces of Namibe and Bengo, from where rich Cretaceous faunas, including mosasaurs, fishes, turtles, plesiosaurs and other marine taxa have been known, bringing to light the first dinosaur from Angola, a Late Turonian non-titanosaurian sauropod.

The stratigraphic sequence extends from the Early Cretaceous (Barremian, 128 Ma) through the Neogene, making this the longest continuous fossiliferous section known in Africa. In addition to dinosaurs, this section records (1) the formation of the eastern margin of the South Atlantic Ocean; (2) a nearly continuous and biostratigraphically significant sequence of sharks and bony fishes that record changes in oceanic currents; (3) the opening of the Atlantic Ocean and the disruption of a land connection between South America and Africa; (4) the biogeographic invasion of the South Atlantic by marine amniotes, including turtles, plesiosaurs, and mosasaurs; (5) interbedded nearshore marine and igneous rocks; (6) a superbly exposed Cretaceous-Paleogene Boundary section; (7) Paleogene squamates and turtles; and (8) Neogene cetaceans and a rhinoceros.

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Besides the rich fish fauna, the known Cretaceous tetrapod fauna comprises turtles (including a recently collected undescribed genus of cryptodiran), mosasaur squamates *Globidens* sp., at least two *Prognathodon*-like taxa, *Angolasaurus bocagei*, *Plioplatecarpus* sp, and *Tylosaurus iembeensis*, plesiosaurs aff. Cimoliasauridae, and a non-titanosaur sauropod dinosaur.

Friday 9:30

COMPARISON OF NEOGENE RECORDS OF ENVIRONMENTAL CHANGE IN THE GREAT PLAINS, U.S.A., BASED ON PALEOSOL CARBONATES AND PALEODIETS OF EQUIDAE

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Neogene records of environmental change in the Great Plains, U.S.A., derived from paleosols and paleodietary studies of fossil Equidae exhibit surprising contrasts. The stable carbon isotope composition ($\delta^{13}C$) of paleosol carbonates suggests C4 grass comprised ca. 20% of plant biomass throughout the Miocene, increased to about 40% of biomass by the early Pliocene, and reached modern abundance by the early Pleistocene. Equids evolved high-crowned (hypsodont) teeth, an adaptation for open habitats and/or grazing by ca. 18 Ma, and $\delta^{13}C$ values of equid tooth enamel indicate C3-dominated diets during the Miocene until 6.6 Ma, at which point several species began to consume C4 vegetation while others maintained C3-dominated diets. To understand these contrasts better, we examined equid paleodiet in the context of a genus level phylogeny. Hypsodonty increased in parallel in several lineages and high $\delta^{13}C$ values characteristic of C_4 consumption arose independently within several derived genera nested within the tribes Equini and Hipparionini. Evolution of hypsodonty and consumption of C_4 biomass do not appear to have promoted taxonomic diversification. Average magnitudes of evolutionary changes across the phylogeny towards increased hypsodonty and $\delta^{13}C$ values were greater than those towards decrease, consistent with driven trends, but the patterns were not sufficiently distinct to reject null hypotheses of passive trends. A weak negative correlation between $\delta^{13}C$ values and stratigraphic range in equid genera suggests C4 consumers may have had higher extinction rates. A possible explanation for the low variability in Miocene paleosol $\delta^{13}C$ values is that habitats dominated by C4 grasses were patchily distributed across the landscape and migrated laterally on timescales rapid relative to carbonate formation; shorter-lived, C4-consuming genera may have been specialists that utilized C4-dominated patches and habitat change was sufficiently rapid to promote greater extinction. Parallel analyses of clades with similar diversity histories in the region, such as Camelidae, could help elucidate the basis of the contrasts between paleosols and equids.

Poster Session II

ISOTOPIC AND GEOCHEMICAL ANALYSES OF FOSSIL FISH REMAINS FROM THE UPPER DEVONIAN ESCUMINAC FORMATION (MIGUASHA, QUEBEC): IMPLICATIONS FOR PALEOENVIRONMENTAL INTERPRETATION

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Devonian Old Red Sandstone fish assemblages have been classically considered to be freshwater in origin. This includes the Escuminac assemblage, renown for the abundance and quality of preservation of fossil vertebrates as well as for the phylogenetic and evolutionary importance of its biota. However, the paleoenvironmental context of the Escuminac Formation is still a matter of debate, ranging from lacustrine to marine, with a recent consensus for a transitional, brackish estuarine paleoenvironment. Our goal is to address this paleoenvironmental debate through direct geochemical (Rare Earth elements) and isotopic (Rb-Sr, Sm-Nd) analyses of fossil material. Apatite-bearing anatomical structures (e.g., teeth, bony plates, scales) of different fish species (acanthodian *Homalacanthus concinnus,* actinopterygian *Cheirolepis canadensis,* placoderm *Bothriolepis canadensis*, dipnoan *Scaumenacia curta*, osteolepiform *Eusthenopteron foordi*) from the base to the top of the Escuminac Formation were analysed. The isotopic analyses were performed by Thermal Ionisation mass spectrometry (TIMS) and compared with Sr isotope data obtained *in-situ* by laser ablation multi-collection inductively coupled mass spectrometry (MC-ICP-MS). Preliminary TIMS $^{87}Sr/^{86}Sr$ isotope ratios vary from 0.70815 to 0.70830 with an average laser ablation analysis of 0.70854 for a single tooth. These ratios are consistent with Devonian seawater Sr isotope compositions and suggest that the fish species and the Escuminac Formation formed within a brackish to marine water environment.

