SAVE THE DATE!

SVP 72nd Annual Meeting
October 17 – 20, 2012
Raleigh Convention Center
Raleigh, NC USA
Members and Friends of the Society of Vertebrate Paleontology,

The Host Committee cordially welcomes you to the 71st Annual Meeting of the Society of Vertebrate Paleontology in Las Vegas. We have planned an exciting scientific program, as well as an engaging selection of pre-meeting and post-meeting field trips and a diverse menu of trips for accompanying guests. If your impression of Las Vegas is simply glitz and gambling, you’re in for a surprise. Beyond the Las Vegas Strip (which itself is packed with wonderful, non-gambling distractions), consider taking a hike in nearby Red Rock Canyon National Conservation Area (which has a new visitor center), visiting the spectacular new Nevada State Museum at the Springs Preserve, checking out the Las Vegas Natural History Museum, or investigating the amazing, new, Frank Gehry-designed Lou Ruvo Center for Brain Health.

Early November is a perfect time to visit Las Vegas. We look forward to a scientifically exciting and culturally memorable SVP meeting.

2011 SVP Host Committee

Presentation Policies

SVP Abstracts are reviewed by the Program Committee and occasionally by outside reviewers. Authors are responsible for the technical content of their articles.

Unless specified otherwise, coverage of abstracts presented orally at the Annual Meeting is strictly prohibited until the start time of the presentation, and coverage of poster presentations is prohibited until the relevant poster session opens for viewing. As defined here, “coverage” includes all types of electronic and print media; this includes blogging, tweeting and other intent to communicate or disseminate results or discussion presented at the SVP Annual Meeting. Content that may be pre-published online in advance of print publication is also subject to the SVP embargo policy.

Still photography, video and/or audio taping or any other electronic recording at the SVP annual meeting is strictly prohibited, with the exception of the designated SVP press event. (The SVP reserves the right to engage professional photographers or audio/videotape professionals to archive sections of the meeting for the Society’s use.)

Editorial policies of Science and Nature magazines: If you are planning to submit, or have submitted, your publication to Science or Nature, be sure you are familiar with their embargo policies.

Please address any questions about program practices to the Program Committee or to the Executive Committee.
## 2011 SVP SCHEDULE OF EVENTS (subject to change)

All events are held at the Paris Las Vegas Hotel unless otherwise noted with an **

<table>
<thead>
<tr>
<th>Event/Function</th>
<th>Tuesday, November 1</th>
<th>Wednesday, November 2</th>
<th>Thursday, November 3</th>
<th>Friday, November 4</th>
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<tr>
<td>Registration Desk</td>
<td>1 pm – 6 pm</td>
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<td>Symposium 1 - To Fins, Limbs, Wings and Back Again</td>
<td>CONCORDE A/B</td>
<td>Symposium 3 – The Evolution and Ecology of Terrestrial Ecosystems of Campanian Laramidia (Western North America)</td>
<td>VENDOME A</td>
<td>Symposium 4 – Vertebrate Diversity Patterns and Sampling Bias</td>
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<tr>
<td>Technical Session</td>
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<td>Technical Session VII</td>
<td>Technical Session XII</td>
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<td>Technical Session IV</td>
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<td>Workshops/Educational Events</td>
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<td>Phylogenetic Comparative Methods Workshop</td>
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<td>Versailles Ballroom 1</td>
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<td>Travel and Expedition Medicine Workshop</td>
<td>For Pre-Registered Attendees</td>
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<td>Protection of Vertebrate Fossil Resources, Including the Paleo Park Initiative Workshop</td>
<td>For Pre-Registered Attendees</td>
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<td>Effective Poster Design Workshop</td>
<td>For Pre-Registered Attendees</td>
<td>Versailles Ballroom 4</td>
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<td>Women in Paleontology Event How to Land a Faculty Position: An Interactive Workshop Featuring Recent Hires</td>
<td>Champagne Ballroom I</td>
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<td>Town Hall Meeting on Evolution IX</td>
<td>For Pre-Registered Attendees</td>
<td>Concorde A/B</td>
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</table>
# 2011 SVP Schedule of Events

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<table>
<thead>
<tr>
<th>Event/Function</th>
<th>Tuesday, November 1</th>
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<tbody>
<tr>
<td><strong>Special Event</strong></td>
<td>7:30 pm</td>
<td>12:30 pm – 1:30 pm</td>
<td><strong>Poster Session II</strong>: 9:30 am – 4:15 pm</td>
<td><strong>Poster Session III</strong>: 9:30 am – 4:15 pm</td>
<td><strong>Poster Session IV</strong>: 9:30 am – 4:15 pm</td>
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<td><strong>A Special Presentation by Dr. “Jack” Horner: Dinosaurs and the Proofs of Evolution</strong></td>
<td><strong>Special Address: Brett Riddle: The History of Biotic Diversification in North American Deserts</strong></td>
<td><strong>Reception</strong>: 4:15 pm – 6:15 pm</td>
<td><strong>Reception</strong>: 4:15 pm – 6:15 pm</td>
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<td><strong>Poster Sessions</strong></td>
<td><strong>Setup</strong>: 7:30 am – 9:30 am</td>
<td><strong>Poster Session I</strong>: 9:30 am – 4:15 pm</td>
<td><strong>Poster Session II</strong>: 9:30 am – 4:15 pm</td>
<td><strong>Poster Session III</strong>: 9:30 am – 4:15 pm</td>
<td><strong>Poster Session IV</strong>: 9:30 am – 4:15 pm</td>
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<td><strong>Reception</strong>: 4:15 pm – 6:15 pm</td>
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<td><strong>Exhibit Viewing</strong></td>
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<tr>
<td><strong>Annual Business Meeting/ Open Executive Committee Meeting</strong></td>
<td><strong>12:30 pm – 1:30 pm</strong></td>
<td><strong>Annual Business Meeting</strong></td>
<td><strong>Open Executive Committee Meeting</strong></td>
<td><strong>12:30 pm – 1:30 pm</strong></td>
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<td><strong>Press Event</strong></td>
<td><strong>4:15 pm – 5:45 pm</strong></td>
<td><strong>CHARMAGNE BALLROOM 1</strong></td>
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<tr>
<td><strong>Social Events</strong></td>
<td><strong>7 am – 10 pm</strong></td>
<td><strong>Welcome Reception</strong></td>
<td><strong>8 pm – 10 pm</strong></td>
<td><strong>Meeting</strong></td>
<td><strong>7 pm – 8:30 pm</strong></td>
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<td><strong>PARIS LAS VEGAS POOLSIDE THIRD FLOOR</strong></td>
<td><strong>Student Roundtable Forum &amp; Reprint Exchange</strong></td>
<td><strong>CHAMAGNE BALLROOM 2</strong></td>
<td><strong>Awards Ceremony (All Invited to Attend)</strong></td>
<td><strong>Awards Banquet Dinner (Tickets Event)</strong></td>
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<td><strong>Beverage Service</strong></td>
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<td><strong>Speaker Ready Room</strong></td>
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# PROGRAM AT A GLANCE

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<th>Concorde A/B</th>
<th>Vendome A</th>
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<th>Concorde A/B</th>
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<tr>
<td>SYMPOSIUM 1</td>
<td>Tech I</td>
<td>SYMPOSIUM 2 Climate Change and Vertebrate Response in the Evolving Arid West of Plio-Pleistocene North America</td>
<td>Romer Prize Session/ Tech V</td>
<td>SYMPOSIUM 3 The Evolution and Ecology of Terrestrial Ecosystems of Campanian Laramidia (Western North America)</td>
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<td>8:00 am</td>
<td>Wilson</td>
<td>Wings</td>
<td>Bell</td>
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<td>Shubin</td>
<td>Porter</td>
<td>McCord</td>
<td>Knell</td>
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<td>Werning</td>
<td>Steadman</td>
<td>Orcutt</td>
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<td>Johanson</td>
<td>Barrett</td>
<td>Mead</td>
<td>van Heteren</td>
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<td>Pierce</td>
<td>Mounce</td>
<td>McDonald</td>
<td>Varriale</td>
<td>Brinkman</td>
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<td>Gatesy</td>
<td>Salzberg</td>
<td>McGuire</td>
<td>Woodward</td>
<td>Eaton</td>
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<td>Fröbisch</td>
<td>Varricchio</td>
<td>Meyers</td>
<td>Hulbert, Jr.</td>
<td>Konishi</td>
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<td>Venditti</td>
<td>Jass</td>
<td>Wang</td>
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<td>Fowler</td>
<td>Mallison</td>
<td>Springer</td>
<td>Johnson</td>
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<td>VanBuren</td>
<td>Sagebiel</td>
<td>Fisher</td>
<td>Drumheller</td>
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<td>Harris</td>
<td>Mothé</td>
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<td>Ridgwell</td>
<td>Arroyo-Cabrales</td>
<td>MacPhee</td>
<td>Farke</td>
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<td>Sánchez</td>
<td>Nabavizadeh</td>
<td>Blois</td>
<td>Graham</td>
<td>Brown</td>
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<td>1:45 pm</td>
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<td>Samuels</td>
<td>Anderson</td>
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<td>Björnsson</td>
<td>Sallam</td>
<td>Barden</td>
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<td>Meachen-Samuels</td>
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<td>Sakamoto</td>
<td>Higgins</td>
<td>Li</td>
<td>Caledo</td>
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<td>Yi</td>
<td>Goswami</td>
<td>Hopkins</td>
<td>Dyke</td>
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<td>Wu</td>
<td>Borths</td>
<td>Mørs</td>
<td>Huynh</td>
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<td>3:15 pm</td>
<td>Botha-Brink</td>
<td>Smits</td>
<td>Rinaldi</td>
<td>Heers</td>
<td>Missiaen</td>
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<td>Perez</td>
<td>English</td>
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<td>Nesbitt</td>
<td>Churchill</td>
<td>Bertrand</td>
<td>Andres</td>
<td>Beard</td>
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<td>4:00 pm</td>
<td>Bhullar</td>
<td>Bloch</td>
<td>Gaudin</td>
<td>Rodrigues</td>
<td>Kohn</td>
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| 4:15 pm   | Poster Session I/Reception RIVOLI B | Poster Session II/Reception RIVOLI B |
| 6:00 pm   |           |           |
## PROGRAM AT A GLANCE

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<thead>
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<th>SYMPOSIUM 4 Vertebrate Diversity Patterns and Sampling Bias</th>
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Novel Approaches to Informal Educational Outreach
Location: Paris Las Vegas/Registration Area Rivoli A
Dates: Wednesday, November 2 through Saturday, November 5

AUTHORS WILL BE PRESENT AT THEIR POSTERS: Wednesday, November 2, 4:15-5:15 p.m.

1 MacFadden, B., Pimiento, C. INNOVATION IN GRADUATE EDUCATION: THE NON-TRADITIONAL MASTERS AND E-PH.D. DEGREES IN STEM DISCIPLINES SUCH AS VERTEBRATE PALEONTOLOGY

2 Oviedo, L., Seymour, G., McFadden, B. FOSSIL HORSES, ORTHOGENESIS, AND PUBLIC UNDERSTANDING OF EVOLUTION


4 Drewniak, P., Semperebon, G. A LIVING LABORATORY APPROACH TO TEACHING STUDENTS ABOUT THE SCIENTIFIC METHOD AND EVOLUTION: CRAFTING A CURRICULUM THAT ALLOWS STUDENTS TO GENERATE THEIR OWN EVIDENCE AND FORMULATE THEIR OWN CONCLUSIONS ABOUT EVOLUTIONARY PROCESSES

5 ElShafie, S., Thompson, K. A PARADIGM SHIFT IN SCIENCE OUTREACH: NEW STUDENT-DEVELOPED PROGRAM FACILITATES AND REINFORCES ACTIVE LEARNING IN PALEONTOLOGY THROUGH PERSONALIZED MENTORING AND DEVELOPMENT OF LEARNING TOOLS

6 Dewar, E., Maceli, A., Pietrantonio, H. VERTEBRATE PALEONTOLOGY AS THE CORNERSTONE OF A FIRST-YEAR COLLEGE SEMINAR

7 Gant, C., Skiljan, R., Tsai, H., Folk, W., Holliday, C. ALLIGATORS NEAR AND FAR: USING THE MAPS IN MEDICINE: INSIDE ALLIGATORS HIGH SCHOOL WORKSHOP AND 3D ALLIGATOR WEBSITE AS EDUCATIONAL TOOLS IN ANATOMY AND EVOLUTION

8 Moots, H., Bucklin, S., Caughron, S. DEVELOPING ADULT EDUCATIONAL PROGRAMS: BEER & BONES, A COCKTAIL PARTY APPROACH TO PUBLIC OUTREACH

9 Weiler, M., Schumaker, K. DEVELOPMENT AND BENEFITS OF STUDENT ORGANIZATION LED OUTREACH PROGRAMS: TWO CASE STUDIES FROM THE UNIVERSITY OF NORTH DAKOTA AND SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

10 Schenck, R. QUALITATIVE CLASSROOM DATA ON THE DEVELOPMENT OF STUDENTS' UNDERSTANDING OF COMPLEX SYSTEMS IN VERTEBRATE PALEONTOLOGY AT A 2-YEAR COMMUNITY COLLEGE

11 Tembe, G., Siddiqui, S. APPLICATIONS OF COMPUTED TOMOGRAPHY TO MUSEUM CONSERVATION AND EXHIBITS
WEDNESDAY MORNING, NOVEMBER 2, 2011
SYMPOSIUM I: TO FINS, LIMBS, WINGS AND BACK AGAIN
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: Nadia Fröbisch, Hans C. E. Larsson

8:00  Wilson, M.  COMPARATIVE MORPHOLOGY AND SUGGESTED HOMOLOGIES OF PAIRED FINS IN JAWLESS AND EARLY JAWED VERTEBRATES

8:15  Shubin, N., Schneider, I.  FOSSILS, GENES AND THE SEARCH FOR ANTECEDENTS OF THE TETRAPOD LIMB

8:30  Schneider, I., Aneas, I., Nobrega, M., Shubin, N.  AUTOPODIAL EXPRESSION IN MOUSE LIMBS DRIVEN BY A HOXD ENHANCER OF FINNED VERTEBRATES

8:45  Johanson, Z.  EVOLUTION OF PAIRED FINS AND THE LATERAL SOMITIC FRONTIER

9:00  Pierce, S., Clack, J., Hutchinson, J.  COMPARATIVE LIMB RANGE OF MOVEMENT IN THE DEVONIAN TETRAPOD *ICHTHYOSTEGA* AND THE EVOLUTION OF TERRESTRIAL LOCOMOTION

9:15  Gatesy, S., Pollard, N.  LIMB DISPARITY, COORDINATION, AND THE EVOLUTION OF TERRESTRIAL LOCOMOTION

9:30  Fröbisch, N., Shubin, N., Schneider, I.  DEVELOPMENT AND EVOLUTION OF THE URODELE LIMB — INTEGRATING MORPHOLOGY, GENES, AND THE FOSSIL RECORD

9:45  Caldwell, M.  380 MILLION YEARS OF TETRAPOD EVOLUTIONARY TRANSFORMATIONS: CONVERGENT EVOLUTION AND THE COUPLING OF AXIAL ELONGATION WITH LIMB AND GIRDLE REDUCTION AND LOSS

10:15  Fowler, D., de Bakker, M., Richardson, M.  HOX GENE EXPRESSION AND ANATOMICAL DIFFERENCES IN ARCHOSAURIA

10:30  Maxwell, E.  INTRASPECIFIC VARIATION IN THE LIMB STRUCTURE OF THE LOWER JURASSIC ICHTHYOSAUR *STENOPTERYGIUS*

10:45  Larsson, H., Dececchi, T., Harrison, L.  INTEGRATING THE GENOTYPE—PHENOTYPE MAP ACROSS THE ORIGIN OF BIRD WINGS

11:00  Dececchi, A., Larsson, H.  THE ORIGIN OF WINGS

11:15  Sánchez, M., Mitgutsch, C., Jiménez, R., Richardson, M.  CIRCUMVENTING CONSTRAINTS IN LIMB EVOLUTION: THE MOLE'S "THUMB" AND LATE GROWTH IN LIVING AND FOSSIL FORMS

11:30  Cooper, L., Jast, J., Cretekos, C., Rasweiler IV, J., Sears, K.  CELLULAR PATTERNS OF BAT (*CAROLLIA*) FORELIMB SKELETGENESIS AND THEIR BIOMECHANICAL CONSEQUENCES


12:00  Weisbecker, V.  UNDERSTANDING THE IMPLICATIONS OF LATE-STAGE LIMB AND GIRDLE DEVELOPMENT ON MAMMALIAN LIMB/GIRDLE EVOLUTION—ADDING A FEW MONOTREMES REALLY HELPS

WEDNESDAY MORNING, NOVEMBER 2, 2011
TECHNICAL SESSION I
PARIS LAS VEGAS, VENDOME A
MODERATORS: Sarah Werning, David Varricchio

8:00  Wings, O.  BEYOND *EUROPASAURUS*: THE LATE JURASSIC VERTEBRATE ASSEMBLAGE OF THE LANGENBERG QUARRY IN OKER/GERMANY

8:15  Porter, W., Witmer, L.  VASCULAR ANATOMY AND ITS PHYSIOLOGICAL IMPLICATIONS IN EXTANT AND EXTINCT DINOSAURS AND OTHER DIAPSIDS

November 2011—PROGRAM AND ABSTRACTS  13
8:30 Werning, S., Irmis, R., Smith, N., Turner, A., Padian, K. ARCHOSAUROMORPH BONE HISTOLOGY REVEALS EARLY EVOLUTION OF ELEVATED GROWTH AND METABOLIC RATES

8:45 Barrett, P., Butler, R., Gower, D., Abel, R. POSTCRANIAL SKELETAL PNEUMATICITY AND THE EVOLUTION OF ARCHOSAUR RESPIRATORY SYSTEMS

9:00 Mounce, R., Wills, M. PHYLOGENETIC CONGRUENCE BETWEEN CRANIAL AND POSTCRANIAL CHARACTERS IN ARCHOSAUR SYSTEMATICS

9:15 Salzberg, S., Novak, B., Poinar, H., Kaye, T., MacCoss, M. DNA, DINOSAURS, AND METAGENOMICS: A NEW TOOL FOR MASS IDENTIFICATION OF DNA FROM FOSSIL BONE

9:30 Varricchio, D., Simon, D., Oser, S., Lawver, D., Jackson, F. DINOSAUR EGGS IN SPACE AND TIME

9:45 Venditti, C., Benton, M., Organ, C., Meade, A., Pagel, M. THE EVOLUTIONARY SOURCES OF MORPHOLOGICAL DIVERSITY IN DINOSAURS

10:15 Mallison, H. FAST MOVING DINOSAURS: WHY OUR BASIC TENET IS WRONG

10:30 VanBuren, C., Bonnan, M. QUANTIFYING THE POSTURE OF QUADRUPEDAL DINOSAURS: A MORMPHOMETRIC APPROACH

10:45 Maidment, S., Bates, K., Allen, V., Barrett, P. 3D COMPUTATIONAL MODELLING OF LOCOMOTOR MUSCLE MOMENT ARMS IN LESOTHOSAURUS DIAGNOSTICUS: IMPLICATIONS FOR BASAL DINOSAUR LOCOMOTION

11:00 Ridgwell, N. A BASAL THYREOPHORAN (DINOSAURIA, ORNITHISCHIA) FROM AFRICA CLARIFIES THE EARLY EVOLUTION OF ARMORED DINOSAURS

11:15 Nabavizadeh, A. THYREOPHORAN JAW MECHANICS AND THE FUNCTIONAL SIGNIFICANCE OF THE PREDENTARY BONE

11:30 Morhardt, A., Ridgely, R., Witmer, L. NEW STUDIES OF BRAIN AND INNER EAR STRUCTURE IN STEGOSAURUS (DINOSAURIA: ORNITHISCHIA) BASED ON CT SCANNING AND 3D VISUALIZATION

11:45 Han, F., Xu, X., Paul, B. ANATOMY OF JEHOLOSAURUS SHANGYUANENSIS AND A PHYLOGENETIC ANALYSIS OF BASAL ORNITHISCHIANS

12:00 Zhao, Q., Benton, M., Hayashi, S., Sander, M., Xu, X. LONG BONE HISTOLOGY AND GROWTH PATTERNS OF PSITTACOSAURUS LUJIATUNENSIS (CERATOPSIA: PSITTACOSAURIDAE)

WEDNESDAY MORNING, NOVEMBER 2, 2011

SYMPOSIUM 2: CLIMATE CHANGE AND VERTEBRATE RESPONSE IN THE EVOLVING ARID WEST OF PLIO-PLEISTOCENE NORTH AMERICA

PARIS LAS VEGAS, VENDOME B

MODERATORS: Eric D. Scott, Kathleen Springer, Jim I. Mead

8:00 Bell, C. TAXON-BASED PALEOECOLOGICAL RECONSTRUCTIONS: CAUTIONARY NOTES ON THE PULL OF THE RECENT

8:15 McCord, R. TORTOISES AS TEMPERATURE PROXIES: A PHYLOGENETIC REAPPRAISAL

8:30 Steadman, D. CHANGING LATE NEOGENE BIRD COMMUNITIES IN NORTHWESTERN MEXICO AND THE SOUTHWESTERN UNITED STATES

8:45 Mead, J., Shaw, C. THE ENVIRONMENTAL RECONSTRUCTION OF EL GOLFO, SONORA, AND THE USE OF HELODERMA

9:00 McDonald, H. NOTHROTHERIOPS SHASTENSIS: THE DESERT-ADAPTED GROUND SLOTH

9:15 McGuire, J. HOW QUATERNARY CLIMATE CHANGE PATTERNSED MORPHOLOGICAL VARIATION IN MICROTUS CALIFORNICUS
WEDNESDAY MORNING, NOVEMBER 2, 2011
SYMPOSIUM 2: CLIMATE CHANGE AND VERTEBRATE RESPONSE IN THE EVOLVING ARID WEST OF PLIO-PLEISTOCENE NORTH AMERICA (continued)

9:30 Meyers, V., Rowland, S. PALEOECOLOGY OF TWO PLIOCENE VERTEBRATE FOSSIL ASSEMBLAGES IN WESTERN NORTH AMERICA: THE PANACA FAUNA OF LINCOLN COUNTY, NEVADA AND THE HAGERMAN FAUNA OF TWIN FALLS COUNTY, IDAHO

9:45 Jass, C. INSIGHT INTO THE “BIG BLACK HOLE”: VERTEBRATE REMAINS FROM ROOM 2, CATHEDRAL CAVE, NEVADA

10:15 Springer, K., Manker, C., Scott, E., Pigati, J., Mahan, S. GEOCHRONOLOGIC AND PALEOENVIRONMENTAL FRAMEWORK OF THE LATE PLEISTOCENE TULE SPRINGS LOCAL FAUNA

10:30 Sagebiel, J., Springer, K., Manker, C., Scott, E. MICROVERTEBRATE FAUNA AND PALEOECOLOGY OF THE TULE SPRINGS LOCAL FAUNA, CLARK COUNTY, NEVADA

10:45 Harris, J., Farrell, A., Howard, C., Scott, K., Shaw, C. CONTRIBUTIONS FROM PROJECT 23 TO OUR UNDERSTANDING OF THE RANCHO LA BREA BIOTA

11:00 Arroyo-Cabral, J., Lopez-Jimenez, A., Sanchez-Miranda, G., Gaines, E., Holliday, V. FAUNAL REMAINS FROM EL FIN DEL MUNDO ARCHAEOLOGICAL SITE, SONORA, MEXICO

11:15 Blois, J., Graham, R., Badgley, C., Williams, J. BIOME SHIFTS WITH PALEOCLIMATE CHANGE: RECONSTRUCTING PAST BIOMES USING MAMMALS

11:30 Polly, P., Dundas, R., Lawing, A. STANDING UP TO CLIMATE CHANGE: COMMUNITY Locomotor ECOMORPHOLOGY AND PALEOENVIRONMENT IN THE PLIO-PLEISTOCENE

11:45 Atwater, A., Davis, E. TOPOGRAPHIC AND CLIMATE CHANGE DIFFERENTIALLY DRIVE PLIOCENE AND PLEISTOCENE MAMMALIAN BETADIVERSITY OF THE GREAT BASIN AND GREAT PLAINS PROVINCES OF NORTH AMERICA

12:00 Scott, E. PLIO-PLEISTOCENE EQUUS IN WESTERN NORTH AMERICA: MORPHOLOGY, MOLECULES, AND CHANGES IN DIVERSITY THROUGH TIME AND SPACE

WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
TECHNICAL SESSION II
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: Nicholas Gardner, Sterling Nesbitt

1:45 Tsuji, L., Smith, R., Sidor, C. WHAT, IF ANYTHING, IS A ‘DWARF’ PAREIASAUR? NEW INFORMATION ON PUMILIOPAREIA PRICEI

2:00 Cisneros, J., Hamley, T., Damiani, R. A PROCOLOPHONID PARAREPTILE FROM THE TRIASSIC OF AUSTRALIA

2:15 Modesto, S., Reisz, R., Scott, D. A NEO DIAPSID REPTILE FROM THE LOWER PERMIAN OF OKLAHOMA

2:30 Gardner, N., Bhullar, B., Holliday, C., O’Keefe, R. CRANIAL ANATOMY IN THE BASAL DIAPSID YOUNGINA CAPENSIS AND ITS RELEVANCE TO HIGHER RADIATIONS OF PERMO-TRIASSIC NEO DIAPSIDA

