

to admit what they don't know. This makes guidance of research easier than with some graduate students ("like having graduate students without the whining"). The use of volunteers has resulted in an extraordinary high level of productivity for the department than if only by staff.

Poster Session I

#### IS *GUANLONG* A TYRANNOSAURID OR A SUBADULT *MONOLOPHOSAURUS*?

CARR, Thomas, Carthage College, Kenosha, WI

*Guanlong wucaii* is a purported Late Jurassic basal tyrannosauroid from the Shishugou Formation of northwestern China. *Guanlong* bears a tall and fenestrated nasal crest that extends along the top of the snout, as in *Monolophosaurus jiangi*, a carnosaur that is about twice the size as *Guanlong*, from a lower level in the same unit. The original cladistic analysis of *Guanlong* used a data matrix relevant to resolving the relationships among basal theropods, which reconstructed it as a basal tyrannosauroid. However, the similarities shared between *Guanlong* and *Monolophosaurus* in the crest prompted a test of the original hypothesis using a data matrix based on characters relevant for resolving ingroup relationships of Tyrannosauroidae.

The data matrix includes 201 characters and 34 theropod species. The matrix was analyzed in PAUP\* 4.0b under a heuristic search; *Guanlong* was reconstructed as a carnosaur, and as the sister species of *Monolophosaurus*. This relationship is supported by the shape of the rostral ramus of the maxilla; a sagittal, elongate, pneumatic, and fenestrated crest along the top of the snout; and a foramen in the pubic process of the ischium. *Monolophosaurus* is distinguished from *Guanlong* by a longer crest that includes the premaxilla and lacrimal, a rostrally-positioned maxillary fenestra, a deep maxilla, a long jugal process of the quadratojugal, and a subocular process on the postorbital. *Guanlong* is distinguished from *Monolophosaurus* by a wide snout tip, short squamosal process of the postorbital, a concave orbital margin of the postorbital, a cornual process on the jugal, the antorbital fossa is deeply excavated into the jugal, absence of a caudal surangular foramen, fewer dentary teeth, apneumatic cervical centra, presence of a rostradorsal notch in the ilium, and the presence of a pubic tubercle. These results suggest two alternative hypotheses for *Guanlong*: it is either the sister taxon, or it is a subadult, of *Monolophosaurus*.

Friday 8:15

#### A NEW PERSPECTIVE ON NON-AVIAN DINOSAUR DIVERSITY

CARRANO, Matthew, Smithsonian Institution, Washington, DC

The taxonomic diversity of non-avian dinosaurs through the Mesozoic Era is very poorly understood. Although counts of known taxa are available (and form the basis for our only existing estimates), the relationship between these samples and true diversity is complex and largely unexplored. More surprisingly, current estimates are entirely empirical; no explicit hypotheses of dinosaur diversity have been offered or tested.

Here, I propose the first hypothetical taxonomic diversity curve for non-avian Dinosauria. This curve was generated *a priori*, based on inferences from large-vertebrate ecology, land area constraints, and biome distributions. It describes an initial steep increase in diversity from the Late Triassic through the end of the Early Jurassic, coincident with the originations and early radiations of all major dinosaur groups. A shallower increase follows through the close of the Jurassic, at which time continental fragmentation spurs a second, steep (exponential?) diversity rise via geographic isolation and increased biome variability. The end-Cretaceous event is considered to have been geologically instantaneous.

Total dinosaur diversity was integrated as the area under this curve. Two "metabolic models" of taxonomic longevity were used: crocodylian and mammalian. These models generate considerably different totals, indicating that physiological considerations should not be ignored when estimating diversity on macroevolutionary scales.

Next I selected five temporal "point samples" from which global dinosaur diversity could be extrapolated. These provided taxonomically rich samples that were rarefied to project the likely total standing diversity at each interval. The shape and scale of a "best fit" curve to these samples was then compared to the hypothesized curve. This provided a first-order test of the model, and a potential source for development of a second model curve. Taphonomic, human-induced, and other sampling biases remain important limiting factors, but these new models provide a new approach for understanding the dynamics of diversification in an important vertebrate radiation.

Marine Reptiles Symposium, Wednesday 1:30

#### MARINE ADAPTATION IN REPTILES: A MODEL FOR THE STUDY OF LARGE SCALE PATTERNS AND PROCESSES OF EVOLUTION

CARROLL, Robert, McGill Univ., Montreal, QB, Canada

Adaptation of reptiles to locomotion, feeding, and reproduction in an aquatic environment resulted in changes throughout the skeleton equivalent in scope to the modifications that occurred in the transitions between fish and amphibians and the origin of birds from dinosaurs. The transitions from terrestrial to aquatic ways of life among reptiles differ, however, in that they occurred many times, independently, from among many distinct lineages: e.g. from initially terrestrial turtles, crocodiles, squamates, sphenodontids, basal lepidosauromorphs, basal archosauriformes, and basal diapsids. Their diversity of ancestry makes this a natural experiment from which one can analyse various patterns and modes of evolutionary changes. The scientific achievements of Betsy Nicholls provide a very informative model for how such research can proceed—via thorough analyses of the func-