Poster Session III

OLD SPECIMENS NEWLY DESCRIBED: CAMP'S PAREIASAUR SKULLS FROM THE KAROO BASIN OF SOUTH AFRICA AND THEIR IMPLICATIONS FOR BASAL PAREIASAUR TAXONOMY

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In the mid-1930s Charles Camp excavated numerous vertebrate fossils from the Permian sediments of the Karoo Basin in South Africa and sent them overseas to the Univ. of California at Berkeley, where they became part of the Univ. of California Museum of Paleontology (UCMP) collections. Among this material are many pareiasaur specimens, rare in North American collections, which have never been described. The pareiasaur material Camp collected includes a great deal of well-preserved post-cranial and cranial specimens. This study describes the osteology of three pareiasaur skulls for the first time since their collection 70 years ago. These specimens provide new insights into the morphology, phylogeny and taxonomy of basal pareiasaurs.The three UCMP pareiasaur skulls belong to the most basal pareiasaur genus *Bradysaurus*. The most basal taxon of this genus, *Bradysaurus seeleyi*, possesses no autapomorphies, therefore the genus *Bradysaurus* can be considered a metataxon. Two of the three UCMP pareiasaur skulls are assigned to the other existing taxon within the genus, *Bradysaurus baini*. *B. baini* possesses three autapomorphies that separate it from *B. seeleyi*: a large round lump on the maxilla immediately behind the external naris, a swollen distal portion of the paroccipital process and teeth of the upper jaw directed ventromedially.

The third UCMP pareiasaur skull may constitute a new taxon within the genus *Bradysaurus* due to three potential autapomorphies, though further comparative work is required to confirm or deny the existence of a new species. The three autapomorphies are: a large boss flanking the anterior portion of both nasals, supratemporal bosses that rise above the skull roof to form a saddle between them, and a posterodorsally facing shelf posterior to the ridge that is formed between the supratemporal bosses. This potentially new taxon also possesses all three autapomorphies of *B. baini*, which would make those characters synapomorphic for both taxa. This would establish these two taxa firmly as sister groups, which results in *B. baini* as yet another taxon within the genus *Bradysaurus* that possesses no autapomorphies and could therefore be considered a metataxon.

Poster Session III

THE ANATOMY OF THE EMU WING: AN EXAMPLE OF PRIMARY DIGITAL REDUCTION IN ARCHOSAURS

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The Emu (*Dromaius novaehollandiae*) is a palaeognathous bird native to Australia that has undergone extreme wing reduction, both in relative size and in the number of ossified elements. It usually ossifies only a single digit corresponding to the digitorum majoris in other birds, and has no free carpal elements. This digital reduction is thought to have taken place over a very short evolutionary time scale since it has occurred since the divergence of the Emu from the rest of the extant ratites. In order to examine the developmental changes accompanying such an extreme adult morphology, we studied the mesenchymal skeletogenic condensations of a series of early stage Emu embryos. We also cleared and stained sets of later stage embryos for the presence of bone and cartilage. Our results indicate that the Emu is the only known example of primary digit reduction in birds. In other words, unlike the state in Ostrich (*Struthio*) in which five digits chondrify, or the chicken in which five digits condense and four chondrify, only three to four digits condense and three chondrify in the Emu. Furthermore, while the number of elements ossifying in flying birds as well as in the Ostrich is constant, the Emu ossifies either one or two digits. There is a wide range of variation in terms of shape, number and position of the elements that remain cartilaginous in late stage embryos. This variability is also seen at the level of wing musculature in adult Emus. This variation in digit number and shape is similar to that observed in the Kiwi, a New Zealand palaeognath that has independently converged on a reduced wing morphology. Emus differ from other birds in that they ossify the distal phalanx of their single digit first. This is most similar to the pattern seen in the pes of other birds (including the Emu); the manus normally ossifies in a proximal-distal direction. Digital reduction has taken place multiple times in birds, and in the theropod lineage more generally. This research sheds light on some morphological and developmental changes that result in a single-digit phenotype in an adult tetrapod.

Poster Session III

ADULT SKELETAL REMAINS OF *IANTHASAURUS*, THE OLDEST KNOWN EDAPHOSAUR (SYNAPSIDA:EUPELYCOSAURIA) FROM THE UPPER PENNSYLVANIAN OF KANSAS

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Infills of an abandoned channel near Garnett, Kansas preserve the most abundant and diverse assemblage of amniotes known from the Carboniferous. Most of the vertebrate remains recovered from the locality are those of terrestrial tetrapods. The most commonly found skeletal remains belong to the diapsid reptile *Petrolacosaurus* and the sphenacodontian *Haptodus garnettensis*. However, other synapsids, represented either by single specimen or relatively few individuals include an undescribed ophiacodontid, an undescribed sphenacodontid, the rare and enigmatic *Xyrospondylus*, and the sphenacodontian *Ianthodon*. The sixth synapsid is the edaphosaur *Ianthasaurus hardestiorum*, known from two fragmetary skeletons and a few isolated vertebrae, all belonging to juvenile individuals.

Recently uncovered parts of a skeleton of *Ianthasaurus* represent an adult individual. Its adult condition is indicated by its large size, 30% larger than all previously known specimens, and the fusion of the neuro-central suture. *Ianthasaurus* is the oldest known member of Edaphosauridae, and significantly smaller than any of the better known members of this clade. The new specimen provides important new, phylogenetically informative cranial and vertebral features. The maxilla is long, with place for at least 32 teeth; both the marginal and palatal teeth are slightly bulbous near their apex, resembling those in the oldest known herbivorous amniote *Edaphosaurus*. The anterior part of the pterygoid is shorter than in the carnivorous sphenacodontids, and similar in relative length to that in *Edaphosaurus*. The tall neural spines have up to eight pairs of lateral tubercles, nearly twice as many as on vertebrae in the comparable region of the column of the juveniles. These adult skeletal features indicate that *Ianthasaurus* may be more closely related to the large *Edaphosaurus* than pre-