2:45 Yi, H. FUNCTIONAL MORPHOLOGY OF THE LOWER JAW IN THE CHORISTODERA (REPTILIA: DIAPSIDA) INDICATES DIET DIVERGENCE BETWEEN ECOMORPHS

3:00 Wu, X., Li, C., Zhao, L., Sato, T., Wang, L. A NEW ARCHOSAUR (DIAPSIDA: ARCHOSAURIFORMES) FROM THE MARINE TRIASSIC OF CHINA

3:15 Botha-Brink, J., Smith, R. OSTEOHISTOLOGY OF TRIASSIC ARCHOSAUROMORPHS FROM THE KAROO BASIN OF SOUTH AFRICA
WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
TECHNICAL SESSION II (continued)

3:30 Sidor, C., Smith, R., Huttenlocker, A., Peecook, B., Hammer, W. NEW INFORMATION ON THE TRIASSIC VERTEBRATE FAUNAS OF ANTARCTICA

3:45 Nesbitt, S., Sidor, C., Angielczyk, K., Smith, R., Tsuji, L. AN ENIGMATIC ARCHOSAURIFORM FROM THE MANDA BEDS (MIDDLE TRIASSIC) OF SOUTHWESTERN TANZANIA: CHARACTER CONFLICT AT THE BASE OF PSEUDOSUCHIA

4:00 Bhullar, B., Bever, G., Merck, J., Lyson, T., Gauthier, J. UNITING MICROEVOLUTION AND MACROEVOLUTION IN DEEP TIME: THE ZONE OF VARIABILITY IN ARCHOSAUROMORPHA

WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
TECHNICAL SESSION III
PARIS LAS VEGAS, VENDOME A
MODERATORS: Julia Meachen-Samuels, Joshua Samuels

1:45 Samuels, J., Van Valkenburgh, B. CARNIVORE DIVERSITY THROUGH THE CENOZOIC OF OREGON

2:00 Bjornsson, C., Feranec, R., Tseng, Z. DETERMINING THE ERUPTION RATE AND DEVELOPMENTAL TIME FOR ADULT CANINES IN THE SABER-TOOTH CAT, SMILODON FATALIS, USING MICROCT AND STABLE ISOTOPES

2:15 Meachen-Samuels, J., Werdelin, L. CARNIVORE POSTCRANIAL DISPARITY: ADAPTATION TO CLIMATE AND HABITAT

2:30 Sakamoto, M., Ruta, M. MORPHOLOGICAL DISPARITY, ALLOMETRY AND PHYLOGENETIC SIGNALS IN THE SKULLS OF EXTANT AND FOSSIL CATS (FELIDAE, CARNIVORA)

2:45 Goswami, A., Martin, J., Foley, L. THE RATE AND CESSATION OF FACIAL GROWTH IN CARNIVORANS

3:00 Borths, M., Goswami, A., Milne, N., Wroe, S. CRANIAL VARIATION IN "CREODONTA" AND IMPLICATIONS FOR CONVERGENCE IN PLACENTAL AND MARSUPIAL CARNIVORES

3:15 Smits, P., Evans, A. CONSTRAINTS ON TOOTH SHAPE AND JAW MOTION IN CARNIVOROUS MAMMALS

3:30 Shabel, A. THE CLAWLESS OTTERS OF AFRICA (AONYX): MORPHOLOGY, ECOLOGY, AND FOSSIL RECORD

3:45 Churchill, M., Boessenecker, R., Clementz, M. BIOGEOGRAPHIC IMPLICATIONS OF OTARIIDAE (MAMMALIA: CARNIVORA) SYSTEMATICS

4:00 Bloch, J., Hunt, R., Rincon, A., MacFadden, B. FIRST RECORD OF A LARGE IMMIGRANT BEARDOG (MAMMALIA, AMPHICYONIDAE) FROM THE EARLY MIocene OF PANAMA

WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
TECHNICAL SESSION IV
PARIS LAS VEGAS, VENDOME B
MODERATORS: Samantha Hopkins, Pennilyn Higgins

1:45 Anderson, D., Casey, K., Erdman, A. DIVERSITY OF SCIURAVIDAE (MAMMALIA: RODENTIA) INCLUDING A NEW SPECIES FROM THE MIDDLE EOCENE OF WYOMING

2:00 Sallam, H., Seiffert, E., Simons, E. NEW GENERA OF HYSTRICOGNATHII (RODENTIA, MAMMALIA) FROM THE LATE EOCENE OF THE FAYUM DEPRESSION, NORTHERN EGYPT

2:15 Schwarz, C., Ruf, I., Martin, T. SHOW ME YOUR EAR: LOCOMOTORY ADAPTATIONS IN THE INNER EAR OF SCIUROMORPHA (RODENTIA, MAMMALIA)
WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
TECHNICAL SESSION IV (continued)

2:30 Higgins, P., Croft, D., Bostelmann, E., Rinderknecht, A., Ubilla, M. PALEODIET AND PALEOENVIRONMENT OF FOSSIL GIANT RODENTS FROM URUGUAY

2:45 Hopkins, S. ROLE OF VOLCANIC ACTIVITY IN THE EVOLUTION OF HYPSELODONTY IN APLODONTID RODENTS

3:00 Mørs, T., Ruf, I., Tomida, Y. MIOCENE BEAVERS (CASTORIDAE, RODENTIA) FROM JAPAN


3:30 Perez, M., Pol, D. DIVERSIFICATION PATTERNS AND THE ORIGIN OF CAVIOIDEA SENSU STRICTO: FOSSILS, GHOST LINEAGES, AND MOLECULAR CLOCK ESTIMATES

3:45 Bertrand, O., Flynn, J., Croft, D., Wyss, A. HIGHER-LEVEL OF EARLY CAVIOMORPHA (RODENTIA: HYSTRICOGNATHI), PALEOGEOGRAPHY, AND EVOLUTION OF HYPSONDONTY

4:00 Gaudin, T., McDonald, H., Rincó A. PHYLOGENETIC ANALYSIS OF THE SLOTH FAMILY MEGALONYCHIDAE (MAMMALIA, XENARTHRA, FOLIVORA) BASED ON CRANIAL DATA

WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
POSTER SESSION I
PARIS LAS VEGAS, RIVOLI B
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Berg, L. MAMMALIAN FEMORA FROM THE CRETACEOUS-PALEOGENE BOUNDARY OF NORTHEASTERN MONTANA

2 Bykowski, R. BITING OFF MORE THAN THEY COULD CHEW: A GEOMETRIC MORPHOMETRIC APPROACH TO THEROPOD FEEDING ECOLOGY

3 Campbell, T. PLIO-PLEISTOCENE PALEOENVIRONMENTAL CHANGE IN THE CRADLE OF HUMANKIND, SOUTH AFRICA: AN APPLICATION OF MODERN RODENT NICHE MODELS TO FOSSIL BEARING LOCALITIES

4 Cleland, T. CHEMICAL AND MORPHOLOGICAL REINVESTIGATION OF THE DINOSAUR HEART

5 Garcia, B. SKELETOCHRONOLOGY OF THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS): THE UTILITY OF VARIOUS ELEMENTS FOR DETERMINING GROWTH PATTERNS AND LONGEVITY

6 Harper, T. THREE DIMENSIONAL DENTAL WEAR ANALYSIS OF THE BISSETKY FAUNA EUTHERIANS, DZARAKUDUK REGION, UZBEKISTAN

7 Kemp, M. HOLOCENE LOSS OF LAGOMORPH SPECIES RICHNESS IN THE GREAT BASIN OF NORTH AMERICA

8 Kim, S. ECOLOGY AND EVOLUTION OF COSMOPOLITODUS HASTALIS AND CARCHARODON CARCHARIAS

9 Liu, J. BIODIVERSITY OF MARINE REPTILES FROM THE MIDDLE TRIASSIC LUOPING BIOTA, YUNNAN, CHINA

10 Mallon, J., Anderson, J. BIOSTRATIGRAPHY OF THE MEGAHERBIVOROUS DINOSAURS FROM THE DINOSAUR PARK FORMATION (UPPER CAMPANIAN) OF ALBERTA

11 Matsumoto, R. FRESHWATER NICHE COMPETITION BETWEEN CHORISTODERES AND CROCODILES IN THE MESOZOIC AND PALEOGENE

12 McGarrity, C. CRANIAL MORPHOLOGY AND VARIATION IN PROSAUROLOPHUS MAXIMUS WITH IMPLICATIONS FOR HADROSAURID DIVERSITY AND EVOLUTION
13 Nakajima, Y. OSTEOSCLEROSIS IN THE LIMB BONES OF TERRESTRIAL AND AQUATIC TURTLES

14 Norton, L. MORPHOLOGICAL VARIATION IN THE SKULL OF AELUROGNATHUS (THERAPSIDA, GORGONOPSIA) AND ITS REPERCUSSION ON THE TAXONOMY OF THE GENUS

15 Pilbro, C. ECOLOGY OF EARLY EOCENE SAN JUAN BASIN, NM PHENACOLEMUR JEPSENI WITH PHENACOLEMUR CITATUS AND PHENACOLEMUR PRAECOX FROM BIGHORN BASIN, WY - A STUDY OF MICROWEAR AND DENTAL VARIATION

16 Pineda Muñoz, S., Casanovas Vilar, I., De Miguel, D., Karme, A., Fortelius, M. EVOLUTION OF HYPSODONTY IN A CRICETID (RODENTIA) LINEAGE: PRELIMINARY RESULTS USING PATCH ANALYSIS

17 Sarringhaus, L. CHANGES IN METACARPAL CURVATURE DURING WILD CHIMPANZEE DEVELOPMENT

18 Scott, J. DENTAL MICROWEAR TEXTURE ANALYSIS OF EXTANT AFRICAN BOVIDAE

19 Shi, Q. A NEW SPECIES OF TSAIDAMOTHERIUM (BOVIDAE, MAMMALIAN): SECOND DISCOVERY OF THE UNICORNSHORN ANTELOPE RESTRICTED TO CHINA IN THE LATE MIocene

20 Stein, K., Sander, M. OSTEOCYTE LACUNA DENSITY IN Saurischian DINOSAURS AND THE CONVERGENCE OF FIBROLAMELLAR BONE IN MAMMALS AND DINOSAURS: DIFFERENT STRATEGIES TO GROW FAST

21 Thomson, T. AQUATIC BEHAVIOR AND LOCOMOTION OF ARCHOSAURIFORM REPTILES INTERPRETED FROM EARLY-MIDDLE TRIASSIC SWIM TRACKS OF THE WESTERN UNITED STATES

22 Watanabe, A. BONE HISTOLOGY OF AN ALASKAN ORNITHOMIMOSAUR: IMPLICATIONS FOR POLAR DINOSAURIAN PHYSIOLOGY

23 Wilson, L. THE FEEDING ECOLOGY OF CRETACEOUS AND MODERN PURSUIT DIVING BIRDS

24 Yamada, E., Nakaya, H. MESOWEAR ANALYSIS OF EXTANT JAPANESE SIKA DEER (CERVUS NIPpon) IN DIFFERENT HABITATS AND SEXES

25 Zhang, Y. MASTICATORY PATTERN RECONSTRUCTION OF MESODMA (NEOPLAGIAULACIDAE, MULTITUBERCULATA, MAMMALIA) BASED ON TOOTH WEAR STUDY

26 Anné J. CHANGING OLD VIEWS WITH NEW TECHNOLOGY: USING XRF TO COMPARE BONE CHEMISTRY OF BIRDS WITH OTHER VERTEBRATES

27 Balanoff, A., Ksepka, D. ENDOCRANIAL MORPHOLOGY OF LIVING AND EXTINCT PENGUINS: TRANSITIONS ASSOCIATED WITH THE EVOLUTION OF UNDERWATER "FLIGHT"

28 Bradford, K., Clarke, J., Middleton, K. ESTIMATING BENDING MECHANICS OF EXTANT AND FOSSIL PENGUIN? CONTOUR FEATHERS

29 Stidham, T. PHYLOGENETIC INFORMATION FROM THE QUADRAT OF DIATRYMA (NEORNITHES)


31 Torres, C., Clarke, J. FEATHERING AND ESTIMATING WING LOADING FOR LITHORNITHID BIRDS FROM THE EARLY EOCENE GREEN RIVER FORMATION

32 Rubilar-Rogers, D., Yury-Yáñez, R., Mayr, G., Gutstein, C., Otero, R. A HUMERUS OF A GIANT LATE EOCENE PSEUDO-TOOTHED BIRD FROM ANTARCTICA

33 Ohashi, T., Hasegawa, Y., Kawabe, S., Okazaki, Y. NEW INFORMATION ON THE PLOTOPTERIDAE SKULLS FROM THE OLIGOCENE KISHIMA GROUP AND ASHIYA GROUP OF NORTHERN KYUSHU, JAPAN

34 Ngo, M., Canchola, J., Dundas, R. AVIFAUNAS OF THE MIDDLE PLEISTOCENE IRVINGTON AND FAIRMEAD LANDFILL LOCALITIES IN CALIFORNIA
WEDNESDAY AFTERNOON, NOVEMBER 2, 2011  
POSTER SESSION I (continued)

35 Fragomeni, A., Prothero, D. STASIS IN LATE QUATERNARY BIRDS FROM THE LA BREA TAR PITS DURING THE LAST GLACIAL-INTERGLACIAL CYCLE

36 Watanabe, J. ONTOGENETIC CHANGES OF MORPHOLOGY AND SURFACE TEXTURE OF LONG BONES IN THE EXTANT GRAY HERON, ARDEA CINEREA (AVES, ARDEIDAE)—A FUNDAMENTAL STUDY FOR ONTOGENETIC AGEING

37 Hanson, B., Bell, A., Cipriani, M., Schachner, E., Farmer, C. ENVIRONMENTALLY INDUCED PHENOTYPIC PLASTICITY IN THE JAPANESE QUAIL (COTURNIX COTURNIX JAPONICA) AND ITS IMPACT ON AVIAN EVOLUTION

38 Botelho, J., Palma, V., Soto, S., Vargas, A. DISTAL FIBULAR REDUCTION AND ITS REVERSION IN EVOLUTION AND DEVELOPMENT


40 Cuff, A., Rayfield, E. VALIDATION OF THE FINITE ELEMENT METHOD ON AN AVIAN SKULL AND IMPLICATIONS FOR DINOSAURIAN MODELING

41 Kambic, R., Gatesy, S. MODELING THEROPOD JOINT STABILITY

42 Dalman, S., Gishlick, A. THEROPOD MATERIAL FROM LAMETA, INDIA, IN THE COLLECTION OF THE AMERICAN MUSEUM OF NATURAL HISTORY AND ITS BEARING ON THE DIAGNOSIS AND PHYLOGENETIC AND TAXONOMIC STATUS OF INDOSUCHUS RAPTORIUS

43 Main, D., Noto, C., Scotese, C. NEW THEROPOD MATERIAL FROM THE CRETACEOUS (CENOMANIAN) WOODBINE FORMATION OF NORTH CENTRAL TEXAS: PALEOBIOGEOGRAPHIC AND PALEOEOCOLOGICAL IMPLICATIONS

44 Sayão, J., Saraiva, A., Silva, H., Kellner, A. A NEW THEROPOD DINOSAUR FROM THE ROMUALDO LAGERSTÄTTE (APTIAN-ALBIAN), ARARIBE BASIN, BRAZIL

45 Kirkland, J., Loewen, M., DeBlieux, D., Madsen, S., Choinski, J. NEW THEROPOD CRANIAL MATERIAL FROM THE YELLOW CAT MEMBER, CEDAR MOUNTAIN FORMATION (BARREMIAN-BASAL APTIAN, CRETACEOUS), STIKES QUARRY, NORTH OF ARCHES NATIONAL PARK, EAST-CENTRAL UTAH

46 Selles, A., Santos-Cubedo, A., Poza, B. INJURY IN A THEROPOD DINOSAUR FROM THE EARLY CRETACEOUS OF SPAIN

47 Fanti, F., Contessi, M., Nigarov, A. NEW DATA ON TWO LARGE DINOSAUR TRACKSITES FROM THE MIDDLE JURASSIC OF EASTERN TURKMENISTAN, CENTRAL ASIA


49 Lee, H., Lee, Y., Adams, T., Kobayashi, Y., Jacobs, L. THEROPOD TRACKWAYS ASSOCIATED WITH ORNITHOMIMID SKELETONS FROM THE NEMEGT FORMATION (MAASTRICHIAN) AT BUGIN TSAV, MONGOLIA

50 Persons, W., Currie, P., Norell, M. SHAKE YOUR TAIL FEATHERS: THE FLAMBOYANT, ATHLETIC, AND POSSIBLY FLIRTATIOUS CAUDAL MORPHOLOGY OF OVIRAPTOROSAURS

51 Lautenschlager, S., Rayfield, E., Witmer, L., Altangerel, P. THE ENDOCRANIAL ANATOMY OF THE MONGOLIAN THERIZINOSAUROID DINOSAUR ERLIKOSAURUS ANDREWSI AS REVEALED BY 3D VISUALIZATION

52 Pei, R., Norell, M. A NEW TROODONTID (DINOSAURIA: THEROPODA) FROM THE LATE CRETACEOUS DJADOKHTA FORMATION OF MONGOLIA
O'Connor, J., Zhou, Z., Xu, X. SMALL THEROPOD WITH BIRD IN STOMACH INDICATES BOTH LIVED IN TREES

Chapman, R., Andersen, A., Makovicky, P., Deck, L., Simpson, W. THE VIRTUALIZATION OF A LARGE TYRANNOSAURUS REX SPECIMEN (SUE) FROM SOUTH DAKOTA

Melstrom, K., D'Emic, M. ACROCANTHOSAURUS ATOKENSIS (DINOSAURIA: THEROPODA) FROM THE CLOVERLY FORMATION OF WYOMING: IMPLICATIONS FOR EARLY CRETACEOUS NORTH AMERICAN ECOSYSTEMS

Testin, J., Tucker, R., Miyashita, T., Holtz, Jr., T. DENTAL MORPHOLOGY OF ALLOSAURUS FRAGILIS (DINOSAURIA: THEROPODA) FROM THE UPPER JURASSIC MORRISON FORMATION OF WESTERN NORTH AMERICA: IS DENTITION MORE INDICATIVE OF TAXONOMY OR FEEDING NICHE?

Birkemeier, T. NEUROCENTRAL SUTURE CLOSURE IN ALLOSAURUS (SAURISCHIA : THEROPODA): SEQUENCE AND TIMING

Ibrahim, N., Sereno, P. NEW DATA ON SPINOSAURIDS (DINOSAURIA: THEROPODA) FROM AFRICA

McFeeters, B., Ryan, M., Schroder-Adams, C., Hinic-Frlog, S. REDIAGNOSIS AND PHYLOGENETIC RELATIONSHIPS OF SIGILMASSASAURUS, A PROBLEMATIC THEROPOD FROM THE MID-CRETACEOUS OF MOROCCO

Machado, E., Campos, D., Kellner, A. A NEW ABELISAURID TIBIA FROM THE LATE CRETACEOUS OF BRAZIL

Thompson, K. COMPARATIVE ANALYSIS OF ABELISAURID SKULLS INDICATES DIETARY SPECIALIZATION

Britt, B., Chambers, M., Engelmann, G., Chure, D., Scheetz, R. TAPHONOMY OF COELOPHYSOID THEROPOD BONEBEDS PRESERVED ALONG THE SHORELINE OF AN EARLY JURASSIC LAKE IN THE NUGGET SANDSTONE OF NE UTAH

Ji, C., Jiang, D., Motani, R., Hao, W., Sun, Z. PRELIMINARY RESULTS OF PHYLOGENETIC ANALYSIS OF TRIASSIC ICHTHYOSAURS

Shang, Q., Li, C., Liu, J. THE SEXUAL DIMORPHISM OF SHASTASAURUS TANGAE (REPTILIA: ICHTHYOSAURIA) FROM GUANLING BIOTA, CHINA

Cuthbertson, R., Russell, A., Anderson, J. RE-EXAMINATION OF THE CRANIAL MORPHOLOGY OF UTATSUSAURUS HATAII FROM THE OSAWA FORMATION (LOWER TRIASSIC) OF MIYAGI, JAPAN

Fischer, V. NEW OPHTHALMOSAURIDS FROM EUROPE AND RUSSIA BROADEN THE BIODIVERSITY OF EARLY CRETACEOUS ICHTHYOSAURS

Pardo Pérez, J., Frey, P., Stinnesbeck, P., Rivas, L. EARLY CRETACEOUS ICHTHYOSAURS FROM THE TYNDALL GLACIER IN TORRES DEL PAINE NATIONAL PARK, SOUTHERNMOST CHILE

Wahl, W. HYOID STRUCTURE AND BREATHING IN ICHTHYOSAURS

Arajo, R., Louis, J., Polcyn, M., Mateus, O., Schulp, A. PLESIOSAUR STRUCTURAL EXTREME FROM THE MAASTRICHTIAN OF ANGOLA

Richards, C., O'Keefe, F., Henderson, D. PLESIOSAUR BODY SHAPE AND ITS IMPACT ON STABILITY

Schwermann, L., Sander, P. A NEW PLESIOSAURIDAE FROM THE PLEISNBACHIAN OF GERMANY AND ITS EVOLUTIONARY IMPLICATIONS

Long, C., Xiaohong, C., Jun, L., Xiongwei, Z. A NEW SPECIES OF PARAPLACODUS (SAUROPTERYGIA: PLACODONTOIDEA) FROM THE MIDDLE TRIASSIC OF SOUTHWESTERN CHINA

Jiang, D., Rieppel, O., Motani, R., Hao, W., Tintori, A. THE MARINE REPTILE SAUROSPHARGIS FROM ANISIAN (MIDDLE TRIASSIC) OF PANXIAN, GUIZHOU, SOUTHWESTERN CHINA
Kuykendall, S., Robbins, J. DISTINGUISHING FORAGING RANGE AND DIVING HABITS AMONG MARINE VERTEBRATES USING CARBON ISOTOPES AND WT. % CARBONATE

Shelton, C., Sander, M. VALIDATING DIMETRODON SPECIES FROM THE BRIAR CREEK BONE BED (LOWER PERMIAN, ARCHER COUNTY, TEXAS) USING BONE HISTOLOGY AND MORPHOMETRICS OF FEMORA AND HUMERI

Liu, J., Li, J. OSTEOMETRY AND PHYLOGENETIC POSITION OF SINOPHEONEUS YUMENENSIS (THERAPSIDA, DINOCEPHALIA) FROM THE DASHANKOU FAUNA (MIDDLE PERMIAN)

Engelmann, G., Chure, D. UP, DOWN, AND SIDEWAYS: ABUNDANT THERAPSID TRACKS ON A DUNE SLIPFACE IN THE NUGGET SANDSTONE (EARLY JURASSIC) FROM NEAR HEBER, UTAH

Green, J. DECIPHERING THE PERIODICITY OF GROWTH INCREMENTS IN THE TUSKS OF LATE TRIASSIC DICYNODONTS (THERAPSIDA: ANOMODONTIA)

Davis, B. MICRO-COMPUTED TOMOGRAPHY REVEALS A DIVERSITY OF PERAMURAN MAMMALS FROM THE PURBECK GROUP (BERRIASIAN) OF ENGLAND

Cifelli, R., Gordon, C. NEW INFORMATION ON TRIBOSPHENIC MAMMALS FROM THE CLOVERLY FORMATION, MONTANA AND WYOMING

Fabre, A., Cornette, R., Prasad, G., Buyer, D., Goswami, A. A 3D MORPHOMETRIC ANALYSIS OF THE LOCOMOTORY ECOLOGY OF DECCANOLESTES, A EUTHERIAN MAMMAL FROM THE LATE CRETACEOUS OF INDIA

Martin, A., Noto, C., Chiappe, L. A BURROW RUNS THROUGH IT: UNUSUAL CO-OCCURRENCE OF A LARGE MAMMAL BURROW SYSTEM AND DINOSAUR SKELETON IN THE MORRISON FORMATION OF UTAH

Bickelmann, C., Müller, J., Du, J., Chang, B. IN VITRO SYNTHESIS OF ANCESTRAL VISUAL PIGMENTS AND ITS IMPLICATION FOR NOCTURNALITY IN EARLY MAMMALS

Muldoon, K., Gerber, B., Karpanty, S. TAPHONOMIC ANALYSIS OF SMALL MAMMAL PREY ASSEMBLAGES DERIVED FROM THREE RAPTORS (ACCIPITRIDAE) IN SOUTHEASTERN MADAGASCAR

WITHDRAWN

Bunn, J., Zohdy, S., King, S., Wright, P., Jernvall, J. TESTING FOR TOOTH WEAR RESISTANT MEASURES OF DIET IN PRIMATES

Allen, K., Gonzales, L., Cooke, S., Kay, R. EVALUATION OF UPPER MOLAR OCCLUSAL MORPHOLOGY FOR DIETARY INFERENCE IN MID- TO LARGE-BODIED PLATYRRHINI (PRIMATES)

Claxton, A., Langdon, J. THE RELATIONSHIP BETWEEN MANUAL PHALANGEAL CURVATURE AND LOCOMOTOR BEHAVIOR IN ANTHROPOID PRIMATES


Pina, M., Moyà-Solà, S., Fortuny, J. INFERRING LOCOMOTION IN MIOCENE APES: THE FEMUR OF HISPANOPITHECUS LAIETANUS

Almécija, S., Tallman, M., Alba, D., Pina, M., Moyà-Solà, S. PROXIMAL FEMORAL AFFINITIES OF MIOCENE APES AND EARLY HOMININS ON THE BASIS OF 3D GEOMETRIC MORPHOMETRICS ANALYSES