tional anatomy, biogeography, and environmental distribution of a wide range of aquatic reptiles, especially those near the base of their initial radiation. Her work has demonstrated the major differences between these groups at their first appearance in the fossil record, and emphasizes the necessity for new approaches to establishing more specific sister-group relationships for the diverse aquatic taxa. The necessity for establishing specific relationships for each clade separately is also shown by the extreme disparity in the results of recent phylogenetic analyses: e.g. turtles are nested within lepidosauromorphs as a sister-taxon of sauropterygians; sauropterygians at the base of archosauromorphs together with ichthyosaurs and thalattosaurs; thalattosaurs nested with lepidosauromorphs or archosauromorphs. Betsy's analyses of broad aspects of adaptation have provided data necessary to determine plausible sequences of ancestor-descendant relationships. Her approach demonstrates how future studies can lead to determining the actual antecedents of the numerous derived lineages and establish the sequences of change that occurred in the early stages of the many transitions between water and land.

Poster Session II

#### A CURSORIAL BIRD FROM THE MAASTRICHTIAN OF ANTARCTICA

CASE, Judd, Saint Mary's College of California, Moraga, CA; REGUERO, Marcelo, Museo de La Plata, La Plata, Argentina; MARTIN, James, South Dakota School of Mines and Technology, Rapid City, SD; CORDES-PERSON, Amanda, Sam Noble Oklahoma Museum of Natural History, Norman, OK

A left femur from the early Maastrichtian, Cape Lamb Member of the Lopez de Bertodano Fm. on Vega Island, Antarctic Peninsula, shows striking similarities to modern cursorial predatory birds of South America (Seriemias, Cariamidae) and of Africa (Secretarybirds, Sagittariidae). The size of the Antarctic femur is nearly identical to those of both modern bird families and thus the Antarctic specimen would be about the same size, at around a meter in height. The crucial features in demonstrating the habit of this Maastrichtian bird are: the enlarged and posteriorly prominent tibiofibular crista; the laterally expansive lateral epicondyle; and the highly planar and vertically oriented fibular trochlea. These apomorphic features are present in the modern yet unrelated cursorial birds and are equally developed in the Antarctic specimen. Considering the proximal femoral features, the biogeographical location and the presence of phororhacoids in the Eocene of Antarctica, then this specimen may represent a taxon which may be ancestral to both cariamids and phororhacoids or it is the basal cariamid which is then ancestral to the phororhacoids, rather than being their descendant.

Poster Session III

#### ON THE LEFT-RIGHT ASYMMETRY IN DINOSAURS

CASTANHINHA, Rui, Loures, Portugal; MATEUS, Octávio, Museu da Lourinhã & Universidade Nova de Lisboa, Lourinhã, Portugal

The study of different kinds of morphological left-right (L-R) asymmetries in all taxa is a very powerful tool to understand evolution since it is a way to measure the developmental stability of an organism against environmental perturbations. Excluding every pathologic or subtle asymmetry and all cases of taphonomic distortion, this work focuses only on two kinds of unambiguous asymmetries: fluctuating and adaptive asymmetry. There are several cases of conspicuous left-right asymmetry in dinosaurs and is probably more common than previously thought. The pneumatic cavities systems in skull and vertebrae of theropods and sauropods are the most common cases reported. The shape (but not the occurrence) of pneumatic cavities might have been exposed to weak selective pressure becoming more random than other body structures. Asymmetries are rarer in the appendicular bones possibly because it represents a strong handicap in the function of the limbs, consequently in the locomotion of the individual. Teeth counting show many exceptions to the typical L-R symmetry. Peculiar cases of adaptive asymmetry are related with the plates of stegosaurs and the ear displacement in the skull of the troodontids, which may have an important role in the physiology and ecology of the animals. The asymmetric displacement maximizes the surface exposure of the stegosaurs dorsal plates. This is an advantage, either the plates were used for thermoregulation, display or specific identification. Work in progress on the braincases of some troodontids specimens shows asymmetric ear openings, which suggests that can be an analogy resulting from convergent evolution between troodontids and strigiformes birds, used for 3D directional acoustics. Asymmetries are more common in animals that develop under stress. Animals that lived under dramatic environmental changes periods—like mass-extinctions episodes are believed to be—should present more asymmetries. However, much more sampling and time accuracy is required in order to be able to relate dinosaur asymmetries to extinction episodes. Asymmetries show strong intra-individual variation and should be taken in consideration in taxonomical studies.

Poster Session II

#### ON THE PRESENCE OF THE DIRE WOLF *CANIS DIRUS* FROM THE VALSEQUILLO BASIN, PLEISTOCENE OF PUEBLA, CENTRAL MEXICO

CASTILLO, Jesus, Univ. Autón. Edo. Hidalgo, Pachuca, Hidalgo, Mexico; BRAVO, Victor, CABRAL, Miguel, Museo de Paleontología, Pachuca, Hidalgo, Mexico

Since the latest 19th century, several authors have reported on the Pleistocene megafauna from Valsequillo as a very important fossiliferous region. The fossil material has been recovered from fluviolacustrine deposits with a faunal assemblage that indicates Ranchoabrean and possibly Irvingtonian ages.

Recent paleontological work carried out on new localities from the Basin, allowed