Susanna, I., Alba, D., Almécija, S., Moyà-Solà, S. VERTEBRAL REMAINS OF THE LATE MIOCENE APE HISPANOPITHECUS LAIETANUS (PRIMATES: HOMINIDAE): FUNCTIONAL MORPHOLOGY AND PALEOBIOLOGICAL INFERENCE
WEDNESDAY AFTERNOON, NOVEMBER 2, 2011
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93 Karme, A., Evans, A., Fortelius, M. GISWEAR: 3D AND GIS DIET ANALYSIS METHOD FOR BUNODONT OMNIVORE GROUPS SUINA AND HOMINIDAE

94 DeMiguel, D., Alba, D., Moyà-Solà, S. DIETARY RECONSTRUCTION OF MIOCENE APES (PRIMATES: HOMINIDAE) FROM CATALONIA (NE SPAIN) BASED ON DENTAL MICROWEAR

95 Kingston, J., MacLatchy, L., Cote, S., Kityo, R., Sanders, W. ISOTOPIC EVIDENCE OF PALEOENVIRONMENTS AND NICHE PARTITIONING OF EARLY MIOCENE FOSSIL FAUNA FROM NAPAK AND MOROTO, UGANDA

96 Thomas, D., Brink, J., Chinsamy, A. CHEMICAL EVIDENCE DEMONSTRATES A THERMAL SPRING DEPOSITIONAL ENVIRONMENT FOR THE FLORISBAD HOMININE SKULL

97 Arbor, T. A MORPHOMETRIC ANALYSIS OF THE MANDIBULAR PREMOLARS AND MOLARS OF SOUTH AFRICAN AUSTRALOPITHECUS

98 Dunsworth, H., Warrener, A., Pontzer, H. LIFE HISTORY JUST ISN’T HIP: HUMAN EVOLUTION WITHOUT AN ‘OBSTETRIC DILEMMA’

99 Samonds, K., Conway, S. LARGE SUBFOSSIL FROG FROM NORTHWESTERN MADAGASCAR

100 Báez A., Gómez, R., Taglioretti, M. NEW FIND OF ENIGMATIC PIPID FROGS IN THE UPPER PLEISTOCENE OF THE SOUTH AMERICAN PAMPAS

101 Folie, A., Rana, R., Rose, K., Kumar, K., Smith, T. A NEW BOMBINATORID FROG FROM THE EARLY EOCENE OF VASTAN, GUJARAT, INDIA

102 Bonde, J., Shirk, A., Druschke, P., Hilton, R. FROG TAPHONOMY IN A HIGH ELEVATION LAKE BASIN ON THE NEVADAPLANO, LATE CRETACEOUS TO EOCENE, SHEEP PASS FORMATION, EAST-CENTRAL NEVADA

103 DeMar, Jr., D. NEW TAXONOMIC, PALEOBIOGEOGRAPHIC, AND BIOSTRATIGRAPHIC RECORDS OF FOSSIL SALAMANDERS (CAUDATA) FROM THE HELL CREEK AND TULLOCK FORMATIONS OF GARFIELD COUNTY, MONTANA

104 Grieco, T. TOOTH INITIATION FOLLOWS AN ALTERNATE ONTOGENETIC CLOCK IN PROMETAMORPHIC PIPID TADPOLES

105 Dong, L., Huang, D., Wang, Y. FOOD SELECTION IN JURASSIC SALAMANDERS FROM INNER MONGOLIA, CHINA

106 Steyer, J., Mateus, O., Butler, R., Brusatte, S., Whiteside, J. A NEW METOPOSAURID (TEMNOSPONDYL) BONEBED FROM THE LATE TRIASSIC OF PORTUGAL

107 McHugh, J. ASSESSING RATE AND SCALE IN TEMNOSPONDYL EVOLUTION

108 Vargas, A., Soto-Acuña, S., Weiss, C., Ossa, L. THE STATUS OF MORPHOLOGICAL AND DEVELOPMENTAL EVIDENCE ON DIGIT IDENTITY IN THE HAND OF ANURA


110 Germain, D. ALONE ON GONDWANA: THE STORY OF THE MOROCCAN DIPLOCAULID

111 Berman, D., Henrici, A., Martens, T., Sumida, S., Anderson, J. A SECOND, NEW SPECIES OF TREMATOPID AMPHIBIAN FROM THE LOWER PERMIAN BROMACKER LOCALITY OF CENTRAL GERMANY

112 Olori, J. CRANIAL GROWTH AND DEVELOPMENT IN PANTYLUS CORDATUS (LEPOSPONDYLI: TETRAPODA)

113 Zigaite, Z., Karatajute-Talimaa, V. ASPIDIN OR GALEASPedin: NEW EARLY VERTEBRATE HISTOLOGY FROM THE LOWER SILURIAN OF SOUTHERN SIBERIA
**WEDNESDAY AFTERNOON, NOVEMBER 2, 2011**
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114 Blais, S., Hermus, C., Wilson, M. NEW SPECIES OF EARLY DEVONIAN ISCHNACANTHID ACANTHODIANS FROM THE MOTH LOCALITY OF NORTHERN CANADA

115 Boyle, J., Ryan, M. A REVISED DIAGNOSIS OF *TITANICHTHYS* (PLACODERMI: ARTHRODIRA) FROM THE CLEVELAND SHALE (FAMENNIAN) OF OHIO, USA, WITH IMPLICATIONS FOR ASPINOTHORACID PHYLOGENY

116 Richter, M., Daeschler, T., Samson, I., Shubin, N. THE DERMAL SCALES OF *TIKTAALIK ROSEA*E

117 Mellbin, B. A DIPNOAN PTERYGOID FROM BERGISCH GLADBACH, GERMANY

118 Cloutier, R., Béchard, I. DEVELOPMENTAL CONSERVATISM IN THE DENTAL SYSTEM OF THE LATE DEVONIAN DIPNOAN, *SCAUMENACIA CURTA* (SARCOPTERYGIID)

119 Gottfried, M., Suarez, M. FIRST FOSSIL RECORD OF A SERRASALMINE TELEOST (PACUS AND PIRANHAS) ON THE WESTERN SIDE OF THE ANDES, FROM THE LATE MIOCENE OF CHILE

120 Claeson, K., Eastman, J., MacPhee, R. WHAT THE HAKE? NEW SPECIMEN OF AN EXTINCT GADIFORM FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTICA

121 ORAL PRESENTATION, November 5, 10:30 a.m.

122 Ostrowski, S. REGIONAL VERSUS TAXONOMIC VARIATION IN VERTEBRAE OF ALBULOID (TELEOSTEI, ELOPOMORPHA) FISHES

123 Galluzzi, C., Shimada, K. A NEW SKELETON OF THE LATE CRETACEOUS BONY FISH, *MICROPYCNODON KANSASENSIS*, FROM THE NIOBRARA CHALK OF KANSAS, USA

124 MartAbad, H., Poyato-Ariza, F. A NEW HALECOMORPH FISH FROM THE EARLY CRETACEOUS WETLAND OF LAS HOYAS

125 WITHDRAWN

**THURSDAY MORNING, NOVEMBER 3, 2011**
**ROMER PRIZE SESSION**
**PARIS LAS VEGAS, CONCORDE A/B**
**MODERATOR: David Fox**

8:00 Dutchak, A. MAMMALIAN FAUNAL CHANGE AT RAVEN RIDGE, NORTHEASTERN UINTA BASIN, COLORADO-UTAH, DURING THE EARLY EOCENE CLIMATIC OPTIMUM

8:15 Knell, M. THE BIOSTRATINOMY OF FOSSIL FRESHWATER TURTLE SHELLS IN FLUVIAL DEPOSITS INTEGRATING ACTUALISTIC EXPERIMENTATION

8:30 Orcutt, J. THE PRESENT IS NOT ALWAYS THE KEY TO THE PAST: MAMMAL BODY SIZE AND CLIMATE IN NEOGENE NORTH AMERICA

8:45 van Heteren, A. THREE-DIMENSIONAL GEOMETRIC MORPHOMETRICAL ANALYSES OF THE FUNCTIONAL MORPHOLOGY OF THE *URSUS SPELAEUS* MANDIBLE

9:00 Varriale, F. DENTAL MICROWEAR AND THE EVOLUTION OF CHEWING IN CERATOPSIAN DINOSAURS

9:15 Woodward, H. AN INTRA-SKELETAL BONE MICROANALYSIS OF *ALLIGATOR MISSISSIPPIENSIS* AND ITS APPLICATION TO NON-AVIAN DINOSAUR OSTEOHISTOLOGY
THURSDAY MORNING, NOVEMBER 3, 2011
TECHNICAL SESSION V
PARIS LAS VEGAS, CONCORDE A/B
MODERATOR: Ross MacPhee, Joshua Miller

9:30 Hulbert Jr, R., Bourque, J., Meylan, P., Poyer, A. MILLENNIUM PARK, A NEW RANCHOLABREAN SITE FROM CENTRAL FLORIDA: EVIDENCE OF THE ELUSIVE SOUTHEASTERN PLEISTOCENE PRAIRIE FAUNA

9:45 Wang, X., Li, Q., Tseng, Z., Takeuchi, G., Deng, T. DID THE MEGAFANIA ORIGINATE FROM TIBET? COLD-ADAPTED PLIOCENE FAUNA FROM ZANDA BASIN SUGGESTS ORIGIN OF ICE AGE MEGABERIVORES IN HIGH PLATEAU

10:15 Johnson, K., Miller, I., Stucky, R., Pigati, J., Holen, S. ZIEGLER RESERVOIR AND THE SNOWMASTODON PROJECT: OVERVIEW AND GEOLOGIC SETTING OF A RECENTLY DISCOVERED SERIES OF HIGH-ELEVATION PLEISTOCENE (SANGAMONIAN) ECOSYSTEMS NEAR SNOWMASS VILLAGE, COLORADO

10:30 Fisher, D., Rountrey, A. SNOWMASS: PROBOSCIDEAN PALEOBIOLOGY BEFORE THE BEGINNING OF THE END


11:00 MacPhee, R., Enk, J., Debruyne, R., Fisher, D., Poinar, H. THE COMPLETE MITOGENOME OF THE COLUMBIAN MAMMOTH, WITH EVIDENCE FOR COLUMBIAN/WOOLLY MAMMOTH INTERBREEDING IN NORTH AMERICA

11:15 Graham, R., Stafford, Jr., T., Semken, Jr., H., Lundelius, Jr., E. TIME AVERAGING AND AMS RADIOCARBON DATING OF LATE QUATERNARY VERTEBRATE ASSEMBLAGES: IMPLICATIONS FOR HIGH-RESOLUTION ANALYSES

11:30 Miller, J. ARCTIC ANTLERS, CARIBOU CALVING GROUNDS, AND THE SPATIAL FIDELITY OF VERTEBRATE DEATH ASSEMBLAGES

12:00 Schikora, T., Schrenk, F. TEMPO-SPATIAL PATTERNS IN THE EVOLUTION OF EXTANT AFRICAN BOVIDAE BASED ON MOLECULAR, FOSSIL AND CLIMATE NICHE DATA

THURSDAY MORNING, NOVEMBER 3, 2011
SYMPOSIUM 3: THE EVOLUTION AND ECOLOGY OF TERRESTRIAL ECOSYSTEMS OF CAMPANIAN LARAMIDIA (WESTERN NORTH AMERICA)
PARIS LAS VEGAS, VENDOME A
MODERATORS: Mark A. Loewen, Eric M. Roberts, Scott D. Sampson

8:00 Fiorillo, A., Tykoski, R. CRETACEOUS DINOSAURS OF ALASKA: IMPLICATIONS FOR BIOGEOGRAPHY IN ANCIENT BERINGIA

8:15 Schmitt, J., Varricchio, D. VOLCANO-TECTONIC PARTITIONING OF LARAMIDIA: INFLUENCE ON CAMPANIAN TERRESTRIAL ENVIRONMENTS AND ECOSYSTEMS

8:30 Roberts, E., Tapanila, L., Rogers, R., Foreman, B. BASIN-SCALE CONTROLS ON CONTINENTAL VERTEBRATE TAPHONOMY: INSIGHTS FROM THE CAMPANIAN OF LARAMIDIA

8:45 Miller, I., Johnson, K. THE CAMPANIAN VEGETATION OF LARAMIDIA

9:00 Brinkman, D., Eaton, J., Newbrey, M., Kirkland, J., Neuman, A. LATITUDINAL DIFFERENTIATION OF FISH ASSEMBLAGES FROM THE LATE CRETACEOUS OF WESTERN NORTH AMERICA — EVIDENCE FROM VERTEBRATE MICROFOSSIL LOCALITIES
THURSDAY MORNING, NOVEMBER 3, 2011
SYMPOSIUM 3: THE EVOLUTION AND ECOLOGY OF TERRESTRIAL ECOSYSTEMS OF CAMPANIAN LARAMIDIA (WESTERN NORTH AMERICA) (continued)

9:15  Eaton, J., Scott, C.  COMPARISON OF LATE SANTONIAN-CAMPANIAN LARAMIDA MAMMALIAN FAUNAS FROM ALBERTA, CANADA, AND UTAH, USA

9:30  Konishi, T., Brinkman, D., Massare, J., Caldwell, M.  TWO NEW SPECIMENS OF AN ENIGMATIC MOSASAUR (SQUAMATA) *PROGNATHODON OVERTONI* FROM THE UPPER CAMPANIAN OF SOUTHERN ALBERTA, CANADA WITH GUT CONTENTS

9:45  Nydam, R.  DIVERSITY AND DISTRIBUTION OF CAMPANIAN (LATE CRETACEOUS) SQUAMATES OF LARAMIDIA FROM CANADA TO MEXICO


10:30  Drumheller, S., Boyd, C.  DIRECT EVIDENCE OF CROCODYLIFORM PREDATION ON SMALL DINOSAURIANS FROM THE KAIPAROWITS FORMATION OF UTAH

10:45  Loewen, M., Zanno, L., Irms, R., Sertich, J., Sampson, S.  CAMPANIAN THEROPOD EVOLUTION AND INTRACONTINENTAL ENDEMISM ON LARAMIDIA

11:00  Farke, A., Loewen, M., Sampson, S., Forster, C.  THE RADIATION OF HORNED DINOSAURS ON LARAMIDIA

11:15  Brown, C., Russell, A., Evans, D., Ryan, M., Brinkman, D.  NEW EVIDENCE CONCERNING DIVERSITY AND ABUNDANCE OF SMALL-BODIED ORNITHOPODS FROM THE BELLY RIVER GROUP (CAMPANIAN) OF ALBERTA

11:30  Evans, D., Gates, T.  NEW PERSPECTIVES ON THE EVOLUTION AND HISTORICAL BIOGEOGRAPHY OF CAMPANIAN HADROSURIDS (ORNITHISCHIA) OF LARAMIDIA

11:45  Gates, T.  LATITUDINAL BIODIVERSITY PATTERNS DURING THE CAMPANIAN OF WESTERN NORTH AMERICA

12:00  Sampson, S., Loewen, M., Irms, R., Sertich, J., Evans, D.  LAURASIAN FAUNAL INTERCHANGE IN THE LATE CRETACEOUS: THE OUT OF LARAMIDIA HYPOTHESIS

THURSDAY MORNING, NOVEMBER 3, 2011
PREPARATORS’ SESSION
PARIS LAS VEGAS, VENDOME B
MODERATORS: Kyle Davies, William Simpson

8:00  Esker, D.  NEW APPLICATIONS FOR MEDIUM AND SMALL SCALE 3D PHOTOGRAMMETRY IN VERTEBRATE PALEONTOLOGY

8:15  Breithaupt, B., Matthews, N.  PHOTOGRAMMETRIC ICHNOLOGY: STATE-OF-THE-ART DIGITAL DATA ANALYSIS OF PALEONTOLOGICAL RESOURCES IN NORTH AMERICA, EUROPE, ASIA, AND AFRICA

8:30  Matthews, N., Noble, T., Musiba, C., Washa, J., Breithaupt, B.  CLOSE-RANGE PHOTOGRAMMETRY OF PARTIAL RE-EXCAVATION OF THE LAETOLI HOMININ FOOTPRINTS, IN NORTHERN TANZANIA

8:45  Henrici, A., Berman, D., Martens, T., Sumida, S.  COLLECTION AND PREPARATION OF VERTEBRATE FOSSILS FROM THE EARLY PERMIAN BROMACKER QUARRY LOCALITY, CENTRAL GERMANY

9:00  Getty, M., Lund, E.  COLLECTION, PREPARATION, AND MOUNTING OF TWO LARGE, ORIGINAL GYROPOSAUR SKELETONS FROM THE KAIPAROWITS FORMATION OF GRAND STAIRCASE ESCALANTE NATIONAL MONUMENT, FOR THE NEW UTAH MUSEUM OF NATURAL HISTORY, SALT LAKE CITY

9:15  Wilkins, W.  THE MAMMOTH SITE OF HOT SPRINGS, SD: CURATION AND PREPARATION OF AN ACTIVE *IN-SITU* DIG SITE
THURSDAY MORNING, NOVEMBER 3, 2011
PREPARATORS’ SESSION (continued)

9:30  Lucking, C., Finlayson, H., Small, B., McFarlane, M., Fisher, D. BEST PRACTICES IN CLEANING, DRYING, AND STABILIZATION WET PLEISTOCENE MEGAFAUNA MATERIAL FROM SNOWMASS, COLORADO

9:45  Cavigelli, J. LESSONS LEARNED FROM “DEAD SHEEP 148”, OR THE FINE ART OF DEALING WITH BIG PLASTER JACKETS

10:15  Roach, B., Fox, M., Bhullar, B. THE PREPARATION OF YPM 57103, A CASE STUDY

10:30  Balcarcel, A. HIGH-RESOLUTION X-RAY COMPUTED TOMOGRAPHIC SCANNING FOR PREPARATION: LOGISTICS AND LIMITATIONS

10:45  Schulp, A., Schouten, R., Metten, L., van de Sande, A., Bontenbal, A. USING NEUTRON RADIOGRAPHY TO QUANTIFY CONSOLIDANT PENETRATION IN FOSSIL BONE

11:00  Brown, M. IMPROVING THE SCIENCE OF PALEONTOLOGY THROUGH EFFECTIVE COMMUNICATION IN THE LABORATORY

11:15  Bader, K. DEFORMATION IN SILICONE MOLDS AND ITS EFFECT ON THE ACCURACY OF CASTS

11:30  Smith, M., Nunan, E. SEISMIC MITIGATION FOR PALEONTOLOGICAL DISPLAY SPECIMENS

11:45  Davies, K., Starly, B. VIRTUAL AND REAL: USING 3D SCANNING, MODELING, AND PRINTING IN RECONSTRUCTING A JUVENILE APATOSAURUS SKELETON

12:00  Fitzgerald, E., Sereno, P., Keillor, T. A TUTORIAL ON TIME-LAPSE PHOTOGRAPHY FOR ONLINE DISSEMINATION OF PALEONTOLOGICAL SCIENCE: FOSSIL PREPARATION, SKELETAL MOUNTING, AND FLESH MODEL RESTORATION AS EXAMPLES

THURSDAY AFTERNOON, NOVEMBER 3, 2011
TECHNICAL SESSION VI
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: Gareth Dyke, Brian Andres

1:45  Carney, R., Vinther, J., Shawkey, M., D’Alba, L., Ackermann, J. BLACK FEATHER COLOR IN ARCHAEOPTERYX


2:15  Wang, X., Dyke, G., Palmer, C. SCALING IN SIZE AND STIFFNESS OF AVIAN PRIMARY FEATHERS: IMPLICATIONS FOR THE STRENGTH OF MESOZOIC BIRD FEATHERS

2:30  Li, D., Zhang, F. A RE-EXAMINATION OF THE CRANIAL MORPHOLOGY OF CONFUCIUSORNIS SANCTUS

2:45  Dyke, G., Vremir, M., Kaiser, G., Naish, D. A DROWNED MESOZOIC BIRD BREEDING COLONY

3:00  Huynh, T., Evangelista, D., Chang, C., Kwong, A., Tse, K. AERODYNAMIC CHARACTERISTICS OF FEATHERED DINOSAUR SHAPES MEASURED USING PHYSICAL MODELS: A COMPARATIVE STUDY OF MANEUVERING

3:15  Heers, A., Baier, D., Jackson, B., Dial, K. FROM BABY BIRDS TO FEATHERED DINOSAURS: THE ONTOGENY AND EVOLUTION OF SKELETAL FORM AND FUNCTION

3:30  English, L., Middleton, K. PHYLOGENETIC PATTERNS OF PTEROSAUR WING SKELETON ALLOMETRY

3:45  Andres, B., Howard, L., Steel, L. PTEROSAURS, MODULES, AND THE ORIGIN OF THE PTERODACTYLOIDEA
THURSDAY AFTERNOON, NOVEMBER 3, 2011
TECHNICAL SESSION VI (continued)

4:00 Rodrigues, T., Kellner, A. PHYLOGENETIC RELATIONSHIPS OF THE PTERANODONTOID PTEROSAURS FROM THE LOWER CRETACEOUS OF BRAZIL

THURSDAY AFTERNOON, NOVEMBER 3, 2011
TECHNICAL SESSION VII
PARIS LAS VEGAS, VENDOME A

MODERATORS: Jaelyn Eberle, Robert Anemone

1:45 Anemone, R., Emerson, C., Conroy, G. FINDING FOSSILS IN NEW WAYS: A NEURAL NETWORK MODEL FOR PREDICTING THE LOCATION OF FOSSIL-BEARING DEPOSITS

2:00 Hunter, J., Pearson, D., Bercovici, A. EARLIEST EVIDENCE FOR THE MAMMALIAN RECOVERY FAUNA IN THE PALEOGENE OF NORTH DAKOTA

2:15 Wilson, G., Self, C. MAMMALIAN DENTAL COMPLEXITY ACROSS THE CRETACEOUS-PALEOGENE BOUNDARY WITH IMPLICATIONS FOR ECOLOGICAL RECOVERY AND EXPANSION


2:45 Wang, Y., Tong, Y., Ye, J., Li, Q. A NEW PANTOLAMBDID PANTODONT (MAMMALIA) FROM THE PALEOCENE OF SOUTH CHINA: AN IMMIGRANT TO THE ‘EAST OF EDEN’ FROM NORTH AMERICA

3:00 Eberle, J., Dawson, M. MAMMALIAN DIVERSITY IN THE EARLY EOCENE HIGH ARCTIC

3:15 Missiaen, P., Rose, K., Rana, R., Kumar, K., Smith, T. REVISION OF INDOBUNE AND CAMBAYTERIUM FROM THE EARLY EOCENE OF VASTAN (INDIA), AND THEIR AFFINITIES WITH ANTHRACOBUNID AND PERISSODACTYL MAMMALS

3:30 Orliac, M., O’Leary, M. ENDOCranIAL STRUCTURES OF DIACODEXIS (MAMMALIA, ARTIODACTYLA)

3:45 Beard, K., Dawson, M., Anemone, R. PALEOBIOLOGICAL IMPLICATIONS OF THE EARLY EOCENE RODENT TUSCAHOMYS BASED ON AN EXTRAORDINARY NEW FAUNAL ASSEMBLAGE FROM THE GREAT DIVIDE BASIN, WYOMING, USA

4:00 Kohn, M., Stromberg, C., Madden, R., Dunn, R., Carlini, A. STABLE ISOTOPE RECORD OF MIDDLE EOCENE TO EARLY MIOCENE CLIMATE, GRAN BARRANCA, SOUTHERN ARGENTINA

THURSDAY AFTERNOON, NOVEMBER 3, 2011
TECHNICAL SESSION VIII
PARIS LAS VEGAS, VENDOME B

MODERATORS: Per Ahlberg, Claudia Marsicano

1:45 Ahlberg, P., Beznosov, P., Luksevics, E., Clack, J. A VERY PRIMITIVE TETRAPOD FROM THE EARLIEST FAMENNIAN OF SOUTH TIMAN, RUSSIA

2:00 Molnar, J., Pierce, S., Clack, J., Hutchinson, J. NEW FEATURES AND FUNCTIONAL MORPHOLOGY OF THE AXIAL SKELETON IN THE EARLY TETRAPOD PEDERPE FINNEYAE

2:15 Kavanagh, K. JOINT PATTERNING AND THE EVOLUTION OF SIZE PROPORTIONS IN FINGERS AND TOES

2:30 Chen, J. A PHYLOGENETIC EVALUATION OF SEQUENCE HETEROCHRONY IN AMPHIBIAN SKULL DEVELOPMENT

2:45 Pardo, J. THE MORPHOLOGY AND RELATIONSHIPS OF THE CARBONIFEROUS-PERMIAN NECTRIDEAN DIPLOCERASPIS BURKEI
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<td>3:00</td>
<td>Huttenlocker, A., Small, B., Pardo, J., Anderson, J.</td>
<td>GAINING UNDERGROUND: NEW RECUMBIBOSTRANS (LEPOSPONDYLI) FROM THE LOWER PERMIAN OF KANSAS AND NEBRASKA AND EARLY MORPHOLOGICAL EVOLUTION OF THE GROUP INFERRED BY MICRO-CT</td>
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<td>3:15</td>
<td>Anderson, J., Reisz, R.</td>
<td>GROWTH SERIES OF THE RECUMBIBOSTRAN (LEPOSPONDYLI; GYMNARTHRIDAE) <em>CARDIOCEPHALUS PEABODYI</em> FROM RICHARDS SPUR, OKLAHOMA; NEW ANATOMICAL INFORMATION AND IMPLICATIONS FOR THE EVOLUTION OF &quot;MICROSAURS&quot;</td>
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<td>3:30</td>
<td>Reisz, R., Fröbisch, N.</td>
<td>A NEW DISSOROPHID TEMNOSPONDYL FROM THE LOWER PERMIAN OF OKLAHOMA</td>
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<td>4:00</td>
<td>Fujiwara, S., Hutchinson, J.</td>
<td>ELBOW ADDUCTOR MOMENT ARM AS AN INDICATOR OF SPRAWLING POSTURE OF THE FORELIMB IN QUADRUPEDAL TETRAPODS</td>
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**THURSDAY AFTERNOON, NOVEMBER 3, 2011**

**TECHNICAL SESSION VIII (continued)**

**THURSDAY AFTERNOON, NOVEMBER 3, 2011**

**POSTER SESSION II**

PARIS LAS VEGAS, RIVOLI B

Authors must be present from 4:15 – 6:15 p.m.

Posters must be removed by 6:30 p.m.

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<td>Linn, T., Welsh, E., Carr, J. THE EFFECTIVE USES OF POLYESTER QUILT BATTING FOR CONSTRUCTING PLASTER JACKETS</td>
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<td>Cavin, J. A TEST OF THREE SOLVENT-BASED CONSOLIDANTS FOR FIELD USE IN THE RAIN</td>
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<td>Keillor, T., Sereno, P. FLESHING OUT A FOSSIL FIND</td>
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<td>Rhue, V. THE MAKING OF THE AGE OF MAMMALS: A BEHIND THE SCENES LOOK AT EXHIBIT PREPARATION AND DISPLAY</td>
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<td>5</td>
<td>Rivin, M. THE COOPER CENTER: A NOVEL PARTNERSHIP FOR THE MANAGEMENT OF PALEONTOLOGICAL RESOURCES</td>
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<td>Tucker, S. NEBRASKA’S HIGHWAY PALEONTOLOGY PROGRAM: 50 YEARS OF LIFE IN THE PAST LANE</td>
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<td>7</td>
<td>Lively, J., Irmis, R. NEW BAENID TURTLES FROM THE KAIPAROWITS FORMATION OF SOUTHERN UTAH: IMPLICATIONS FOR LARAMIDIAN BIOGEOGRAPHY</td>
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<td>Contessi, M., Fanti, F., Aljane, H. NEW DINOSAUR-DOMINATED TRACKSITES IN LATE JURASSIC AND EARLY CRETACEOUS OF SOUTHERN TUNISIA</td>
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<td>Lovelace, D. VERTEBRATE ICHNOLOGY OF THE EARLY TRIASSIC RED PEAK FORMATION (CHUGWATER GROUP), CENTRAL WYOMING</td>
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<td>Nour-Eddine, J., Belvedere, M., Breda, A., Gattolin, G., Dyke, G. A VARIED ICHNOCOENOSIS IN THE CRETACEOUS KEM KEM BEDS OF MOROCCO</td>
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<td>DeBlieux, D., Hunt, G., Kirkland, J., Ferris-Rowley, D., Milner, A. SIGNIFICANT NEW MESOZOIC LOCALITIES FOUND DURING A PALEONTOLOGICAL RESOURCE INVENTORY OF BLM WILDERNESS LANDS IN WASHINGTON COUNTY, UTAH</td>
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<td>Crandall, J., Hellert, S., Smith, N., Hammer, W., Makovicky, P. ANATOMY AND AFFINITIES OF LARGE ARCHOSAUROMORPHS FROM THE LOWER FREMOUW FORMATION (EARLY TRIASSIC) OF ANTARCTICA</td>
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THURSDAY AFTERNOON, NOVEMBER 3, 2011
POSTER SESSION II (continued)


14 Scheyer, T., Desojo, J., Cerda, I. COMPARATIVE PALEAEOHISTOLOGY OF TRIASSIC RAUISUCHIAN AND AETOSAURIAN OSTEOERMS (ARCHOSAURIA: PSEUDOSUCHIA)

15 Parker, W., Martz, J., Dubiel, R. A NEWLY RECOGNIZED SPECIMEN OF THE PHYTOSAUR REDONDASAURUS FROM THE UPPER TRIASSIC OWL ROCK MEMBER (CHINLE FORMATION) AND ITS BIOSTRATIGRAPHIC IMPLICATIONS

16 Zawiskie, J., Dawley, R., Nesbitt, S. THE RELATIONSHIPS AND TYPE LOCALITY OF HEPTASUCHUS CLARKI, CHUGWATER GROUP (MIDDLE TO UPPER TRIASSIC), SOUTHEASTERN BIG HORN MOUNTAINS, WYOMING, USA

17 Lucas, S., Heckert, A., Lockley, M. THE TRACKMAKER OF THE LATE TRIASSIC TETRAPOD FOOTPRINT ICHNOTAXON BRACHYCHIROTHERIUM WAS AN AETOSAUR

18 Schneider, V., Heckert, A., Fraser, N. DIVERSITY OF AETOSAURS (ARCHOSAURIA: STAGONOLEPIDIDAE) IN THE UPPER TRIASSIC PEKIN FORMATION (DEEP RIVER BASIN), NORTH CAROLINA

19 Holloway, W., O’Keefe, R. A VIRTUAL PHYTOSAUR (ARCHOSAURIA: CRUROTARSI) ENDOCAST AND ITS IMPLICATIONS FOR SENSORY SYSTEM EVOLUTION IN ARCHOSAURS

20 MOVED TO ORAL PLATFORM, WEDNESDAY, NOVEMBER 2

21 Fechner, R., Schwarz-Wings, D. A FUNCTIONAL EXPLANATION FOR THE PROPUBIC AND OPISTHOPUBIC PELVIS IN EXTANT ARCHOSAURS AND DINOSAURS

22 David, R., Allain, R., Berthoz, A., Janvier, P. A NEW WAY TO ESTIMATE THE DIRECTIONAL SENSITIVITY OF THE SEMICIRCULAR CANALS SYSTEM

23 Taylor, E., Schachner, E., Farmer, C. VARIATION IN HINDLIMB MUSCLE ATTACHMENT SITES IN THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) AND IMPLICATIONS FOR PALEOBIOLOGICAL RECONSTRUCTIONS

24 Felice, R., O’Connor, P. CROCODYLIFORM AQUATIC LOCOMOTION AND AXIAL FLEXIBILITY: COMPARATIVE VERTEBRAL ANATOMY OF MESOEUCROCODYLIANS

25 George, I., Holliday, C. TRIGEMINAL NERVE MORPHOLOGY IN ALLIGATOR MISSISSIPPIENSIS: IMPLICATIONS FOR INFERING SENSORY POTENTIAL IN EXTINCT CROCODYLIFORMS

26 Suzuki, D., Hayashi, S., Chiba, K., Tanaka, K. JAW MECHANICS OF CROCODILES REVEAL THEIR FAST MASTICATION


29 Schubert, B., Mead, J., Stout, J. LATE NEOGENE ALLIGATOR EVOLUTION AND A DESCRIPTION OF SPECIMENS FROM THE GRAY FOSSIL SITE, SOUTHERN APPALACHIANS, USA

30 Gold, M. CRANIAL ANATOMY AND ONTOGENY OF GAVIALIS GANGETICUS USING COMPUTERIZED AXIAL TOMOGRAPHY: IMPLICATIONS FOR GAVIALOID PHYLOGENY

31 Nestler, J. A GEOMETRIC MORPHOMETRIC ANALYSIS OF CROCODYLUS NILOTICUS: OSTEOTOLOGICAL EVIDENCE FOR A CRYPTIC SPECIES COMPLEX

32 Noto, C., Drumheller, S., Main, D., Allen, E. LIFE AND DEATH IN A CRETACEOUS COASTAL SWAMP: EXAMPLE FROM THE WOODBINE FORMATION OF TEXAS
Lockley, M., Lucas, S. CROCS NOT THEROPODS WERE LIKELY TOP PREDATORS ON THE CRETACEOUS DINOSAUR FREEWAY: IMPLICATIONS OF A LARGE TRACK CENSUS

Bennett, III, G., Main, D., Peterson, R., Anderson, B. A TAPHONOMIC AND PALEOECOLOGICAL COMPARISON OF ISOLATED CROCODYLIFORM TEETH FROM THE WOODBINE FORMATION OF TEXAS AND THE HELL CREEK FORMATION OF MONTANA

Figueiredo, R., Kellner, A. A NEW SPECIMEN OF *ARARIPESUCHUS* (MESOEUCROCODYLIA) WITH SOFT TISSUE PRESERVATION FROM THE LOWER CRETACEOUS ROMUALDO FORMATION (ARARIPES BASIN), BRAZIL

Allen, E., Main, D., Noto, C. A NEW CROCODYLIFORM FROM THE MIDDLE CRETACEOUS WOODBINE FORMATION OF TEXAS

Householder, M., Williams, S., Tremaine, K. A NEW, SMALL-BODIED ALLIGATOROID FROM THE HELL CREEK FORMATION (LATE MAASTRICHTIAN) OF MONTANA

Hill, R., O’Connor, P. THE EVOLUTION OF EXOSKELETAL OSSIFICATIONS IN NOTOSUCHIAN CROCODYLIFORMS

Pritchard, A., Turner, A. THE PALATE AND BRAINCASE IN GONIOPHOLIDID CROCODYLIFORMS: INSIGHTS FROM A NEW SKULL OF *EUTREATURANO SUCHUS DELFSI*

Skiljan, R., Gant, C., Holliday, C. STRUCTURE AND FUNCTION OF A PROTOSUCHIAN MANDIBULAR SYMPHYSIS USING ANATOMICALLY INSIGHTS FROM *ALLIGATOR MISSISSIPPIENSIS*

Anggraini, N., Schmitt, J., Jackson, F. RAPID MICROBIALLY-MEDIATED CALCIUM CARBONATE PRECIPITATION: A MODEL FOR PERMINERALIZATION OF EMBRYONIC SOFT TISSUE IN SAUROPOD EGGS

Jackson, F. INFLUENCE OF VERTISOL DEVELOPMENT ON SAUROPOD EGG TAPHONOMY AND DISTRIBUTION IN NESTING GROUND DEPOSITS

Delcourt, R., Grillo, O., Azevedo, S., Romano, P. CLAVICULAR RING: A NEW METHOD TO ARTICULATE THE PECTORAL GIRDLE IN STEM-SAUROPODOMORPHS

Bittencourt, J., Langer, M. NEW INFORMATION ON THE SAUROPODOMORPH FAUNA OF THE UPPER TRIASSIC CATURRITA FORMATION, SOUTH BRAZIL

Holwerda, F., Pol, D., Gröcke D., Rauhut, R. TOOTH MORPHOTYPES OF SAUROPOD DINOSAURS FROM THE CANADON ASFALTO FORMATION (MIDDLE JURASSIC) OF PATAGONIA


Tsuihiji, T., Watabe, M., Tsogtbaatar, K., Barsbold, R., Suzuki, S. A SAUROPOD (DINOSAURIA: SAURISCHIA) BRAINCASE FROM THE LOWER CRETACEOUS OF THE EASTERN GOBI DESERT IN MONGOLIA

Marpmann, J., Carballido, J., Remes, K., Sander, P. ONTOGENETIC CHANGES IN THE SKull ELEMENTS OF THE LATE JURASSIC DWARF SAUROPOD *EUROPASAURUS HOLGERI*

Trujillo, K., DeMar, D., Foster, J., Bilbey, S. AN EXCEPTIONALLY LARGE JUVENILE *CAMARASAURUS* FROM THE MORRISON FORMATION (UPPER JURASSIC) OF ALBANY COUNTY, WY, USA

Mocho, P., Royo-Torres, R., Ortega, F., Silva, B. "EUHELOPODIDAE" (SAUROPODA) TEETH FROM THE UPPER JURASSIC OF PORTUGAL

Sassani, N. THE CHINESE COLOSSUS: AN ANALYSIS OF THE PHYLOGENY OF *RUYANGOSAURUS GIGANTEUS* AND ITS IMPLICATIONS FOR TITANOSAUR EVOLUTION

Fronimos, J. PATTERNS OF POSTCRANIAL PNEUMATICITY IN THE LATE CRETACEOUS TITANOSAUR *ALAMOSAURUS SANJUANENSIS*
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Gorscak, E., O’Connor, P., Stevens, N., Roberts, E. A BASAL TITANOSAURIAN FROM THE MIDDLE CRETAEOUS GALULA FORMATION, RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA

Schroeter, E., Boles, Z., Lacovara, K. THE HISTOLOGY OF A MASSIVE TITANOSAUR FROM ARGENTINA AND IMPLICATIONS FOR MAXIMUM SIZE

Cerda, I., Paulina Carabajal, A., Salgado, L., Coria, R., Moly, J. THE FIRST RECORD OF SAUROPOD DINOSAURS FROM ANTARCTICA

Moacdieh, E., Wilson, J. A QUANTITATIVE APPROACH TO SAUROPOD NECK MORPHOLOGY

Whitlock, J. CHARACTER VISUALIZATION METHODS IN PHYLOGENETIC ANALYSIS

Deng, T. MAMMALIAN ZOOGEOGRAPHY OF THE HIPPARION FAUNA DURING THE LATE MIOCENE IN CHINA

Davis, E., Scott, E., Jenkins, D. MULTIVARIATE DISCRIMINANT ANALYSIS OF PHALANGES OF SMALL EQUUS ALLOWS IDENTIFICATION OF PLEISTOCENE SPECIES AT PAISLEY CAVES, OREGON

Wolf, D., Bernor, R., Hussain, S. SYSTEMATICS, BIOSTRATIGRAPHY, GEOCHRONOLOGY AND PALEODIET OF THE SIWALIK HIPPARIONS FROM THE POTWAR PLATEAU, NORTHERN PAKISTAN

Asami, R., Ibarra, Y., Scott, E., Dundas, R. EQUUS FROM THE MIDDLE IRVINGTONIAN FAIRMEAD LANDFILL LOCALITY, MADERA COUNTY, CALIFORNIA

Barrón-Ortiz, C., Theodor, J., Arroyo-Cabrales, J. FEEDING ECOLOGY OF THE LATE PLEISTOCENE EQUIDS FROM EL CEDRAL, SAN LUIS POTOSI, MEXICO, AS EVIDENCED BY DENTAL WEAR

Baskin, J., Scott, E., Lundelius, E. EVIDENCE FROM MORPHOLOGICAL VARIATION IN LARGE SAMPLES ON THE NUMBER OF SPECIES OF EQUUS IN THE LATE PLEISTOCENE OF NORTH AMERICA

Hernesniemi, E., Fortelius, M. MESOWEAR ANALYSIS APPLIED TO LOWER MOLARS OF HORSE SPECIES

O’Sullivan, J. X-RAY VISION SEES THROUGH ‘THE FEROCIOUS PONY HYPOTHESIS’

Sanisidro, O., Alberdi, M., Morales, J. SEXUAL DIMORPHISM IN ELASMOOTHERIINA (MAMMALIA, RHINOCEROTIDAE) WITH REMARKS ON HISPANTHERIUM MATRITENSE

Holbrook, L., Coombs, M. ON THE PHYLOGENY OF THE CHALICOTHERIIDAE (MAMMALIA, PERISSODACTYLA)

Coombs, M., Rounds, C. A SKULL OF MOROPUS (PERISSODACTYLA, CHALICOTHERIIDAE, SCHIZOTHERIINAE) WITH AN ASSOCIATED PREMAXILLA FROM THE EARLY HEMINGFORDIAN OF NORTHWEST NEBRASKA, USA

Saarinen, J., Fortelius, M. PATTERNS OF BODY MASS AND DIET OF LARGE UNGULATES FROM MIDDLE AND LATE PLEISTOCENE OF UK AND GERMANY AND THEIR CONNECTIONS WITH ENVIRONMENT

Nakaya, H., Onodera, M., Yamada, E., Kunimatsu, Y., Nakatsukasa, M. PALEOENVIRONMENTS OF THE LATE MIOCENE NAKALI AND SAMBURU HILLS, KENYA, FROM RODENT FAUNA AND HERBIVORE MESOWEAR

Prado, J., Alberdi, M. CLIMATIC CHANGE AND PLEISTOCENE MAMMAL DIVERSITY IN THE PAMPEAN REGION OF ARGENTINA

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Alberdi, M., Prado, J., Azanza, B. HOW DID PAST ENVIRONMENTAL CHANGE AFFECT LARGE MAMMAL DIVERSITY IN SPAIN?


Gould, F. CONSTRUCTING A ROBUST ECOMORPHOLOGICAL INDICATOR OF LOCOMOTOR MODE FROM THE DISTAL FEMORAL ARTICULAR SURFACE MORPHOLOGY

Du, A., Behrensmeyer, A., Blumenschine, R., Faith, J. LANDSCAPE NEOTAPHONY AND EAST AFRICAN CARNIVORE GUILD STRUCTURE: MODELING HOMININ SCAVENGING OPPORTUNITIES

Linden, E. MORPHOLOGICAL RESPONSES OF THE DIRE WOLVES (CANIS DIRUS) OF RANCHO LA BREA OVER TIME DUE TO CLIMATIC CHANGES

Koper, L. DESCRIPTION OF THE DIRE WOLF FORELIMB CANIS DIRUS GUILDAYI FROM RANCHO LA BREA

Binder, W. IT’S COMPLICATED: CHANGES IN CANIS DIRUS TEETH AND LIMBS AT RANCHO LA BREA GIVE SIMILAR EVIDENCE OF OPPOSING TRENDS OVER TIME

Madan, M., Prothero, D., Sutyagina, A. SIZE AND SHAPE STASIS IN RANCHO LA BREA FELIDS DURING THE LATE PLEISTOCENE: UNIVARIATE AND MULTIVARIATE STATISTICAL APPROACHES

Carlon, B., Hubbard, C. MORPHOMETRIC ANALYSIS OF RANCHO LA BREAN FELID ILIA

Christine, J., Wallace, S. IDENTIFICATION OF FRAGMENTARY LATE PLEISTOCENE MUSTELOIDS THROUGH MORPHOMETRIC ANALYSES

Ruez, Jr., D. PRAIRIE PALEOECOLOGY: ICE AGE MAMMALS AND TEMPERATURES IN THE U.S. MIDWEST

Ferrer, E., Matzke, N. PHYLOGENETIC DIVERSITY VERSUS SPECIES RICHNESS ACROSS THE MID-MIOCENE CLIMACTIC OPTIMUM: A CASE STUDY IN CANIDS

Cullen, T., Rybczynski, N., Schr-Adams, C. PRELIMINARY DESCRIPTION OF A SMALL SKULL SPECIMEN OF ENALIARCTOS (CARNIVORA, PINNIPEDIMORPHA) FROM THE MIOCENE OF WESTERN OREGON

Siliceo, G., Salesa, M., Antón, M., Morales, J. COMPARATIVE STUDY OF TWO POPULATIONS OF THE SABERTOOTHED FELID PROMEGANTEREON OYGIA (FELIDAE, MACHAIRODONTINAE) FROM BATALLONES-1 AND BATALLONES-3 SITES (LATE MIOCENE, MN 10, TORRESÓN DE VELASCO, MADRID, SPAIN)


Domingo, M., Domingo, L., Badgley, C., Morales, J. DIET OF THREE MIOCENE HYPERCARNIVORES FROM THE MADRID BASIN (SPAIN) BASED ON CARBON-ISOTOPE COMPOSITION OF TOOTH ENAMEL

Wallace, S., Hulbert, R. A NEW MACHAIRODONT FROM THE PALMETTO FAUNA (LATE HEMPHILLIAN) OF FLORIDA, WITH COMMENTS ON THE ORIGIN OF THE SMILODONTINI

Campbell, T., Bromm, G., Hilton, R. OSTEOARTHRITIS IN AN AMPHICYONID FROM THE EARLY BARSTOVIAN, YELLOW HILLS FAUNA, NORTHWESTERN NEVADA
93 Lynch, E., Wallace, S. IN THE TREES OR ON THE GROUND?: READressing THE LOCOMOTOR CLASSIFICATION OF EXTINCT AND EXTANT MUSTELOIDS USING PRINCIPLE COMPONENTS ANALYSIS

94 Hensley-Marschand, B. HYAENIDAE: DIVERSITY AND PHYLOGENETICS IN THE LATE CENOZOIC

95 Hartstone-Rose, A., Simpler, E., Heckler, A. THE DIET OF THE MIO-PLIocene CARNIVORES OF LANGEBAANWEG, SOUTH AFRICA

96 King, L., Wallace, S. EFFECT OF THE GENETIC BOTTLENECK ON THE SEXUAL DIMORPHISM OF THE BLACK FOOTED FERRET (MUSTELA NIGRIPES)

97 Serrano, F., Figueirido, B., Martín, A., Wallace, S., Palmqvist, P. USING GEOMETRIC MORPHOMETRICS TO EXPLORE THE MASTICATORY SYSTEM OF AILURIDS

98 WITHDRAWN

99 Canavan, R., Clementz, M., Bywater-Reyes, S. STABLE ISOTOPE COMPOSITION OF GLYPTODONT OSTEODERMS: A TOOL FOR INTERPRETING PALEO-ENVIRONMENT

100 Shaw, B., Ruedas, L. ELUCIDATING SEMI-ARBOREAL LOCOMOTION OF SMALL GROUND SLOTHS (SUPERORDER XENARTHRA, ORDER PILOSA) THROUGH INDEX ANALYSES


102 Holte, S. THE OSTEOLOGICAL ONTOGENY OF THE MEGALONYX JEFFERSONII MATERIAL FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA

103 McAfee, R. EXPANDING THE POST-CRANIAL TAXONOMIC CHARACTERIZATION OF THE LATE PLEISTOCENE GROUND SLOTH MYLODON DARWINI

104 Raymond, K., Prothero, D. STASIS IN THE LATE PLEISTOCENE GROUND SLOTHS (PARAMYLODON HARLANI) FROM RANCHO LA BREA TAR PITS, CALIFORNIA

105 Lindsey, E. A SLOTH-DOMINATED LATE-QUATERNARY ASPHALT SEEP FROM SANTA ELENA, ECUADOR

106 Haupt, R., DeSantis, L., Green, J. DENTAL MICROWEAR TEXTURE ANALYSIS OF DENTIN

107 Grimm, B., Graham, R. THE EFFECTS OF WEATHERING ON RARE EARTH ELEMENT (REE) UPTAKE: A STUDY FROM THE PLEISTOCENE TARKIO VALLEY AND EOCENE BONES GALORE FOSSIL SITES

108 Kalthoff, D., Rose, K., von Koenigswald, W. WHO IS EATING MY TEETH? BIOEROSIONAL TUNNELING IN FOSSIL MAMMAL DENTITIONS

109 Hodnett, J., Elliott, D., Olsen, T. THE PETALODONTIFORMES (CHONDRICTHYES; EUCONDRORCEPHALI) FROM THE MARINE PERMIAN (LEONARDIAN/GUADELOUPIAN) KAIBAB FORMATION, NORTHERN ARIZONA

110 Richards, K., Clack, J. A MID-CARBONIFEROUS CHONDRICHTHYAN BRAINCASE FROM THE PEAK DISTRICT OF DERBYSHIRE, UK

111 Koot, M., Twitchett, R., Cuny, G., Hart, M. EFFECTS OF THE LATE PERMIAN EXTINCTION ON THE PERMIAN-TRIASCIC SHARK FAUNA

112 Shimada, K., Everhart, M., Reilly, B., Rigsby, C. FIRST ASSOCIATED SPECIMEN OF THE LATE CRETACEOUS SHARK, CRETODUS (ELASMOBRANCHII: LAMNIFORMES)

113 Dickerson, A., Shimada, K., Reilly, B., Rigsby, C. NEW DATA ON THE LATE CRETACEOUS CARDABIODONTID SHARK BASED ON AN ASSOCIATED SPECIMEN FROM KANSAS, USA
THURSDAY AFTERNOON, NOVEMBER 3, 2011
POSTER SESSION II (continued)

114 King, L., Main, D., Noto, C., Bennett, G. SHARK COPROLITES AS PALEOENVIRONMENTAL AND PALEOECOLOGICAL INDICATORS AT THE ARLINGTON ARCHOSAUR SITE, WOODBINE FORMATION (CENOMANIAN), NORTH CENTRAL TEXAS

115 Harrison, L., Vavrek, M., Becker, M., Larsson, H. INSIGHT INTO THE CENOMANIAN (LATE CRETACEOUS) TERRESTRIAL AND MARINE VERTEBRATE FAUNA OF BYLOT ISLAND, NUNAVUT

116 Klug, S., Kriwet, J. NODE AGE ESTIMATIONS AND THE ORIGIN OF ANGEL SHARKS, SQUATINIFORMES (NEOSELACHII, SQUALOMORPHII)

117 Pimiento, C., Hendy, A., MacFadden, B., Ehret, D., Jaramillo, C. MIOCENE CHONDRICTHYANS FROM PANAMA

118 Tulu, Y., Chinsamy, A. LANGEBAANWEG QUARRY, WESTERN CAPE, SOUTH AFRICA: THE ELASMOBRANCH FAUNA AND COMPARISONS TO FAUNAS OF PCS (LEE CREEK) PHOSPHATE MINE AND SHARKTOOTH HILL

119 Popov, E., Takeuchi, G. MIOCENE - EARLY PLIOCENE CHIMAEROID FISHES (HOLOCEPHALI, CHIMAEROIDEI) FROM CALIFORNIA AND A REVIEW OF THE GLOBAL NEOGENE CHIMAEROID DIVERSITY AND DISTRIBUTION

120 Qu, Q., Ahlberg, P., Blom, H., Zhu, M., Li, G. WHAT IS A PORE-CANAL SYSTEM?

121 Chen, D., Blom, H., Ahlberg, P. THREE-DIMENSIONAL HISTOLOGY OF TOOTH CUSHIONS OF LOPHOSTEUS FROM THE LATE SILURIAN OF ESTONIA

122 Jerve, A. EVIDENCE OF ENDOCHONDRAL OSSIIFICATION IN SPINE MATERIAL FROM THE UPPER DEVONIAN, SCAT CRAIG LOCALITY, SCOTLAND

123 Fielitz, C., Shimada, K., Friedman, M. A FOURTH SPECIES OF APATEODUS (TELEOSTEI: AULOPIFORMES) AND ITS IMPLICATIONS TO THE DIVERSITY OF APATEODUS

124 Youssef, M., Sallam, H., Friedman, M., O’Connor, P., Sertich, J. A SAURODONTID FISH FROM THE LATE CRETACEOUS OF DAKHLA OASIS, WESTERN DESERT, EGYPT

125 Romano, C., Brinkmann, W., Ware, D., Jenks, J., Lucas, S. NEW EARLY TRIASSIC FISH FAUNAS FROM THE WESTERN UNITED STATES AND THE RECOVERY OF FISHES AFTER THE END-PERMIAN MASS EXTINCTION

FRIDAY MORNING, NOVEMBER 4, 2011
SYMPOSIUM 4: VERTEBRATE DIVERSITY PATTERNS AND SAMPLING BIAS
PARIS LAS VEGAS, CONCORDE A/B

MODERATORS: Roger B. J. Benson, Philip D. Mannion, Richard J. Butler

8:00 Lloyd, G., Friedman, M. 400-MILLION YEARS OF ‘FISHES’: A SURVEY OF SAMPLING BIASES BASED ON THE UK RECORD

8:15 Brusatte, S., Lloyd, G., Wang, S., Montanari, S., Yi, H. COPING WITH ROCK RECORD BIAS IN STUDIES OF MÓRPHOLOGICAL EVOLUTION: NEW METHODS FOR ANALYZING DISPARITY AND EVOLUTIONARY RATES

8:30 Benson, R., Ruta, M., Atkinson, E. THE COLONISATION OF LAND: POOR SAMPLING OF EARLY AMNIOTES AND SUSTAINED HIGH EVOLUTIONARY RATES IN THE ORIGIN OF THERAPSIDS

8:45 Benton, M., Ruta, M. TETRAPOD EVOLUTION THROUGH THE PERMIAN AND TRIASSIC: ROCK RECORD, SUPERTREES, AND DETECTING EVENTS

9:00 Fröbisch, J. VERTEBRATE DIVERSITY ACROSS THE END-PERMIAN EXTINCTION - SEPARATING BIOLOGICAL AND GEOLOGICAL SIGNALS

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FRIDAY MORNING, NOVEMBER 4, 2011
SYMPOSIUM 4: VERTEBRATE DIVERSITY PATTERNS AND SAMPLING BIAS (continued)

9:15  Whiteside, J., Irmis, R.  NON-BIOTIC CONTROLS OF PERMO-TRIASSIC TETRAPOD DIVERSITY: IMPLICATIONS FOR UNDERSTANDING THE END-PERMIAN EXTINCTION ON LAND

10:15  Carrano, M., Oreska, M.  THE IMPORTANCE OF VERTEBRATE MICROFOSSIL BONEBEDS IN UNDERSTANDING THE FOSSIL RECORD: EXAMPLES FROM THE CLOVERLY FORMATION
10:30  Vavrek, M., Brinkman, D.  BASELINE LEVELS OF ALPHA AND BETA DIVERSITY IN VERTEBRATE MICROFOSSIL ASSEMBLAGES
10:45  Campione, N., Hsieh, S., Evans, D.  DIVERSITY DYNAMICS IN THE LATE CRETACEOUS OF NORTH AMERICA: SAMPLING AND BODY SIZE BIASES
11:00  Mannion, P., Benson, R., Upchurch, P., Butler, R., Carrano, M.  A TEMPERATE PALEODIVERSITY PEAK IN MESOZOIC DINOSAURS AND EVIDENCE FOR LATE CRETACEOUS GEOGRAPHICAL PARTITIONING
11:15  Chew, A., Oheim, K.  SPATIALLY CONSTRAINED RAREFACTION AND GEOGRAPHIC INFORMATION SYSTEMS: MITIGATING THE EFFECTS OF THE SPECIES-AREA RELATIONSHIP IN DIVERSITY ANALYSIS
11:30  Carrasco, M.  COMPARING EXTANT MAMMALIAN SPECIES DIVERSITY TO PALEOSPECIES RICHNESS: PROBLEMS AND SOLUTIONS
11:45  Stegner, M., Holmes, M.  USING PALEONTOLOGICAL DATABASES TO ASSESS SPATIAL AND TEMPORAL CONSERVATION OF MAMMALIAN COMMUNITY STRUCTURE AS AN AID TO CONSERVATION PLANNING
12:00  Rook, D., Heim, N., Marcot, J., Peters, S.  CONTRASTING PATTERNS OF ROCK AND BIOTIC DIVERSITY IN THE MARINE AND TERRESTRIAL FOSSIL RECORDS OF NORTH AMERICA

FRIDAY MORNING, NOVEMBER 4, 2011
TECHNICAL SESSION IX
PARIS LAS VEGAS, VENDOME A
MODERATORS: Patrick Druckenmiller, Jack Conrad

8:00  Druckenmiller, P., Hurum, J., Knutsen, E., Nakrem, H.  AN EXCEPTIONAL NEW ICHTHYOSAUR FROM THE UPPER JURASSIC AGARDHFJELLET FORMATION (VOLGIAN), SVALBARD, NORWAY
8:15  Beardmore, S., Orr, P., Furrer, H.  DEATH, DECAY AND DISARTICULATION: RECONSTRUCTING TAPHONOMIC HISTORIES OF TRIASSIC MARINE REPTILES FROM MONTE SAN GIORGIO, SWITZERLAND
8:30  Jiang, L., Motani, R., Chen, G., Jiang, D., Tintori, A.  THE EMERGENCE OF MARINE REPTILES DURING THE TRIASSIC RECOVERY—RECORDS FROM THE LOWER TRIASSIC OF CHAOHU, CHINA
8:45  Neenan, J., Scheyer, T.  THE BRAINCASE OF PLACODUS GIGAS AGASSIZ, 1833 (SAUROPTERYGIA: PLACODONTIA) - A NEW RECONSTRUCTION BASED ON µ³ CT SCANNING
9:00  O’Keefe, F., Chiappe, L.  VIVIPARITY AND CETACEAN-LIKE LIFE HISTORY IN A MESOZOIC MARINE PLESIOSAUR (REPTILIA: SAUROPTERYGIA)
FRIDAY MORNING, NOVEMBER 4, 2011
TECHNICAL SESSION IX (continued)

9:15 Conrad, J. RE-EXAMINATION SHOWS THAT SINEOAMPHISBAENA HEXATABULARIS IS A MICRO-TEIID (GYMNOPHTHALMIDAE, SQUAMATA), NOT AN ABERRANT AMPHISBAENIAN OR MACRO-TEIID

9:30 Hipsley, C., Müller, J. CRANIAL OSTEOLOGY OF THE EOCENE AMPHISBAENIAN SPATHORHYNCHUS FOSSORIUM AS REVEALED BY X-RAY COMPUTED TOMOGRAPHY

9:45 Stocker, M., Kirk, E. DISCERNING THE DIVERSITY AND BIOGEOGRAPHIC HISTORY OF AMPHISBAENIANS (SQUAMATA) IN THE LATE UINTAN (MIDDLE EOCENE) BASED ON THE FIRST SPECIMENS FROM WEST TEXAS


10:45 Evans, S., Wang, Y. THE EARLY CRETACEOUS LIZARD YABEINOSAURUS: INSIGHTS FROM NEW SPECIMENS

11:00 Edwards, N., Barden, H., Manning, P., Bergmann, U., Wogelius, R. SYNCHROTRON RAPID SCANNING X-RAY FLUORESCENCE OF SOFT-TISSUE PRESERVED IN FOSSILS

11:15 Head, J., Bloch, J., Rincon, A., Bourque, J., Jaramillo, C. AN ENIGMATIC DERIVED SNAKE FROM THE EARLIEST EOCENE OF EQUATORIAL SOUTH AMERICA

11:30 Williams, M. FOSSIL SNAKES AND CLIMATE CHANGE: CORRELATING THE NEOGENE COLUBRID SNAKE RADIATION TO GLOBAL CLIMATIC CHANGES


12:00 Ehret, D., Bourque, J., Hulbert, Jr., R. GIANT BOX TURTLES (TESTUDINES: EMYDIDAE) OF THE TERRAPENE PUTNAMI COMPLEX FROM THE LATE BLANCAN (EARLY PLEISTOCENE) OF FLORIDA

FRIDAY MORNING, NOVEMBER 4, 2011
TECHNICAL SESSION X
PARIS LAS VEGAS, VENDOME B
MODERATORS: Richard Kay, Stephen Chester

8:00 Habersetzer, J., Rabenstein, R. STUDIES IN TAPHONOMY OF EXTANT AND MESSEL BATS

8:15 Padian, K., Dial, K. PHYLOGENETIC DISTRIBUTION OF ECOLOGICAL TRAITS IN THE ORIGIN AND EARLY EVOLUTION OF BATS

8:30 Manz, C., Bloch, J. EVIDENCE FOR SCANSORIALITY IN THE FORELIMB OF NORTH AMERICAN PALEOCENE INSECTIVORES (MAMMALIA, EULIPOTYPHLA)

8:45 Yapuncich, G., Boyer, D., Secord, R., Bloch, J. THE FIRST DENTALLY ASSOCIATED SKELETON OF PLAGIOMENIDAE (MAMMALIA, DERMOPTERA) FROM THE LATE PALEOCENE OF WYOMING

9:00 Chester, S., Bloch, J., Sargis, E., Silcox, M., Williamson, T. ARBOREALITY IN PALAEOCHTHONID PLESIADAPIFORMS (MAMMALIA, PRIMATES): NEW EVIDENCE FROM A PARTIAL SKELETON OF EARLY PALEOCENE TORREJONIA WILSONI

9:15 Secord, R., Bloch, J., Chester, S., Boyer, D., Krigbaum, J. FOREST STRUCTURE, CLIMATE, AND TIMING OF MAMMALIAN IMMIGRATIONS DURING THE PALEOCENE-EOCENE THERMAL MAXIMUM IN NORTH AMERICA

9:30 Jones, K., Rose, K. PREMOLAR EVOLUTION IN THE EARLIEST EUPRIMATES OF WYOMING
9:45 Maiolino, S., Boyer, D., Lemelin, P., Bloch, J., Groenke, J. SEMI-ARTICULATED FOOT OF EOCENE NOTHARCTUS: NEW EVIDENCE FOR A GROOMING CLAW IN AN ADAPIFORM PRIMATE FROM NORTH AMERICA


10:30 Matson, S., Fox, D., Rook, L., Oms, O. CARBON ISOTOPIC RECORD OF THE RELATIVE ROLES OF BIOTIC AND ABIOTIC FACTORS IN THE LATE MIOCENE EXTINCTION OF OREOPITHECUS BAMBOLI, BACCINELLO BASIN, TUSCANY


11:00 Cooke, S. A NEW THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC APPROACH FOR DIETARY RECONSTRUCTION IN EXTINCT PLATYRRHINE PRIMATES FROM PATAGONIA, COLOMBIA, AND THE CARIBBEAN

11:15 Kay, R., Allen, K., Gonzales, L., Krueger, K. DIETARY RECONSTRUCTION OF ANTILLOTHRIX BERNENSIS, A HOLOCENE MONKEY FROM THE DOMINICAN REPUBLIC

11:30 Crowley, B., Godfrey, L. STABLE ISOTOPES EXPLAIN ANACHRONISTIC PLANT DEFENSES IN MADAGASCAR

11:45 Musiba, C., Matthews, N., Noble, T., Kim, J., Domuez-Rodrigo, M. HOW MANY INDIVIDUALS LEFT THEIR FOOTPRINTS AT LAETOLI? REINTERPRETATION OF THE TRACKWAYS BASED ON RECENTLY ACQUIRED 3D DATA

12:00 Bates, K., Bennett, M., Lei, R., Russell, S., Crompton, R. UNDER PRESSURE: HOW MUCH DO FOOTPRINTS TELL US ABOUT FOOT MOTION AND PRESSURE?

FRIDAY AFTERNOON, NOVEMBER 4, 2011
TECHNICAL SESSION XI
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: P. Martin Sander, Hans-Dieter Sues

1:45 Falkingham, P., Bates, K., Mannion, P. EVOLUTIONARY TRENDS IN SAUROPOD BODY PLAN EXPRESSED IN FOSSIL TRACKS AND TRACKWAYS

2:00 Sereno, P., Ogrodnik, J. MASS DISTRIBUTION AND FOOTPRINT AREA IN ELEPHANTS: FUNCTIONAL RAMIFICATIONS FOR LARGE-BODIED EXTANT AND EXTINCT TERRESTRIAL VERTEBRATES

2:15 Dumont, M., Borbely, A., Kostka, A., Sander, M., Kaysser-Pyzalla, A. CRYSTALLOGRAPHIC INVESTIGATIONS OF A GROWTH SERIES OF APATOSAURUS LONG BONES: IMPLICATIONS FOR BIOMECHANICS

2:30 Waskow, K., Sander, P. THE AGE OF GIANTS — HISTOLOGICAL EVIDENCE FOR ONTOGENY IN POST CRANIAL ELEMENTS OF SAUROPODS AND ITS IMPLICATIONS FOR GROWTH HISTORY

2:45 Sander, P., Oliver, W., Griebeler, E., Fowler, D., Henderson, D. HIGH MAXIMUM GROWTH RATE IN CF. MAMENCHISAUROS ARGUES AGAINST LOW BASAL METABOLIC RATE AS THE EXPLANATION FOR SAUROPOD DINOSAUR GIGANTISM

3:00 Bochmer, C., Rauhut, O., Woerheide, G. COMPARATIVE SHAPE ANALYSIS OF THE NECK IN EXTINCT AND EXTANT ARCHOSAURS: IMPLICATIONS FOR VERTEBRAL EVOLUTION IN SAUROPOMORPH DINOSAURS
FRIDAY AFTERNOON, NOVEMBER 4, 2011
TECHNICAL SESSION XI (continued)

3:15 Gee, C. SAUROPOD HERBIVORY DURING LATE JURASSIC TIMES: NEW EVIDENCE FOR CONIFER-DOMINATED VEGETATION IN THE MORRISON FORMATION IN THE WESTERN INTERIOR OF NORTH AMERICA

3:30 D’Emic, M. EARLY EVOLUTION OF TITANOSAURIFORM SAUROPOD DINOSAURS: TAXONOMIC REVISION, PHYLOGENY, AND PALEOBIOGEOGRAPHY

3:45 Sues, H., Witmer, L., Averianov, A. TITANOSAURIA (SAUROPODA) FROM THE UPPER CRETACEOUS (TURONIAN) BISSEKTY FORMATION OF UZBEKISTAN

4:00 Wilson, J., D’Emic, M. THE VALIDITY AND PALEOBIOGEOGRAPHIC HISTORY OF THE TITANOSAUR SAUROPOD ALAMOSAURUS SANJUANENSIS FROM THE LATEST CRETACEOUS OF NORTH AMERICA

FRIDAY AFTERNOON, NOVEMBER 4, 2011
TECHNICAL SESSION XII

PARIS LAS VEGAS, VENDOME A

MODERATORS: Nathan Smith, Michael Habib

1:45 Dial, K. FROM EXTANT TO EXTINCT: EMPIRICAL STUDIES OF TRANSITIONAL FORMS AND ALLOMETRIC CORRELATES DELIMIT BOUNDARIES OF FUNCTIONAL CAPACITY

2:00 Atterholt, J. PHYLOGENETIC MAPPING OF TRAITS OF THE AVIAN ALTRICIAL-PRECocial SPECTRUM, AND ITS IMPLICATIONS FOR INFERRING EARLY AVIALAN LIFE HISTORY

2:15 Smith, N. BODY MASS AND FORAGING ECOLOGY PREDICT EVOLUTIONARY PATTERNS OF SKELETAL PNEUMATICITY IN THE DIVERSE "WATERBIRD" CLADE

2:30 Bourdon, E., Cracraft, J. GASTORNIS IS A TERROR BIRD: NEW INSIGHTS INTO THE EVOLUTION OF THE CARIAMAE (AVES, NEORNITHES)

2:45 Ando, T., Fordyce, R. MORPHOLOGY AND FUNCTION IN WAİMANU PENGUINS: EARLY WING-PROPELLED DIVERS

3:00 Habib, M., Hall, J. FLIGHT PERFORMANCE OF GIANT PSEUDODONTORN BIRDS

3:15 Ksepka, D., Thomas, D. EVIDENCE FOR MULTIPLE CENOZOIC INVASIONS OF AFRICA BY PENGUINS (AVES, SPHENISCIFORMES)

3:30 Meijer, H., James, H., Sutikna, T., Due, R., Tocheri, M. THE LIANG BUA AVIFAUNA: FAUNAL COMPOSITION, DIVERSITY, AND EXTINCTION

3:45 Prassack, K. A LITTLE BIRD TOLD ME: WETLANDS DOMINATED THE PLIO-PLEISTOCENE LANDSCAPE (LOWERMOST BED II DEPOSITS, ~1.75MA) AT OLDUVAI GORGE, TANZANIA

4:00 Hargrave, J. FOSSIL AVIFAUNA OF THE PLEISTOCENE FOSSIL LAKE FORMATION (OREGON): CAN BIRDS BE USED AS A PROXY TO DETERMINE PALEOCLIMATIC CONDITIONS?

FRIDAY AFTERNOON, NOVEMBER 4, 2011
TECHNICAL SESSION XIII

PARIS LAS VEGAS, VENDOME B

MODERATORS: Matthew Mihlbachler, Brian Beatty


2:00 Schultz, J., Martin, T. STRUCTURE AND FUNCTION OF DRYOLESTID MOLARS (MAMMALIA, CLADOTHERIA)
FRIDAY AFTERNOON, NOVEMBER 4, 2011
TECHNICAL SESSION XIII (continued)

2:15  Fraser, D. MODEL SELECTION AND THE PHYLOGENETIC COMPARATIVE METHOD: RUMINANT GRAZERS DO NOT HAVE LARGER MASSETER MUSCLES

2:30  Gailer, J., Kaiser, T. QUANTIFYING CHEWING EFFICIENCY OF RUMINANT DENTAL PATTERNS —AN APPROACH USING THREE-DIMENSIONAL METROLOGY SYSTEMS

2:45  Landwehr, C., Kaiser, T. THREE-DIMENSONAL QUANTIFICATION OF OCCLUSAL PATTERN IN EXTANT EQUIDS

3:00  Calandra, I., Schulz, E., Pinnow, M., Krohn, S., Kaiser, T. FRUIT PROPORTION AND CONSUMPTION OF HARD ITEMS IN THE DIETS OF PRIMATES CORRELATE WITH MICROTEXTURES

3:15  Mihlbachler, M., Beatty, B. EFFECTS OF VARIABLE MAGNIFICATION AND IMAGING RESOLUTION ON PALEODIETARY INTERPRETATIONS DERIVED FROM DENTAL MICROWEAR ANALYSIS

3:30  Hoffman, J., Clementz, M. THE DISTRIBUTION OF GRIT-INDUCED MICROWEAR FEATURES ACROSS THE OCCLUSAL SURFACES OF ARTIODACTYL MOLARS

3:45  Boardman, G., Secord, R. RECONSTRUCTING THE DIETS AND MICROHABITATS OF FOUR LATEST EOCENE - EARLIEST OLIGOCENE PERISSODACTYLS (MAMMALIA) BASED ON STABLE ISOTOPES, DENTAL MESOWEAR, AND DENTAL MICROWEAR TEXTURE

4:00  Beatty, B., Mihlbachler, M. DENTAL MESOWEAR AND LONG-TERM PALEODIETARY TRENDS IN HORSES AND OTHER UNGULATES FROM THE EARLY MIOCENE-EARLY HOLOCENE OF FLORIDA

FRIDAY AFTERNOON, NOVEMBER 4, 2011
POSTER SESSION III
PARIS LAS VEGAS, RIVOLI B
Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1  Pearson, M., Benson, R., Upchurch, P., Fröbisch, J., Kammerer, C. RECONSTRUCTING THE DIVERSITY OF THE EARLIEST TERRESTRIAL HERBIVOROUS TETRAPODS

2  WITHDRAWN

3  Bennett, S. FIRST EVIDENCE OF A CRANIAL CREST IN THE PTEROSAUR RHAMPHORHYNCHUS MÜENSTERI


5  Carroll, N., Poust, A., Varricchio, D. A THIRD AZHDARCHID PTEROSAUR FROM THE TWO MEDICINE FORMATION (CAMPANIAN) OF MONTANA

6  Paulina Carabajal, A., Rauhut, O., Codorniu, L., Pol, D. NEUROANATOMY OF A PTEROSAUR FROM THE JURASSIC OF PATAGONIA USING COMPUTERIZED TOMOGRAPHY

7  Burch, S., Sertich, J. GIANT PTEROSAUR REMAINS FROM THE CAMPANIAN OF THE MORONDAVA BASIN, WESTERN MADAGASCAR

8  Cunningham, J., Habib, M. CAPACITY OF THE PTEROSAUR, ANHANGUERA SANTANAE, TO LAUNCH FROM WATER

9  Vila Nova, B., Sayao, J. USE OF LINEAR MORPHOMETRY TO DEFINE DIAGNOSTIC MORPHOLOGICAL VARIATION IN THE APPENDICULAR SKELETON OF ANHANGUERIDAE AND TAPEJARIDAE PTEROSAURS (PTEROSAURIA, PTERODACTYLOIDEA)
Kawabe, S., Endo, H., Shimokawa, T., Miki, H., Matsuda, S. ALLOMETRIC MORPHOLOGICAL CHANGES IN THE AVIAN BRAIN

Boyd, C., Ksepka, D. QUANTIFYING HISTORICAL TRENDS IN THE COMPLETENESS OF THE AVIAN FOSSIL RECORD

Taras, J., Clarke, J., Baier, D. VARIATION IN THE DELTOPECTORAL CREST IN BIRDS


Li, Z., Zhou, Z., Clarke, J. A REEVALUATION OF THE RELATIONSHIPS AMONG BASAL ORNITHURINE BIRDS FROM CHINA AND NEW INFORMATION ON THE ANATOMY OF HONGSHANORNIS LONGICRESTA

Case, J., Patrick, D., Nezat, C., Clarke, J. RARE EARTH ELEMENT FINGERPRINTING AND 87SR/86SR RATIOS SUPPORT A LATEST MAASTRICHTIAN AGE FOR ANTARCTICA'S FIRST DISCOVERED CRETACEOUS BIRD, POLARORNIS GREGORYI

Naish, D., Dyke, G., Cau, A., Escuillié, F., Godefroit, P. A GIGANTIC BIRD FROM THE UPPER CRETACEOUS OF CENTRAL ASIA

O'Connor, P., Rogers, R., Groenke, J., Burch, S., Turner, A. A MULTI-TAXON THEROPOD DINOSAUR ACCUMULATION FROM THE LATE CRETACEOUS OF MADAGASCAR: NEAR-INSTANTANEOUS ENTOMBMENT OF SMALL-BODIED AVIALANS

Lü, J., Xu, L., Zhang, Jia, S., Chang, H. A NEW GOBIPTERYGID BIRD FROM THE LATE CRETACEOUS CENTRAL CHINA AND ITS BIOGEOGRAPHIC IMPLICATIONS

Lyson, T., Bercovici, A., Chester, S., Sargis, E., Pearson, D. DINOSAUR EXTINCTION: CLOSING THE “THREE METER GAP”

Hedrick, B., Dodson, P., Manning, P. DECIPHERING THE DINOSAURIAN BODY PLAN: USING MORPHOMETRICS TO INFER FUNCTIONAL MORPHOLOGY

Davis, M. COMPLETE CENSUS OF PUBLISHED FOSSIL DINOSAUR INTEGUMENT QUANTIFIES TAPHONOMIC BIAS TOWARDS PREVALENCE OF HADROSAURID SKIN

Boatman, E., Fakra, S., Marcus, M., Schweitzer, M., Goodwin, M. COMPOSITION OF TYRANNOSAURUS AND BRACHYLOPHOSAURUS SOFT TISSUES AT HIGH SPATIAL RESOLUTION: NEW INSIGHTS INTO PROTEIN DIAGENESIS

Iijima, M., Sato, T., Watabe, M., Tsogtbaatar, K., Ariunchimeg, Y. BONE BED OF BABY OVIRAPTOROSAUR AND HADROSAUROID DINOSAURS FROM THE BAYANSHREEE FORMATION (LATE CRETACEOUS) IN SOUTHEASTERN MONGOLIA

Hall, L., Goodwin, M. A DIVERSE DINOSAUR TOOTH ASSEMBLAGE FROM THE UPPER JURASSIC OF ETHIOPIA: IMPLICATIONS FOR GONDWANAN DINOSAUR BIOGEOGRAPHY

Birthsel, T., Milner, A., Hurlbut, M. THE REINTERPRETATION OF AN EARLY JURASSIC DINOSAUR TRACKSITE IN WARNER VALLEY, WASHINGTON COUNTY, UTAH

Zhang, S., Zhao, Z., Xu, X. A LARGE CLUTCH OF DINOSAUR EGGS SHOWING UNEXPECTED VARIABILITY FROM YUN COUNTY, HUBEI PROVINCE, CHINA

Croghan, J., Barta, D., Brundridge, K., Drost, J. EGGSHELL THICKNESS VARIATION IN CHINESE EGGS

Oser, S., Jackson, F. EGGSHELL ABRASION: AN EXPERIMENT TO CHARACTERIZE THE RESULT OF SEDIMENT INTERACTION ON FRAGMENTARY FOSSIL AND MODERN EGGSHELL

Drost, J., Bury, C., Jackson, F., Varricchio, D., Jin, X. DIAGENETIC ALTERATION AND COLORATION BANDING IN SPHEROOLITHID EGGS FROM THE TIANTAI BASIN, CHINA
30 Brundridge, K., Barta, D., Jackson, F., Varricchio, D., Jin, X. FOSSIL EGGS FROM ZHEJIANG PROVINCE, CHINA: EVIDENCE OF A REDUCING ENVIRONMENT FACILITATED BY ORGANIC DECOMPOSITION

31 Barta, D., Brundridge, K., Jackson, F., Varricchio, D., Jin, X. SPHEROOLITHID EGGS FROM THE CRETACEOUS TIANTAI BASIN, ZHEJIANG PROVINCE, CHINA

32 Cadena, E., Bourque, J., Rincon, A., Bloch, J., Jaramillo, C. CENOZOIC FOSSIL TURTLES FROM THE PANAMA CANAL BASIN

33 Luján, À., Alba, D., Delfino, M., Fortuny, J., Carmona, R. CRANIAL REMAINS OF CHEIROGASTER (TESTUDINES: TESTUDINIDAE) FROM THE LATE MIocene OF ECOPARC DE CAN MATA (VALLÈS-PENEDÈS BASIN, NE IBERIAN PENINSULA): TAXONOMIC AND PHYLOGENETIC IMPLICATIONS

34 Hirayama, R., Sonoda, T., Kato, T., Takahashi, A. OLIGOCENE PIG-NOSED TURTLES (CARETTOCHELYIDAE: TESTUDINES) FROM WESTERN JAPAN

35 Morris, Z., Ferrer, E. ONTOGENETIC VARIATION IN EPIPLASTRAL SHAPE AMONG EOCENE TESTUDINOID TURTLES (ECHMATEMYS) OF WESTERN NORTH AMERICA

36 Cherney, M., Gingerich, P., Wilson, J., Zalmout, I., Antar, M. NEW SPECIMENS OF CORDICHELYS (PLEURODIRA, PODOCNEMIDIDAE) FROM LATE EOCENE MARINE STRATA OF FAYUM, EGYPT, AND A REEVALUATION OF CORDICHELYS ANTIQUA

37 Burroughs, R. NEW FOSSIL BOX TURTLES FROM THE PALEogene OF WEST TEXAS: A NEW TAXON WITH CRITICAL INSIGHTS INTO THE EVOLUTIONARY HISTORY OF BOX TURTLES

38 Jasinski, S., Lucas, S., Moscato, D. INVESTIGATION INTO THE TURTLES FROM THE LATE CRETACEOUS TO PALEOCENE IN THE SAN JUAN BASIN, NEW MEXICO

39 Vitek, N. GIANT FOSSIL SOFT-SHELLED TURTLES OF NORTH AMERICA

40 Li, L., Liu, J., Joyce, W., Tong, H. THE OLDEST MORPHOLOGICALLY MODERN SOFT-SHELLED TURTLE (TESTUDINES, PAN-TRIONYCHIDAE) FROM THE JEHOL BIOTA OF CHINA

41 Lawver, D., Jackson, F., Horner, J. TURTLE EGGS AND EMBRYOS IN A CLUTCH FROM THE UPPER CRETACEOUS (CAMPANIAN) JUDITH RIVER FORMATION OF MONTANA

42 Syromyatnikova, E., Danilov, I., Sukhanov, V. THE MORPHOLOGY AND PHYLOGENETIC POSITION OF ADOCUS/ADOCOIDES AMTGAI, AN ADOCID TURTLE FROM THE LATE CRETACEOUS OF MONGOLIA

43 Ullmann, P., Lacovara, K. LARGEST KNOWN SPECIMEN AND FIRST MANDIBLE OF THE CRETACEOUS SIDE-NECKED TURTLE TAPHROSPHYS SULCATUS (TESTUDINES: PLEURODIRA)

44 Early, C., Cadena, E., Ksepka, D. INFERENCES OF THE PALEOECOLOGY OF THE BASAL PLEURODIRE NOTOEMYS ZAPATOCÆNIS BASED ON COMPUTED TOMOGRAPHY IMAGERY


46 Pérez-García, A., Ortega, F., Gasulla, J., Ortega, F. A NEW LARGE CRYPTODIRAN TURTLE FROM THE LOWER CRETACEOUS OF SPAIN

47 Marinheiro, J., Mateus, O. OCCURRENCE OF THE MARINE TURTLE THALASSEMY IN THE KIMMERIDGIAN OF OKER, GERMANY

48 Suarez, C., Kohn, M. DOES CARBONATE CONTENT OF BIOGENIC APATITE CORRELATE WITH BODY TEMPERATURE?

49 Sload, E., Heckert, A., Lucas, S., Schneider, V. THREE DIMENSIONAL DIGITAL MICROSCOPY OF SMALL- AND MICROVERTEBRATE FOSSILS
Evans, T. A TERRESTRIAL VERTEBRATE TAPHOFACIES MODEL OF A HIGH ENERGY LAKESHORE ENVIRONMENT

Tomiya, S. QUANTITATIVE INFERENCES ON MICROVERTEBRATE DEATH ASSEMBLAGES BASED ON RIGHT-LEFT DISPARITY OF SKELETAL PRESERVATION

Crofts, S. FINITE ELEMENT ANALYSIS OF CANONICAL DUROPHAGOUS TEETH

Mitchell, J. USING PHYLOGENETIC CHARACTERS TO INFERENCE EVOLUTIONARY RATES

Belvedere, M., Baucon, A., Furin, S., Mietto, P., Muttoni, G. SHARING ICHNOLOGICAL DATA: FROM THE THEORETICAL MODEL TO THE DEVELOPMENT OF ICHNOBASE

Daniel, J. NOT ALL GHOST LINEAGES ARE REAL: MISPERCEPTIONS OF WHAT TAXA REPRESENT MAY CAUSE ILLUSIONS

Moses, R., Kohn, M. EXPERIMENTAL BONE DIAGENESIS: DIFFUSION PROFILES AND TIMING OF RARE EARTH AND TRACE ELEMENT UPTAKE

Bezold, S., Kondrashov, P., Lucas, S. A NEW SPECIES OF HERPETOTHERIINA (MAMMALIA, MARSUPIALIA) FROM THE TORREJONIAN OF NEW MEXICO

Williamson, T., Peppe, D., Secord, R., Brusatte, S., Weil, A. A LONG-TERM TERRESTRIAL RECORD OF EARLY PALEOCENE CLIMATE AND ECOSYSTEM CHANGE IN THE SAN JUAN BASIN, NEW MEXICO

DeSantis, L., Beavins Tracy, R., Koontz, C., Roseberry, J., Velasco, M. MAMMALIAN NICHE CONSERVATION THROUGH DEEP TIME

Christensen, H. MAMMALIAN COMMUNITY CHANGE IN THE PALEOCENE OF NORTH AMERICA

De Bast, E., Sigé, B., Smith, T. PRESENCE OF PENTACODONTID MAMMALS IN THE EUROPEAN PALEOCENE

Coster, P., Benammi, M., Mahboubi, M., Tabuce, R., Tabuce, R. MAGNETIC POLARITY STRATIGRAPHY, BIOSTRATIGRAPHY AND AGE OF THE EARLY MIDDLE CONTINENTAL EOCENE DEPOSITS OF EL KOHOL AND GOUR LAZIB FORMATIONS (ALGERIA)

Voss, M. VERTEBRAL ANOMALIES IN FOSSIL SEA COWS (MAMMALIA, SIRENIA): DID THEY CAUSE BACKACHES?

Fahlke, J., Bastl, K., Semprebon, G. DIETARY ADAPTATIONS IN EOCENE ARCHAEOCETE WHALES REVEALED BY MICROWEAR AND MACROWEAR ANALYSIS AND STOMACH CONTENTS

Field, D., Racicot, R., Uhen, M. A NEW MARINE TETRAPOD ASSEMBLAGE FROM THE EOCENE OF WESTERN SAHARA

Glynn, A., Marcot, J. ENVIRONMENTAL INFLUENCES ON MAMMALIAN UNGULATE GUILD COMPOSITION IN THE LATE PALEOGENE: A TAXON-FREE APPROACH USING DENTAL MEASUREMENTS

Theodor, J., Seale, B. PETROSAL MORPHOLOGY OF THE PROTOCERATID CETARTIODACTYL PROTHERAS CELER

Welsh, E. NEW APPROACHES IN UNDERSTANDING THE SYSTEMATICS OF LEPTAUCHENIINE OREODONTS (ARDIODACTYLA: MERYCODONTITIDAE) AND IMPLICATIONS OF A NEW STRATIGRAPHIC OCCURRENCE OF SESPIA IN THE HIGH PLAINS

Ruf, I., Czubak, A. CT ANALYSIS OF THE ETHMOIDAL REGION IN CAINOTHERIIDAE (ARDIODACTYLA, MAMMALIA)

Papazian, J., Dewar, E. CONCORDANCE OF DIETARY SIGNALS BETWEEN TOOTH CREST LENGTHS AND ENAMEL MICROWEAR OF EOCENE AND Oligocene Ungulates

O’Brien, H. ADVANTAGEOUS ARTIODACTYL ANATOMY: ASSESSING THE FUNCTION AND EVOLUTIONARY HISTORY OF THERMOREGULATORY CRANIAL VASCULATURE WITHIN THE Ruminantia
FRIDAY AFTERNOON, NOVEMBER 4, 2011
POSTER SESSION III (continued)

72 Tabrum, A. BRIDGERIAN MAMMALS FROM THE TYPE LOCALITY OF THE SAGE CREEK FORMATION, SAGE CREEK BASIN, BEAVERHEAD COUNTY, MONTANA


74 Zack, S. THE DECIDUOUS DENTITION OF DIDYMICTIS (VIVERRAVIDAE) AND THE FIRST APPEARANCE OF HYAENODONTIDAE

75 Figueirido, B., Janis, C., Pérez-Claros, J., Palmqvist, P. MAMMALIAN FAUNAL DYNAMICS IN NORTH AMERICA OVER DEEP TIME

76 Janis, C., Figueirido, B., Pérez-Claros, J., Palmqvist, P. MAMMALIAN FAUNAL DYNAMICS OVER DEEP TIME II: COMPARISON BETWEEN CARNIVORES AND HERBIVORES

77 Spaulding, M. THE TAXONOMIC POSITION OF PALAEGALE (MAMMALIA: CARNIVORAMORPHA)

78 Hoffmann, S., Martin, T. REVISED PHYLOGENY OF PHOLIDOTA: IMPLICATIONS FOR FERAE

79 Bastl, K., Semprebon, G., Nagel, D. THE DIETARY PREFERENCE OF HYAENODON (HYAENODONTIDAE, MAMMALIA) USING STEREOMICROWEAR WITH NEW INSIGHTS REGARDING ITS ECOMORPHOLOGY

80 Ahrens, H. POSTCRANIAL MORPHOLOGY OF DIPSALIDICTIS TRANSIENS (MAMMALIA: OXYAENIDAE): FUNCTIONAL INTERPRETATIONS AND TAXONOMIC SIGNIFICANCE

81 Morse, P., Bloch, J. PARTIAL HYAENODONTID (MAMMALIA, CREODONTA) SKELETON FROM THE PALEOCENE-EOCENE THERMAL MAXIMUM OF NORTH AMERICA

82 Sartin, C. VARIATION IN THE MOLAR MORPHOLOGY OF DIDELPHIS VIRGINIANA AND ITS IMPLICATIONS FOR THE FOSSIL RECORD

83 Burrows, A. DIET CATEGORIZATION FOR DIDELPHID MARSUPIALS USING TOOTH ENAMEL MICROWEAR

84 Bennett, C., Goswami, A. MORPHOLOGICAL CONSTRAINT IN THE METATHERIAN CRANIUM

85 Bravo-Cuevas, V., Baños-Rodríguez, R., Olvera-Badillo, P. ECOLOGICAL DIVERSITY OF A LARGE MAMMALIAN COMMUNITY FROM THE LATE PLEISTOCENE OF HIDALGO, CENTRAL MEXICO: A PRELIMINARY APPROACH

86 Stilson, K., Hopkins, S., Davis, E. DETECTING AND ACCOUNTING FOR DEPOSITIONAL BIAS IN THE LATE MIOCENE MCKAY RESERVOIR FAUNA

87 George, C. COMPARISON OF IDENTIFICATION TECHNIQUES FROM QUATERNARY DEPOSITS USING FOSSIL SHREWS (SORCIDAE: MAMMALIA)

88 Furió, M., Alba, D., Carmona, R., Rifà, E. NEW FOSSIL REMAINS OF LANTANOTHERIUM (ERINACEIDAE, MAMMALIA) FROM THE VALLESIAN (LATE MIOCENE) OF VILADECAVALLS (NE SPAIN)

89 Horovitz, I., Scheyer, T., Carlini, A., Aguilera, O., Sánchez-Villagra, M. NEW ASTRAPOTHERE POSTCRANIAL REMAINS FROM THE LATE MIOCENE OF VENEZUELA

90 Eastham, L., Feranec, R., Begun, D., Laszlo, K. RESOURCE PARTITIONING IN LATE MIOCENE CENTRAL EUROPEAN MAMMALS: ISOTOPIC EVIDENCE FROM THE RUDABANYA FAUNA

91 Miller, W., Delgado de Jesus, R., Gomez Nunez, R., Vallejo Gonzalez, J., Lopez Espinosa, J. A NEW LATE PLEISTOCENE VERTEBRATE SITE FROM COAHUILA, MEXICO

92 Peppe, D., Deino, A., Lehmann, T., Dunsworth, H., Harcourt-Smith, W. NEW AGE CONSTRAINTS FOR THE EARLY MIOCENE FAUNAS OF RUSINGA AND MFANGANO ISLANDS (LAKE VICTORIA, KENYA)

FRIDAY AFTERNOON, NOVEMBER 4, 2011
POSTER SESSION III (continued)

94 Milideo, L., Graham, R., Falk, C., Semken, H. EFFECTS OF GEOGRAPHIC AREA AND SAMPLE SIZE ON TAPHONOMIC OVERPRINTING

95 Murray, L., Jefferson, G. THE PROBLEM OF FAUNAL LISTS

96 Bridges, T., Evans, T., Novak, B., Varricchio, D. THE EFFECTS OF VARIOUS ENVIRONMENTS AND SEDIMENTS ON THE DECAY OF SOFT TISSUE WITHIN ODOKOILEUS VIRGINIANUS PHALANGES

97 Gill, F. FAECAL LIPID BIOMARKERS FROM MODERN AND ANCIENT HERBIVORES

98 Nachman, B., Milleson, M., Kappelman, J., Tabor, N., Todd, L. ISOTOPIC INDICATORS OF SEASONALITY IN THE LATE PLISTOCENE OF NORTHWEST ETHIOPIA


100 Ditchfield, P., Vaughan, A., Bishop, L., Kingston, J., Plummer, T. ENVIRONMENTAL RECORDS OF BED I, OLDUVAI, TANZANIA FROM STABLE ISOTOPES OF MAMMALIAN TOOTH ENAMEL

101 Steininger, C. ECOCLOGICAL PROFILE FOR SOUTH AFRICA AND EAST AFRICAN EARLY HOMININ FOSSIL SITES USING STABLE CARBON ISOTOPES FROM FOSSIL BOVID DENTITION

102 Yann, L., Haupt, R., DeSantis, L., Romer, J., Corapi, S. MAMMALIAN OXYGEN ISOTOPE VALUES AS AN INDICATOR OF REGIONAL CLIMATIC DIFFERENCES IN THE PLISTOCENE NORTH AMERICA

103 Bibi, F., Boisserie, J., White, T. PALEOENVIRONMENTAL CHANGE IN EASTERN AFRICA THROUGH THE FOSSIL RECORD OF BOVIDAE

104 Winkler, D., Kaiser, T., Schulz, E. NO GRASS TODAY: DIETARY RECONSTRUCTION AND DENTAL EVOLUTION OF THE BALEARIC CAVE GOAT MYOTRAGUS (PLIO-HOLOCENE, SPAIN)

105 Carr, J., Pagnac, D. WHY THE LONG FACE? DENTAL MICROWEAR COMPARISON OF LONGIROSTROMERYX AND BLASTOMERYX (ARTIODACTYLA, MOSCHIDAE)

106 Goble, E. SKELETAL ELEMENT AND BOVID ABUNDANCE ANALYSES IN PALEOENVIRONMENTAL RECONSTRUCTION OF THE CHEMERON FORMATION, TUGEN HILLS, KENYA

107 Rowland, S., Hardy, F., McLaurin, B. THE WILKIN-QUARRY RANCHOLABREAN BIOTA OF LINCOLN COUNTY, NEVADA

108 Tsubamoto, T., Htike, T., Maung-Thein, Z., Egi, N., Takai, M. THE ANTHRACOTHERES (MAMMALIA, ARTIODACTYLA) FROM THE NEogene OF CENTRAL MYANMAR

109 Miller, E., Gunnell, G., Clementz, M., Abdel Gawad, M., Hamdan, M. NEW ANTHRACOTHERES (ARTIODACTYLA) FROM WADI MOGHRA, EGYPT, AND THEIR BEARING ON HIPPOPOTAMUS PHYLOGENY

110 Rincon, A., Bloch, J., MacFadden, B., Jaramillo, C. FIRST OCCURRENCE OF ANTHRACOTHERES (ARTIODACTYLA, ANTHRACOTHERIIDAE) FROM THE EARLY MIocene OF CENTRAL AMERICA

111 Prothero, D., Pollen, A. A NEW SPECIES OF THE PECCARY MACROGENIS FROM THE LATE CLARENDONIAN (LATE MIocene) BLACK HAWK RANCH LOCALITY, CONTRA COSTA COUNTY, CALIFORNIA

112 Grenader, J., Prothero, D. A NEW, PRIMITIVE SPECIES OF THE FLAT-HEADED PECCARY PLATYGONUS FROM THE LATE HEMPHILLIAN (LATEST MIocene) OF KANSAS, NEBRASKA, AND TEXAS

113 Hou, S., Deng, T. THE SYSTEMATIC POSITION OF CHLEUASTOCHOERUS

114 McHorse, B., Hopkins, S., Davis, E. TAXONOMY, PALEOECOLOGY, AND FUNCTIONAL MORPHOLOGY OF MIocene CAMELIDS IN THE JUNTURA FORMATION

115 Curran, S. A VERY COMPLETE DORCATHERIUM PIGOTTI (TRAGULIDAE, MAMMALIA) SKELETON FROM RUSINGA ISLAND, KENYA: IMPLICATIONS FOR FUNCTIONAL MORPHOLOGY
FRIDAY AFTERNOON, NOVEMBER 4, 2011
POSTER SESSION III (continued)

116 Kottachchi, N., Ibarra, Y., Dundas, R. CAMELOPS FROM THE MIDDLE PLEISTOCENE (MIDDLE IRVINGTONIAN) FAIRMEAD LANDFILL LOCALITY, MADERA COUNTY, CALIFORNIA

117 Bredehoeft, K. MORPHOMETRICS OF THE MOOSE TRIBE, ALCEINI: CERVALCES VS. ALCES


119 Vietti, L., Bailey, J., Flood, B. EARLY FRAMBOIDAL PYRITE FROM A SIMULATED WHALE FALL: NEW INSIGHTS INTO MARINE TETRAPOD BONE DIAGENESIS

120 Varadian, E., Beatty, B., Geisler, J. 3D MORPHOMETRIC ANALYSIS OF INTERSPECIFIC VARIATION IN ODONTOCETE PETROSALS

121 Dooley, Jr., A. CHARACTERISTICS OF THE CARMEL CHURCH BONEBED, A MARINE VERTEBRATE DEPOSIT FROM THE MIocene OF VIRGINIA

122 El Adli, J., Boessenecker, R. THE MUSCULATURE OF THE TEMPOROMANDIBULAR REGION IN THE MIO-PLIOCENE BALEEN GENUS HERPETOCETUS AND ITS INFERRENCE FOR FEEDING STRATEGY


SATURDAY MORNING, NOVEMBER 5, 2011
TECHNICAL SESSION XIV
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: Max Langer, Jonah Choiniere

8:00 Langer, M., Cabreira, S., Bittencourt, J., Silva, L., Schultz, C. A NEW EUSAURISCHIAN FROM THE SANTA MARIA FORMATION, LATE TRIASSIC OF BRAZIL, HIGHLIGHTS MOSAIC PATTERN OF CHARACTER EVOLUTION DURING THE RISE OF DINOSAURS


8:30 Souter, T., Abourachid, A., Baylac, M., Cornette, R., Hutchinson, J. FUNCTIONAL 3D KINEMATICS AND SURFACE MORPHOMETRICS OF THEROPOD HIP-JOINT

8:45 Du, T., Larsson, H. THEROPODS IN MORPHOSPACE: A GEOMETRIC MORPHOMETRIC APPROACH TO VARIATION AND DIVERSITY IN THEROPOD CRANIOFACIAL MORPHOLOGY

9:00 Zelenitsky, D., Therrien, F., Ridgely, R., McGee, A., Witmer, L. IMPORTANCE OF OLFACTION DURING THEROPOD EVOLUTION

9:15 Bourke, J., Witmer, L. COMPUTER MODELING OF NASAL AIRFLOW IN TWO EXTANT AVIAN DINOSAURS (TURKEY AND OSTRICH), WITH IMPLICATIONS FOR MODELING AIRFLOW IN EXTINCT THEROPODS

9:30 Lee, A., O’Connor, P. VARIATION IN BONE HISTOLOGY AND GROWTH OF THE NOASAURID THEROPOD MASIASKASURUS KNOPFLERI

9:45 Zanno, L., Makovicky, P. BODY MASS EVOLUTION IN OMNIVOROUS/HERBIVOROUS COELUROSAURIAN DINOSAURS

10:15 Miyashita, T. CRANIAL MORPHOLOGY OF THE BASAL TYRANNOSAUROID ITEMIRUS MEDULLARIS AND EVOLUTION OF THE BRAINCASE PNEUMATICITY IN NON-AVIAN COELUROSAURS

10:30 Carr, T. A COMPARATIVE STUDY OF ONTOGENY BETWEEN DERIVED TYRANNOSAUROIDS: EVIDENCE FOR HETEROCHRONY
SATURDAY MORNING, NOVEMBER 5, 2011
TECHNICAL SESSION XIV

10:45  Goodwin, M., Stanton, K., Stanton, K., Horner, J., Carlson, S. OXYGEN ISOTOPIC VARIABILITY AND PRESERVATION IN TYRANNOSAURUS REX, MODERN RATITES AND CROCODYLIANS: REVISITING THE THERMOPHYSIOLOGY OF T. REX USING $\delta^{18}O$

11:00  Allain, R., Vullo, R., Leprince, A., Néraudeau, D., Tournepiche, J. AN ORNITHOMIMOSAUR-DOMINATED BONEBED FROM THE EARLY CRETACEOUS OF SOUTHWESTERN FRANCE


11:30  Xu, X., Sullivan, C., Zhang, F., O'Connor, J. A NEW EUMANIRAPTORAN PHYLOGENY AND ITS IMPLICATIONS FOR AVIALAN ORIGINS

11:45  Lamanna, M., Sues, H., Schachner, E., Lyson, T. A NEW CAENAGNATHID Oviraptorosaur (THEROPODA: MANIRAPTORA) FROM THE UPPER CRETACEOUS (MAASTRICHTIAN) HELL CREEK FORMATION OF THE WESTERN UNITED STATES

12:00  Müller, J., Bussert, R., David, E., Klein, N., Salih, K. NEW DISCOVERIES AND INVESTIGATIONS ON THE LATE CRETACEOUS VERTEBRATE FAUNA OF NORTHERN SUDAN

SATURDAY MORNING, NOVEMBER 5, 2011
TECHNICAL SESSION XV

PARIS LAS VEGAS, VENDOME A

MODERATORS: Kenneth Angielczyk, Christian Kammerer

8:00  Hawthorn, J., Reisz, R. A NEW SMALL OPHIACODONTID (SYNAPSIDA, EUPELYCOSAURIA) FROM THE LATE PENNYSYLVANIAN OF GARNETT, KANSAS

8:15  Brink, K., Reisz, R., Scott, D. ONTOGENY AND TAXONOMY OF A NEW SPHENACODONTID SPECIMEN FROM THE EARLY PERMIAN OF TEXAS

8:30  Sigurdsen, T., Huttenlocker, A., Modesto, S., Rowe, T., Damiani, R. REASSESSMENT OF THE MORPHOLOGY AND PALEOBIOLOGY OF THE THEROCEPHALIAN TETRACYDONODON DARTI (THERAPSIDA) BASED ON CT-SCANNING, AND THE PHYLOGENETIC RELATIONSHIPS OF BAURIOIDEA

8:45  Angielczyk, K., Steyer, J., Sidor, C., Smith, R., Whatley, R. DICYNODONT (THERAPSIDA, ANOMODONTIA) ASSEMBLAGES FROM THE LUANGWA BASIN, ZAMBIA: TAXONOMIC UPDATE AND IMPLICATIONS FOR BIOSTRATIGRAPHY AND BIOGEOGRAPHY

9:00  Camp, J., Liu, J. THE TAXONOMY AND CRANIAL MORPHOLOGY OF CHINESE LYSTROSAURUS

9:15  Smith, R., Botha-Brink, J. ANATOMY OF AN EXTINCTION: END-PERMIAN DROUGHT INDUCED DIE-OFF IN THE KAROO BASIN, SOUTH AFRICA

9:30  Kammerer, C. THE ORIGIN AND EARLY EVOLUTION OF THE GORGONOPSIDA

9:45  Rubidge, B., Day, M., Angielczyk, K., Guven, S. MIDDLE PERMIAN BIODIVERSITY CHANGES AND THE GUADALUPIAN EXTINCTION ON LAND; UNRAVELING EVIDENCE FROM THE BEAUFORT GROUP, SOUTH AFRICA

10:15  Jasinoski, S., Chinsamy, A. MICROSTRUCTURAL ANALYSIS AND GROWTH OF THE TRITYLODON MANDIBLE

10:30  Luo, Z. NEGATIVE ALLOMETRY IN ONTOGENY AND EVOLUTION OF MAMMALIAN MIDDLE EAR IN MESOZOIC MAMMALS

10:45  Rowe, T., Macrini, T., Luo, Z. OLDEST FOSSIL EVIDENCE ON ORIGIN OF THE MAMMALIAN BRAIN

11:00  Martin, T., Averianov, A., Lopatin, A. MIDDLE JURASSIC MAMMALS FROM THE ITAT FORMATION AT BEREZOVSK QUARRY IN WESTERN SIBERIA (RUSSIA)
SATURDAY, NOVEMBER 5, 2011
TECHNICAL SESSION XV (continued)

11:15  Rougier, G., Gaetano, L., Makovicky, P. AN ENIGMATIC LARGE-SIZED PARTIAL SKELETON OF AN EUCYNODONT FROM THE ANTLERS FORMATION, TRINITY GROUP, EARLY CRETACEOUS OF TEXAS

11:30  Corfe, I., Smith, A., Häkkinen, T., Gill, P., Jernvall, J. THE DEVELOPMENTAL BASIS OF 200 MILLION YEAR OLD MAMMAL TEETH

11:45  Evans, A., Proctor, K. THE INHIBITORY CASCADE IN MARSUPIALS

12:00  Buchholtz, E., Yang, J., Bailin, H., Laves, S., Drozd, L. LOCALIZATION OF THE DIAPHRAGM AND AXIAL PATTERNING IN MAMMALS

SATURDAY MORNING, NOVEMBER 5, 2011
TECHNICAL SESSION XVI
PARIS LAS VEGAS, VENDOME B
MODERATORS: Catherine Boisvert, Katharine Criswell

8:00  Gai, Z., Donoghue, P., Janvier, P. THE TRUE TRABECULAE CRANII IN STEM-GNATHOSTOME GALEASPIDS (AGNATHA)

8:15  Scott, B., Wilson, M. NEW OSTEOSTRACAN TAXA FROM THE LOWER DEVONIAN (LOCHKOVIAN) MAN ON THE HILL LOCALITY IN CANADA, INCLUDING A NEW NON-CORNUATE OSTEOSTRACAN

8:30  Zhu, M., Yu, X., Qu, Q. NEW CHARACTER DIAGNOSIS YIELDS NOVEL PERSPECTIVES ON THE INTERRELATIONSHIPS OF MAJOR GNATHOSTOME GROUPS

8:45  Brazeau, M., Friedman, M. THREE-DIMENSIONAL GILL ARCH STRUCTURE IN A STEM GNATHOSTOME REVEALED BY SYNCHROTON TOMOGRAPHY

9:00  Anderson, P., Friedman, M., Brazeau, M., Rayfield, E. THE INITIAL RADIATION OF JAWS: FUNCTIONAL STABILITY IN THE FACE OF FAUNAL AND ENVIRONMENTAL CHANGE

9:15  Boisvert, C., Trinajstic, K., Currie, P. INSIGHTS ON THE EVOLUTION OF THE PELVIC GIRDLE OF EARLY GNATHOSTOMES FROM THE DEVELOPMENT OF THE ELEPHANT SHARK (CAllORhinChUs MiLli) AND PRESERVED SOFT TISSUE IN DEVONIAN PLACODERMS

9:30  Finarelli, J., Coates, M. RE-DESCRIPTION OF THE SKELETAL ANATOMY OF CHONDRENCHLYES PROBLEMATICA AND ANCESTRAL CONDITIONS IN THE HOLOCEPHALI

9:45  Choo, B. A TALE OF TWO “MIMIA”S. A NEW BASAL ACTINOPTERYGIAN FROM THE LATE DEVONIAN GOGO FORMATION, WESTERN AUSTRALIA

10:15  Sallan, L. WHEN IS AN EEL NOT AN EEL? AXIAL REGIONALIZATION AND SPECIALIZATION IN AN EARLY ACTINOPTERYGIAN FISH, TARRASIUS PROBLEMATICUS

10:30  Khalloufi, B., Grand, A., Zarageta i Bagils, R. INFERRING AGE AND BIOGEOGRAPHIC RELATIONSHIPS FROM A VERTEBRATE FOSSIL ASSEMBLAGE: NEW METHODOLOGIES FOR JBEL TSELFAT (UPPER CRETACEOUS, MOROCCO)

10:45  Kriwet, J. ORIGIN AND DIVERSIFICATION OF CODS AND ALLIES (TELEOSTEI, GADIFORMES)

11:00  Dutel, H., Maisey, J., Schwimmer, D., Janvier, P., Clément, G. THE GIANT COELACANTH MEGALOCOELACANTHUS DOBIEI FROM THE UPPER CRETACEOUS OF NORTH AMERICA AND ITS BEARINGS ON THE PHYLOGENY OF MESOZOIC COELACANTHS

11:15  Criswell, K. THE PHYLOGENETIC RELATIONSHIPS AND EVOLUTIONARY HISTORY OF LEPIDOSIRENID LUNGFISHES: A TOTAL-EVIDENCE APPROACH

11:30  Qiao, T., Lu, J., Zhu, M., John, A. CRANIAL ANATOMY OF A PRIMITIVE OSTEICHTHYAN PSAROLEPIS BASED ON HIGH-RESOLUTION COMPUTED TOMOGRAPHY
SATURDAY MORNING, NOVEMBER 5, 2011
TECHNICAL SESSION XVI (continued)

11:45  Lemberg, J., Taft, N., Daeschler, T., Shubin, N. VASCULARIZATION AND DORSOVENTRAL ASYMMETRIES IN THE PECTORAL FIN OF TIKTAALIK ROSEA E SHED LIGHT ON THE FIN TO LIMB TRANSITION

12:00  Liu, J., Wilson, M., Chang, M., Murray, A. THE EARLY DIVERSITY OF NON-CYPRINID CYPRINIFORMS (OSTARIOPHYSI, CYPRINIFORMES) IN THE EOCENE OF EAST ASIA AND NORTH AMERICA

SATURDAY AFTERNOON, NOVEMBER 5, 2011
TECHNICAL SESSION XVII
PARIS LAS VEGAS, CONCORDE A/B
MODERATORS: Aaron Wood, Julien Louys

1:45  Ross, D., Marcot, J. RATES AND PATTERNS OF NORTH AMERICAN CAMELID LIMB EVOLUTION IN THE CONTEXT OF CENOZOIC ENVIRONMENTAL CHANGE

2:00  Bormet, A. ENVIRONMENTAL INFLUENCES ON THE EVOLUTION AND GEOGRAPHIC DISTRIBUTION OF CAMELIDAE (ARTIODACTYLA, MAMMALIA)

2:15  Levering, D., Hopkins, S., Davis, E. DECREASING LIMB INERTIA AMONG NORTH AMERICAN UNGULATES ACROSS THE PALEOGENE NEOGENE BOUNDARY

2:30  Rössner, G., Mörs, T., Mayda, S., Göhlich, U., Sánchez, I. EXTENDING KNOWLEDGE ON THE EVOLUTIONARY HISTORY OF TRAGULIDAE (MAMMALIA, CETARTIODACTYLA) — NEW DISCOVERIES FROM EUROPE AND AFRICA

2:45  Souron, A. SYSTEMATICS OF EXTANT AND EXTINCT AFRICAN SUIDAE INFERRED FROM LANDMARK-BASED GEOMETRIC MORPHOMETRIC ANALYSIS OF CRANIO-MANDIBULAR SHAPE

3:00  Louys, J., Montanari, S., Plummer, T., Hertel, F., Bishop, L. DIVERGENT TOES: EVOLUTION OF AFRICAN ANTELOPE PROXIMAL PHALANGES AND IMPLICATIONS FOR DIVERGENCE OF SHAPE AND SIZE

3:15  Wood, A. REGIONAL DIFFERENCES IN TARSAL MORPHOTYPES AMONG LATE MIOCENE-PLIOCENE EQUIDS: A 3D GEOMETRIC MORPHOMETRIC STUDY

3:30  Mkrtchyan, R., Belmaker, M., Hynek, S., Belyaeva, E., Aslanian, S. STEPHANORHINUS CF. HUNDSHEIMENSIS FROM KURTAN, A NEW EARLY PLEISTOCENE SITE IN THE LORI PLATEAU, ARMENIA: IMPLICATIONS FOR THE BIOGEOGRAPHY OF RHINOCEROTIDAE SEDN AWARD

3:45  Kapner, D., Mihlbachler, M. FUNCTIONAL MORPHOLOGY AND EVOLUTION OF LOCKING MECHANISM IN THE SHOULDER OF RHINOCEROTID PERISSODACTYLS

4:00  Matzke, N., Maguire, K. INCLUSION OF FOSSIL SPECIES RANGE DATA IN DISPERSAL-EXTINCTION-CLADOGENESIS (DEC) ANALYSES CORRECTS LOW ESTIMATES OF EXTINCTION RATE AND IMPROVES ESTIMATES OF HISTORICAL BIOGEOGRAPHY

SATURDAY AFTERNOON, NOVEMBER 5, 2011
TECHNICAL SESSION XVIII
PARIS LAS VEGAS, VENDOME A
MODERATORS: Casey Holliday, Joseph Sertich

1:45  Pol, D., Rauhut, O., Lecuona, A., Leardi, J. A NEW BASAL CROCODYLOMORPH FROM THE LATE JURASSIC OF PATAGONIA AND ITS IMPLICATIONS FOR THE EVOLUTION OF THE CROCODYLIFORM BRAINCASE

2:00  Holliday, C., Gardner, N. A NEW EUSUCHIAN CROCODYLIFORM WITH NOVEL CRANIAL INTEGUMENT AND THE ORIGIN OF CROCODYLIA
2:15 Sertich, J. NEW REMAINS OF MIADANASUCHUS OBLITA FROM THE LATE CRETACEOUS OF MADAGASCAR AND A REEVALUATION OF TREMATOCHAMPSIDAE

2:30 Hastings, A., Bloch, J., Rincon, A., MacFadden, B., Jaramillo, C. NEW PRIMITIVE CAIMANINE (CROCODYLIA, ALLIGATORIDAE) FROM THE MIOCENE OF PANAMA


3:00 Wilberg, E. COMPARATIVE MORPHOMETRICS AND PHYLOGENETIC PERSPECTIVES ON THE MORPHOSPACE OF THE CROCODYLIFORM SKULL

3:15 Montefeltro, F., Larsson, H. EVOLUTION OF THE OTIC REGION OF FOSSIL CROCODYLIFORMES

3:30 Schachner, E., Metzger, R., Farmer, C. DEVELOPMENT OF THE LUNG IN ALLIGATOR MISSISSIPPIENSIS (ARCHOSAURIA: CROCODYLOMORPHA) AND THE EVOLUTION OF THE ARCHOSAURIAN RESPIRATORY SYSTEM

3:45 Owerkowicz, T., Yang, J., Blank, J., Eme, J., Hicks, J. MICROSTRUCTURE OF THE FEMORAL GROWTH PLATE IN THE AMERICAN ALLIGATOR: EFFECTS OF GROWTH RATE, LOCOMOTOR ACTIVITY AND CIRCULATORY PATTERN

4:00 Tsai, H., Holliday, C., Ward, C. PELVIC ANATOMY OF ALLIGATOR MISSISSIPPIENSIS AND ITS SIGNIFICANCE FOR INTERPRETING LIMB FUNCTION IN FOSSIL ARCHOSAURS

SATURDAY AFTERNOON, NOVEMBER 5, 2011
TECHNICAL SESSION XIX
PARIS LAS VEGAS, VENDOME B
MODERATORS: Robert Fordyce, Mark Clementz

1:45 Uhen, M. A NEW PROTOCETID WHALE FROM THE MIDDLE EOCENE OF MISSISSIPPI

2:00 Fordyce, R. A NEW LATE OLIGOCENE ARCHAIC SQUALODONTID FROM NEW ZEALAND

2:15 Graf, J., Jacobs, L., Polcyn, M., Mateus, O., Schulp, A. NEW FOSSIL WHALES FROM ANGOLA

2:30 Aguirre-Fernández, G., Fordyce, R. NEW ZEALAND FOSSILS REVEAL EARLY MIOCENE GLOBAL DISTRIBUTION FOR SMALL KENTRIODON DOLPHINS

2:45 Martín, J., Berta, A., Deméré, T. INTERPRETING THE FOSSIL RECORD OF MYSTICETI (CETACEA) USING NEW METHODOLOGIES IN DIVERGENCE DATING

3:00 Geisler, J., Martínez, M., Lambert, O., Boessenecker, R. EVOLUTION OF HIGH-FREQUENCY HEARING IN ODONTOCETES (MAMMALIA: CETACEA)

3:15 Govender, R., Chinsamy, A. EARLY PLIOCENE (5MA) SHARK—CETACEAN INTERACTION AT LANGEBAANWEG, WEST COAST, SOUTH AFRICA

3:30 Hayashi, S., Nakajima, Y., Chiba, K., Sawamura, H., Ando, T. BONE HISTOLOGY SUGGESTS INCREASING AQUATIC ADAPTATIONS IN DESMOSTYLLIA

3:45 Clementz, M., Sewall, J. REDUCED MERIDIONAL GRADIENT IN EOCENE SEAWATER TEMPERATURES INFERRED FROM THE STABLE ISOPTOE COMPOSITION OF FOSSIL SIRENIAN TOOTH ENAMEL

4:00 Motani, R., Montañez, I. PAST GLOBAL WARMING AND EMERGENCE OF MARINE MAMMALS AND REPTILES
SATURDAY AFTERNOON, NOVEMBER 5, 2011
POSTER SESSION IV
PARIS LAS VEGAS, RIVOLI B

Authors must be present from 4:15 – 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Snyder, D. INTERPRETATIONS OF A FOSSIL TRACKWAY FROM THE ST. LOUIS LIMESTONE


3 Whatley, R., Behrensmeyer, A., Amaral, W., Parker, W., Domeischel, J. FIRST LATE TRIASSIC VERTEBRATE LOCALITIES IN THE OWL ROCK MEMBER, UPPER CHINLE FORMATION, PETRIFIED FOREST NATIONAL PARK, AZ


5 Behrensmeyer, A., Whatley, R., Parker, W., McIntire, S. TAPHONOMIC INFORMATION FROM LABORATORY EXCAVATION OF A NEW MICROVERTEBRATE LOCALITY IN THE OWL ROCK MEMBER OF THE CHINLE FORMATION, PETRIFIED FOREST NATIONAL PARK, ARIZONA

6 Milner, A., Irmis, R., Jeffrey, M., Birthisels, T., Lockley, M. NEW INFORMATION ON LATE TRIASSIC TERRESTRIAL ECOSYSTEMS OF UTAH: TETRAPOD FOSSILS FROM THE CHINLE FORMATION OF LISBON VALLEY


9 Torices, A., Barroso-Barcenilla, F., Cambra-Moo, O., Pérez, S., Serrano, H. VERTEBRATE MICROFOSSIL ANALYSIS IN THE PALAEONTOLOGICAL SITE OF ‘LO HUECO’ (UPPER CRETACEOUS, CUENCA, SPAIN)

10 Bamforth, E., Larsson, H. CYCLING OF VERTEBRATE ALPHA DIVERSITY PRECEDING THE CRETACEOUS MASS EXTINCTION: EVIDENCE FROM THE LATEST MAASTRICHTIAN OF CENTRAL CANADA

11 Callapez, P., Barroso-Barcenilla, F., Cambra-Moo, O., Segura, M. FIRST MOLLUSC DATA AND PALAEOENVIRONMENTAL IMPLICATIONS IN “LO HUECO” VERTEBRATE SITE (UPPER CRETACEOUS, CUENCA, SPAIN)

12 Rivera-Sylva, H., Hedrick, B., Guzman-Gutierrez, R., Gonzalez, A., Dodson, P. A NEW CAMPANIAN VERTEBRATE LOCALITY FROM NORTHWESTERN COAHUILA, MEXICO

13 Gallagher, W., Miller, K., Sherrell, R., Field, P., Olsson, R. VERTEBRATE FOSSIL ASSEMBLAGES AND IRIDIUM CONCENTRATIONS IN THE CRETACEOUS-PALEOGENE SECTION OF THE NEW JERSEY COASTAL PLAIN

14 Yamamura, D., Schmitt, J. SANDSTONE DIAGENESIS AS A PROXY INDICATOR OF PORE FLUID GEOCHEMISTRY: IMPLICATIONS FOR FOSSILIZATION OF VERTEBRATE SKELETAL MATERIAL IN THE HELL CREEK FORMATION (UPPER CRETACEOUS), EASTERN MONTANA

15 Canoville, A., Chinsamy, A. GROWTH PATTERNS AND PALAEOECOLOGY OF PAREIASAURS (PARAREPTILIA, PAREIASAURIDAE) INFERRED FROM LONG BONE HISTOLOGY AND MICROANATOMY
SATURDAY AFTERNOON, NOVEMBER 5, 2011
POSTER SESSION IV (continued)

16 MacDougall, M., Reisz, R. A NEW PARAREPTILE FROM THE LOWER PERMIAN RICHARDS SPUR FISSURE FILL DEPOSITS OF OKLAHOMA

17 Li, C., Zhao, L., Liu, J. COMPARATIVE STUDY OF TWO POPULATIONS OF THE SABERTOOTHED FELID PROMEGANTEREON OGYRIA (FELIDAE, MACHAIRODONTINAE) FROM BATALLONES-1 AND BATALLONES-3 SITES (LATE MIOCENE, MN 10, TORREJÓN DE VELASCO, MADRID, SPAIN)

18 Kobayashi, Y., Lu, J., Wei, X., Liu, Y. PARENTAL CARE IN A CRETACEOUS CHORISTODERAN DIAPSID

19 Sato, T., Konishi, T., Hirayama, R., Caldwell, M. A REVIEW OF THE CRETACEOUS MARINE REPTILES FROM JAPAN

20 Hsiang, A. APPLICATION OF NONSTATIONARY MODELS OF SEQUENCE EVOLUTION TO HIGHER-ORDER AMNIOTE AND SQUAMATE SYSTEMATICS

21 Pellegrini, R., Beatty, B. ENAMEL AND DENTINE HISTOLOGY OF A MOSASAUR PTERYGOID TOOTH: IMPLICATIONS FOR DEVELOPMENT

22 Moscato, D., Wallace, S. ANALYSIS OF VARIATION IN SNAKE VERTEBRAE USING GEOMETRIC MORPHOMETRICS

23 Kennedy, A., Bauer, A. AN ANALYSIS OF THE HERPETOFAUNA FROM THE PINDAÏ CAVES OF NEW CALEDONIA: AN EXAMPLE OF HUMAN-INDUCED EXTINCTION IN THE LATE QUATERNARY SOUTH PACIFIC?


25 Burk, D., Sandau, S., Alderks, D. NEW ASSOCIATED SKELETAL MATERIAL OF A VARANID LIZARD, SANIWA CF. ENSIDENS, FROM THE EOCENE UINTA FORMATION OF THE UINTA BASIN, UTAH, USA

26 Sim, T., Kellner, A. REMARKABLE NEW LIZARD SPECIMENS FROM THE EARLY CRETACEOUS OF BRAZIL

27 Tuomola, A., Säilä, L. A NEW ANGUIMORPH LIZARD (REPTILIA: SQUAMATA) FROM EARLY CRETACEOUS OF ÖÖSH, MONGOLIA

28 Montanari, S., Norell, M. DIETARY INFERENCES OF PROTOCERATOPSIAN DINOSAURS FROM THE LATE CRETACEOUS OF MONGOLIA BASED ON STABLE ISOTOPE GEOCHEMISTRY

29 Frederickson, J. A QUANTITATIVE CLADISTIC RECONSTRUCTION OF CRANIOFACIAL ONTOGENY IN PROTOCERATOPS ANDREWSI

30 Baker, K., Scannella, J., Hall, L., Horner, J. BIOGEOGRAPHIC IMPLICATIONS OF A PARTIAL CERATOPSID SKELETON FROM THE LOWER TWO MEDICINE FORMATION (CAMPANIAN), MONTANA

31 Tanoue, K. DEPRESSION OF JAW JOINT IN EARLY EVOLUTION OF CERATOPSIANS

32 Borkovic, B., Russell, A. BOVID HORNS AS MODELS FOR CERATOPSID CRANIAL HORNS

33 Cummins, R., Farke, A. FLEXIBILITY ALONG THE VERTEBRAL COLUMN OF LEPTOCERATOPS GRACILIS AND ITS IMPLICATIONS FOR LOCOMOTION

34 Levitt, C. BONE HISTOLOGY AND GROWTH OF CHASMOSAURINE CERATOPSID DINOSAURS FROM THE LATE CAMPANIAN KAIPAROWITS FORMATION, SOUTHERN UTAH

35 Brandau, D., Irmis, R. THE ORIGIN AND TAPHONOMY OF CHASMOSAURINE (ORNITHISCHIA: CERATOPSIDAE) DINOSAUR BONEBEDS IN THE UPPER CRETACEOUS KAIPAROWITS FORMATION, SOUTHERN UTAH

36 McDonald, A. A SUBADULT SPECIMEN OF RUBEOSAURUS OVATUS (DINOSAURIA: CERATOPSIDAE) AND ITS IMPLICATIONS FOR CENTROSAURINE PHYLOGENY
SATURDAY AFTERNOON, NOVEMBER 5, 2011
POSTER SESSION IV (continued)


38 Tikson, J., Evans, D., Ryan, M. ENDOCRANIAL MORPHOLOGY OF CENTROSAURUS (ORNITHISCHIA: CERATOPSIDAE) AND BRAIN-BODY SIZE RELATIONSHIPS IN CERATOPSIDAN DINOSAURS

39 Beach, A. TRICERATOPS AND TOROSAURUS SYNONYMITY: AN EVALUATION OF TWO LARGE SPECIMENS FROM BRIGHAM YOUNG UNIVERSITY


41 Fowler, D., Scannella, J., Horner, J. REASSESSING CERATOPSID DIVERSITY USING UNIFIED FRAMES OF REFERENCE

42 Tykoski, R., Fiorillo, A. A NEW SPECIES OF PACHYRHINOSAUR (CERATOPSIDAE:CENTROSAURINAE) FROM THE LOWER MAASTRICHTIAN OF THE NORTH SLOPE OF ALASKA

43 Schott, R., Evans, D. NEW INFORMATION ON PACHYCEPHALOSAUR DINOSAUR DIVERSITY IN THE FOREMOST FORMATION (CAMPANIAN) OF ALBERTA

44 Ryan, M., Evans, D., Bell, P., Tsogtbaatar, K., Badamgarav, D. TAPHONOMY OF THE “DRAGON’S TOMB” SAUROLOPHUS (DINOSAURIA:HADROSAURIDAE) BONEBED, NEMEGT FORMATION (LATE CRETACEOUS), MONGOLIA

45 You, H., Li, D. BASAL HADROSAURIFORM DINOSAURS FROM THE EARLY CRETACEOUS MAZOGNSHAN AREA OF GANSU PROVINCE, NORTHWESTERN CHINA

46 Stack, K., Druckenmiller, P. ANATOMY AND RELATIONSHIPS OF A NEW TURONIAN HADROSAUROID FROM THE MATANUSKA FORMATION OF SOUTHERN ALASKA

47 Prieto-Marquez, A. USING SUBADULT SPECIMENS FOR PHYLOGENETIC INFERENACE IN HADROSAUROID DINOSAURS: BACTROSAURUS (LATE CRETACEOUS OF CHINA) AS A CASE STUDY

48 Erickson, G., Norell, M. THE HISTOLOGY OF HADROSAURID DINOSAUR TEETH -- REPTILES THAT EXCEEDED MAMMALS IN DENTAL COMPLEXITY?

49 Clayton, K., Irmis, R., Getty, M., Lund, E., Nicholls, W. AN EXCEPTIONALLY PRESERVED HADROSAURID DINOSAUR SKELETON WITH INTEGUMENT IMPRESSIONS FROM THE UPPER CRETACEOUS KAIPAROWITS FORMATION OF UTAH


51 Marquart, C. POPULATIONS, PLASTICITY AND PHENOTYPE: THE PROBLEMS OF CONTINUOUS VARIATION AND MISSING LINKS IN IGUANODONTIAN DINOSAURS

52 Norman, D. HYPSELOS PINUS FITTTONI: AN EXEMPLAR OF NOMENCLATURAL CONFUSION AND STANDARDS OF TAXONOMIC PRACTICE IN WEALDEN IGUANODONTIANS

53 Gasulla, J., Sanz, J., Ortega, F., Escaso, F. THE MAXILLAE OF IGUANO DON BERNISSARTENSIS FROM MORELLA: NEW INFORMATION ON UNKNOWN FEATURES

54 Sobral, G., Mueller, J. NEW INFORMATION ON THE BRAINCASE AND INNER EAR OF THE ORNITHOPOD DINOSAUR DYSAL OT S AURUS LETTOWVORBECKI BASED ON X-RAY COMPUTED MICROTOMOGRAPHY

55 Arbour, V., Currie, P. TAPHONOMIC FILTERS OF AGE GROUPS OF THE ANKYLOS AURID DINOSAUR PINACOSAURUS
56 Foster, J. ECOLOGICAL SEGREGATION OF THE LATE JURASSIC ORNITHISCHIAN DINOSAURS STEGOSAURUS AND CAMPTOSAURUS (MORRISON FORMATION, NORTH AMERICA): WAS IT PRONOUNCED OR SUBTLE?


58 WITHDRAWN

59 Porro, L., Barrett, P., Witmer, L. A 3D SKULL OF LESOTHOSAURUS DIAGNOSTICUS: DIGITAL PREPARATION, RECONSTRUCTION AND FEEDING MECHANICS

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NEW ZEALAND FOSSILS REVEAL EARLY MIOCENE GLOBAL DISTRIBUTION FOR SMALL KENTRIODON DOLPHINS
AGUÍRE-FERNÁNDEZ, Gabriel, Universidad de Otago, Dunedin, New Zealand; FORDYCE, Robert, University of Otago, Dunedin, New Zealand

Archicarchids in the extinct family Kentriodontidae (Delphinoidea) have been reported widely from Northern Hemisphere Miocene localities. Kentriodontids have been implicated in the origins of the living groups Delphinidae, Monodontidae and Phocoenidae. New species of kentriodontids from New Zealand expand the record beyond well-documented Northern Hemisphere fossils. Of note are: a generalized Early Miocene (basal?) kentriodontid (OU22066; Paturua); a species of Pithanodelphininae (ZMT 114; Kakahu); a Kentriodon-like species from near the Oligo-Miocene boundary (AUGD V9; Port Waikato); and 2 skulls (OU22375 and OU22172; Karitane) phenetically close to *P. kernisi* (type species of Kentriodon). The 2 Kentriodon skulls were recovered from the Caversham Sandstone, New Zealand Altonian Stage (about 16-19 Ma, Early Miocene) which is roughly contemporaneous with the Calvert Formation of the Atlantic Coastal Plain. They represent a species with an estimated condylobasal length of 360-400 mm, and body length of about 1.7 m, comparable in size to living cetorhinar dolphins (*Sotalia guianensis*). The New Zealand stocks provide compelling evidence that Early Miocene Kentriodon, and perhaps *P. kernisi*, ranged from temperate North Atlantic (and South Atlantic?) waters across the tropics to the temperate Southwest Pacific. Amongst living dolphins, the genus *Stenella* has comparable distributions. Other contemporaneous (Altonian) cetaceans from southern New Zealand include an unprepared cf. Kentriodon, the eurhodelphinid *Phocaenopsis mantelli*, and an archidolphinid (*?) all from the Mt Harris Formation. These, and other unprepared Odontoceti and Mysticeti, will broaden our understanding of southern Early Miocene assemblages beyond that of the widely-discussed Patagonian Cetacea. The new Kentriodon sp(l) may elucidate the phylogeny and diversity of Kentriodontidae, and perhaps the early history of stem delphinoids.

Technical Session VIII (Thursday, November 3, 1:45 pm)

A VERY PRIMITIVE TETRAPOD FROM THE EARLIEST FAMENNIAN OF SOUTH TIMAN, RUSSIA
AHLBERG, Per, Uppsala University, Uppsala, Sweden; BEZNOSOV, Pavel, Institute of Geology, Komi Scientific Centre, Syktyvkar, Russia; LUKSEVICS, Ervins, Latvian University, Riga, Latvia; CLACK, Jennifer, University of Cambridge, Cambridge, United Kingdom

Three field seasons collecting in the Gosnogorsk Formation, a basal Famennian lacustrine or lagoonal deposit from a tropical coastal setting in present-day South Timan, Russia, has yielded an extensive collection of cranial, mandibular and some postcranial tetrapod stem bones. They are preserved in limestone and prepared using acetic acid, producing clean surfaces even on complex structures such as sutureal areas. All bones are attributable to a single previously unknown species, on the basis of a shared distinctive ornament and close morphological match between duplicate elements. Furthermore, several suites of bones can be assigned to single individuals because of sutural fit. The material also includes an articulated snout and several articulated skull tables, enabling us to present a provisional but fairly well constrained skull reconstruction. We tentatively identify it as a tetrapod sensu stricto, i.e. a taxon with limbs rather than paired fins, because a cleithrum + partial scapulocoracoid shows a characteristic tetrapod morphology, similar to *Ichthyostega* and quite different from *Panderichthys* or *Tiktaalik*. However, the material shows a number of primitive character-istics, which suggest that it is the least crownward of known tetrapods. The snout does not have the spade-shape typical of early tetrapods, vomer morphology is intermediate between the elpistosteid and tetrapod conditions, the pterygoids are separated by the parasphenoid, the braincase has a well-developed crista parotica attached to the skull roof, the postorbital separates the squamosal from the supratemporal as in *Tiktaalik*, and the cleithrum carries dermal ornament. The Gosnogorsk Formation tetrapod will thus provide important data for elucidating the phylogeny and diversity of Kentriodontidae, and perhaps the early history of stem delphinoids.

Poster Session III (Friday, November 4)

POSTCRANIAL MORPHOLOGY OF *DIPSALIDICTIS TRANSIENS* (MAMMALIA: OXYANIDAE): FUNCTIONAL INTERPRETATIONS AND TAxonomic SIGnificance
AIHRENS, Heather, Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Oxyanidae comprises Late Paleocene to Late Eocene archaic carnivores, which are considered part of the paraphyletic assemblage "Creodontia." Though oxyanids are quite common in Early Eocene deposits of western North America, little is known about the postcranial morphology and phylogenetic relationships within the family or to other members of Ferata. One factor complicating our understanding of the relationships of Oxyanidae is the debated validity of the genus *Dipsalidictis*. Here, I describe a well-preserved specimen of *Dipsalidictis transiens* (TPU-PU 16161) from the Willwood Formation (Early Eocene) of the Bighorn Basin, Wyoming. This is the first detailed description of the skeleton of *Dipsalidictis*. Notable features of the forelimb include a greater tubera of the humerus extending higher than the humeral head, a radial head which is more ovoid than round, and a well-developed attachment surface for the pronator quadratus muscle on the medial aspect of the distal radius. Notable features of the pelvis and hind limb include a well-developed anterior inferior iliac tubercle and a fairly deep and narrow patellar groove. There are also several important character-istics of the tarsals, including a shallow astragalar trochlea, an astragalar sustentacular facet that is continuous with the plantar surface of the astragal head, a convex and smooth calcaneal ectal facet, and a distally positioned calcaneal sustentacular facet. Thily positioned calcaneal sustentacular foramina of both talar and metatarsal features in *Dipsalidictis transiens* indicates that the tarsus was likely scanorial, with numerous features of the ankle suggesting the ability to climb. Additionally, several features of *Dipsalidictis transiens* are inconsistent with previously discussed postcranial generic differences between *Dipsalidictis* and *Oxyanua.* Thus, the taxonomic assignment of *Dipsalidictis transiens* and postcranial distinction of the genus should be reassessed.

Technical Session X (Friday, November 4, 10:45 am)

A NEW PARTIAL SKELETON OF THE FOSSIL GREAT APE *HISPANOPITHECUS* (PRIMATES: HOMINIDAE) FROM THE LATE MIocene OF CAN FEU (VALLÉS-PENÉDEs BASIN, NE IBERIAN PENINsULAR)
ALBA, David, Institut Català de Paleontologia, UAB, Barcelona, Spain; ALMÈCIIÀ, Sergio, Department of Vertebrate Paleontology, American Museum of Natural History and NYCEP, New York, NY, USA; MOYÀ-SOLÀ, Salvador, ICREA at Unitat d’Antropologia Biologica (Dept. BABVE) & Institut Català de Paleontologia, UAB, Barcelona, Spain; CASANOVAS VILAR, Isaac, Institut Català de Paleontologia, UAB, Barcelona, Spain; MENDEZ, Josep, Institut Català de Paleontologia, UAB, Barcelona, Spain

A new partial skeleton of the fossil great ape *H. laietanus*, recovered in 2001 during the construction of a building in Can Feu (Sant Quirze del Vallès, Catalonia, Spain), is reported. Associated small mammal remains indicate an estimated age of 9.99-9.72 Ma (early Val-lesian), based on the occurrence of *Cricetulodon cf. sabaddellensis* and the lack of *Progonomy-ys*. *IPS34575* includes dentognathic and postcranial elements from a single individual: right i1, p3 and m1-m3; left p3-m3; partial left ulna; fragment of radial diaphysis; distal fragment of left humeral diaphysis; proximal fragment of the clavicle; and several scarrapal fragments. Dental morphology and proportions suggest an attribution to *H. laietanus*. A body mass (BM) of 23-25 kg can be estimated for *IPS34575* on the basis of ulnar articular measurements and radial diaphysal diameters. The smaller dental and postcranial size of *IPS34575* as compared with male specimens of *H. laietanus*—particularly the partial cranium and skull *IPS18800/IPS18800* from Can Llobateres 2 (9.6 Ma), with an estimated BM of 39 kg. Both postcranial size and p3 morphology indicate that *IPS34575* corresponds to a female individual. Unique amongst available remains of *Hispanopithecus*, *IPS34575* almost completely preserves the proximal morphology of the ulna. The latter is remarkably modern hominoid-like, as evidenced by the short olecranon process (although less reduced than in *Oreopithecus* and *Pongo*), and the relatively broad trochlear notch (more so than in *Griphopithecus*) with a median keel (less marked than in *Oreopithecus*, but fully comparable with *H. hungaricus*). Overall, *IPS34575* most closely resembles the incomplete ulna known for *H. hungaricus* in both size and shape, although differing from the latter by the more slender proximal diaphysis and the more protruding and less inclined coronoid process. Overall, *IPS34575* reflects an elbow complex suitable for preserving stability along the full range of flexion/extension and enabling a broad range of pronation/supination, thereby confirming previous inferences of specialized suspensory behaviors in *Hispanopithecus*.

How did past environmental change affect large mammal diversity in Spain?
ALBERDI, Maria, Departamento de Paleobiolog&Museo Nacional de Ciencias Naturales (CSIC), Madrid, Spain; PRADO, José, INCUAPA, Departamento de Arqueolog Universidad Nacional del Centro de la Provincia de Buenos Aires, Olavarria, Argentina; AZANZA, Beatriz, Departamento de Ciencias de la Tierra, Universidad de Zaragoza, Zaragoza, Spain

The Cenozoic basins of Spain provide one of the most valuable and rich records of fossil mammals and continental environments, giving exceptional opportunities to evaluate the ecological and evolutionary responses of mammalian communities to climatic change over the span of millions of years. This knowledge is essential for linking the dynamics of biotic change from ecological to evolutionary time scales and for understanding the processes that transform ecosystems over geologic time. We present the patterns of large mammal diversity and home-range size changes during the Late Miocene to Pleistocene in order to identify the tempo and mode of the major ecological shifts in community structure, and to put them in the context of late Cenozoic climatic change. We seek to understand the factors in which assemblages of large mammals that occur together in Spain are distributed in time, and the ways in which these assemblages can be influenced by dispersal constraints, environmental constraints, and internal dynamics. This knowledge is essential for recognizing the patterns behind the temporal distribution that leads to the forming of hypotheses about the origin and genuine structure of the Iberian biome. Trends in mammal diversity over time were analyzed using a taxon-free characterization. Species were assigned to various ecologi-cal categories in accordance with ranging and preferred habitat. Home range-size of fossil species was estimated using the regression for each family, habitat preference and trophic categories. Our results support the idea of the major role of past climatic changes as drivers of mammalian evolution.
AN ORNITHOMIMOSAUR-DOMINATED BONEBED FROM THE EARLY CRETACEOUS OF SOUTHWESTERN FRANCE

ALLAIN, Ronan, Muséum national d’Histoire naturelle, Paris, France; VULLO, Romain, Université Rennes 1, Rennes, France; LEPRINCE, Amélie, Université Rennes 1, Rennes, France; NÉRAUDEAU, Didier, Université Rennes 1, Rennes, France; TOURNEPICHÉ, Jean-François, Musée d’Angoulême, Angoulême, France

Lignite deposits from the new Hauvertian-Barremian locality of Angeac-Charente (southwestern France) have yielded a rich and diverse vertebrate assemblage. Besides fish microfaunas mostly referable to hybodontiform sharks, semionotiforms and icthyoscorpiforms, several reptilian taxa, including three turtles, one plesiosaur, four crocodilians and four dinosaurs (one ornithopod, one sauropod, two theropods), have been identified. However, first preliminary results indicate that this bonebed is largely dominated by ornithomimosaur remains. To date, 207 disarticulated postcranial elements representing at least 8 individuals have been unearthed from the bonebed and are now housed in a local paleo-museum. Furthermore, it is worth to note that pelvic and hindlimb bones are dominant and that no cranial elements have been found so far. While most of these ornithomimosaur bones are well preserved, with no abrasion, long bones often display post-mortem fractures with sharp edges. Some scratches can be observed on the bone surface. Such observations reveal peculiar taphonomic conditions and are congruent with the hypothesis of a short-term burial event possibly followed by trampling. Distinct age-classes are present, with juveniles, sub-adults and adults. This would suggest gregarious habits, a behavior previously reported for this group of herbivorous theropod dinosaurs. According to the preliminary anatomical study, the ornithomimosaur of Angeac-Charente belongs to a new taxon. The unambiguous fossil record of European ornithomimosauras has been so far restricted to Pelecynimus from the Spanish Barremian locality of Las Hoyanta, a primitive toothed form known only by a single specimen. Comparisons with historical material from the Wealden of the Isle of Wight suggest that ornithomimosauras were also present in the Early Cretaceous of England. The new, abundant material from Angeac-Charente will provide crucial information on the phylogeny and paleobiogeography of ornithodirans.

ANew Crocodyliform from the Middle Cretaceous Woodbine Formation of Texas

ALLEN, Eric, University of Iowa, Iowa City, IA, USA; MAIN, Derek, University of Texas at Arlington, Arlington, TX, USA; NOTO, Christopher, University of Wisconsin-Parkside, Kenosha, WI, USA

The Arlington Archosaur Site (AAS) is a prolific fossil locality in the Cretaceous (Cenomanian) Woodbine Formation of Texas. It represents a Cretaceous delta plain ecosystem preserving a diverse coastal fauna including sharks, rays, lungfish, turtles, ornithischians, theropods, and crocodyliforms. Here, we report on the discovery of a new large mesoeucrocodylian crocodyliform with a short dentary symphysis, paired dermal pneumacanines, and a robust triangular snout which differentiates this taxon from the longirostrine crocodyliform Woodhinesuchus, also from the Woodbine Formation. As such, it represents an ecomorphotype not previously reported from the formation. Remains include a disarticulated partially complete skull and considerable postcranial material from a single large (~5m adult) individual and additional disarticulated material from a second adult, at least one subadult, and several juveniles, elucidating a partial growth series. Phylogenetic analysis of the new form indicates a relationship basal to alternatively Goniopholididae with which it shares rostral and osteoderms morphology but is excluded based on the lack of a mandibular fossa, or Thalattosuchia primarily based on the shape of the postorbital. Either hypothesis would require a substantial ghost lineage as both of these lineages originate in the Early Jurassic. These results have profound implications for crocodyliform phylogeny and evolution as broad-scale relationships among mesoeucrocodylians are in flux, particularly in regard to the placement and interrelationships of goniopholidids. This find may represent a previously unknown component of mesoeucrocodylian diversity.

Evaluation of upper molar occlusal morphology for dietary inference in mid- to large-bodied platyrrhini (primates)

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Previous work on lower molar morphology has demonstrated quantifiable differences in shear crest length and occlusal relief among animals of differing diets. We explore the use of upper molar occlusal morphology to predict diet in platyrrhine primates and compare the results to those obtained from associated lower molars. The sum of shear crest lengths and mesiodistal tooth lengths were measured for associated upper and lower first molars of large samples of nine platyrrhine genera (Alouatta, Ateles, Brachyteles, Cacajao, Callithrix, Chiropotes, Lagothrix, Pithecia, Saimiri). Shear quotients (SQ) were calculated as residuals taken from a line with slope 1.0 (isometry) and passed through the mean log molar length and log sum of crest lengths for extant platyrhines. The Relief Index (RFI) was measured using laser scan models of upper and lower first molars. RFI was calculated as the 3D crown surface area relative to the projected 2D area. Species were assigned to one of three diet categories based on most frequently consumed foods (soft fruit, hard-objects (nuts), and leaves). For both upper and lower molars, pairwise comparisons of species mean SQ values, with a Bonferroni correction, show significant differences among all diet categories (p<0.02). Using discriminant function analysis (DFA), we examined classification success of SQ and RFI values to assign individual specimens to a diet category. RFIs for lower molars only separate hard-object feeders from other dietary groups, with no significant separation between any of the other dietary categories. Upper molar RFIs for 82 individuals show that SQ correctly predicts diet for both lower and upper molars (82% and 76% respectively, assuming all diet groups have the same number of individuals). The combination of upper and lower molar SQ has even higher predictive power (87% successfully classified). Upper and lower molar RFI values produce lower correct classification rates for individuals (47% and 53% correct). As with lower molar data, upper molar RFIs and SQs provide a strong dietary signal. Misclassification of individual specimens, but not species, cautions against the use of single specimens to infer diet in extinct species.

Proximal femoral affinities of miocene apes and early hominins on the basis of 3D geometric morphometrics analyses

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Elucidating the path of the evolutionary changes that occurred in hominins since their divergence from African apes requires a good understanding of the most likely morphotype of their last common ancestor (LCA). Most researchers rely only on extant taxa as comparative models for this LCA, and, in particular, chimpanzees. This is especially relevant for making inferences about hominins origins and the appearance of bipedalism, which is a very ancient ancestor of our lineage. The morphology of the proximal femur is particularly useful for making locomotor inferences in primates, and is considered by itself to be a good indicator of bipedal capabilities in early hominins. For the first time in the literature, we compare the morphological affinities of the proximal femora of early hominins with all great apes, hylobatids, cercopithecids monkeys, and the most complete available Miocene apes using three-dimensional geometric morphometrics. We collected 14 landmarks on the proximal femur of 14 apes were designed to capture the femoral part of the acetabulum, as well as the acetabular margin and head. RFIs for lower molars only separate

Diversity of sciuravids fluctuated from the time of their first appearance in the Wasatchian (early Eocene) to their extinction in the Uintian (late middle Eocene). These fluctuations in diversity are known to have occurred during a time period marked by dramatic global climate change, but potential correlations between climatic events and morphological disparity are obscured by the fact that the genotype, Sciuravus nitidus, with its high level of intraspecific variation, has become a wastebasket taxon. Here we present a critical reevaluation of the alpha taxonomy of S. nitidus based on a relatively large sample size of well-preserved specimens, including associated mandibular and mandibular fragments collected from the middle Eocene of Wyoming. The sample includes over 150 fossil specimens from Wa7-Br2, from which a total of 11 species representing five different genera were identified, including a new species from the middle Eocene (Br2) of Wyoming. The new species is intermediate in size between S. wilsoni and S. nitidus and has features common to sciuravids (e.g. trigonid elevated above the talonid, retention of cusp with loops, rectangular lower molars) as well as unique features (e.g. wide external valley studded with ectostylids and mesostylid dividing the central valleys of m1-2, m3 hypoloph connecting to the hypoconal). Other species recognized include: S. nitidus, S. undans, S. popi, S. wilsoni, Dawsonovmys woodii, Knightomyops depressus, K. senior, K. crennesii, Taxomys sp., and Tillosmys senex. Overall patterns of diversity change support previous hypotheses about the impact of climate on Eocene mammals. In particular, sciuravids species diversity increased during the wet, paratropical conditions of Wa7-Br1b, peaking at Br2, a time followed by cooler, more arid conditions. Diversity of sciuravids falling from the time of their first appearance in the Wasatchian (early Eocene) to their extinction in the Uintian (late middle Eocene). These fluctuations in diversity are known to have occurred during a time period marked by dramatic global climate change, but potential correlations between climatic events and morphological disparity are obscured by the fact that the genotype, Sciuravus nitidus, with its high level of intraspecific variation, has become a wastebasket taxon.
that interval and make Sciuvaridae the most diverse group of middle Eocene rodents known in North America.

Technical Session VIII (Thursday, November 3, 3:15 pm)

GROWTH SERIES OF THE RECUMBIROSTRAN (LEPOSPONDYLID; GYMNARTHRAEID) CARDIOCEPHALUS PEABODYI FROM RICHARDS SPUR, OKLAHOMA: NEW ANATOMICAL INFORMATION AND IMPLICATIONS FOR THE EVOLUTION OF (MICROSAURS)

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Developmental data represent a rapidly growing new source for information on character evolution in fossils; even partial growth series have the potential to inform on the acquisition of new features within higher taxa. We have assembled a partial growth series of the recumbirostran lepospondyl Cardiocephalus peabodyi, a group currently undergoing intensive investigation because of their possible role in the origin of the extant caecilians. Digital dissection using micro-CT has revealed for the first time the complete anatomy of the palate, usually obscured by closely articulating lower jaws. C. peabodyi lacks an ossified tectum synoticum and a distinct orbitosphenoid as recently described in other recumbirostans; similar to other taxa the sphenethmoid articulates with the medial portion of a longitudinally-oriented ventral flange of the frontal. Importantly, the smallest skull in the series possesses a ventral emargination of the cheek region. This emargination additionally has distinct small ossicles where fully ossified bone is present in the adult. This is very similar to what has been described in presumably adult specimens of the ostodolepids Microcerot and Pelodosotis. Other ‘microsaurs’ with an emarginated cheek include Haploposaron and Listrosaurus, although these taxa lack described ossicles and the latter may be a juvenile. Thus, the bridge between the maxillary arcade and suspensorium appears to be a late forming structure in ‘microsaurs’ (although following a relatively unique pattern). It is therefore a relatively simple heterochrony to achieve the distinctive morphologies of ostodolepids and hapisdopareiontds rather than the result of an adaptive change in mandibular musculature, as previously hypothesized.

Technical Session XVI (Saturday, November 5, 9:00 am)

THE INITIAL RADIATION OF JAWS: FUNCTIONAL STABILITY IN THE FACE OF FAUNAL AND ENVIRONMENTAL CHANGE

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Of the approximately 58,000 living vertebrate species, 99% have jaws. In the Silurian and earliest Devonian (~444-410 Million years ago), this major clade (known as gnathostomes) shared ecological space with a wide range of jawless fishes (agnathans) which often dominated the vertebrate faunas. However, by the end of the Devonian, 100 million years later, a major faunal shift occurred that left younger assemblages composed almost exclusively of gnathostomes. Several qualitative scenarios have been inspired by this pattern to explain the trophic radiation and ecological ascendance of the earliest gnathostomes. Here we present the first quantitative analysis of functional variation in early gnathostome mandibular elements, placing constraints on our understanding of evolutionary patterns during this critical interval.

A series of biomechanically relevant morphological metrics were collected from lower jaws of 198 Devonian gnathostome genera and were used to create a functionally informed mandibular morphospace. Disparity metrics were calculated across stratigraphic bins. Resulting profiles of morphospace occupancy were compared with richness data documenting the relative contribution of gnathostomes and agnathans to faunal assemblages throughout the Devonian.

Functional disparity among Early Devonian gnathostomes is comparable with that seen in the Late Devonian even as the taxonomic richness of the clade increases substantially over the period. As much as half of mandibular morphospace is occupied by stem gnathostomes, specifically placoderms. By contrast, major groups of living vertebrates (ray-finned fishes, tetrapods) show conservative morphologies with little indication of functional diversification. Much of early mandibular functional innovation seems to have occurred on the stem, suggesting that ecological proliferation is not coincident with the initial radiation of extant gnathostomes. Steady levels of gnathostome functional diversity in the face of the plummeting relative richness of agnathans raises questions about the role of active displacement in this fundamental shift in vertebrate biodiversity between the beginning and close of the Devonian.

Technical Session XII (Friday, November 4, 2:45 pm)

MORPHOLOGY AND FUNCTION IN WAIMANU PENGUINS: EARLY WING-PROPELLED DIVERS

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Species in the archaic fossil penguin genus Waimanu (Sphenisciformes, Aves) show features structurally intermediate betweenvolent seabirds and more-crowndown penguins, in addition to some archaic characters seen in Mesozoic birds. Waimanu includes two species from New Zealand: the larger and older W. mangeri (Early Paleocene) and smaller W. tuatahi (Late Paleocene), both from marine shelf strata of Waipara Greensand, North Canterbury. These species, the oldest named penguins, are known from 4 specimens that include the skull, vertebrae, pelvis, wing elements, and hind-limb elements. The skull has a distinct nasal fossa consistent with a marine lifestyle. The straight, slender bill, comparable to that of Icadyptes and Platydyptes, and unexceptional cervical vertebrae, rule out a specialized diet; there is no reason to propose a crustacean diet (as in some living penguins) or fish-eating habits. The nearly flat, amphiocular thoracic vertebrae contrast with the opisthocoelic condition in later penguins, and allow that condition in more-crowndown penguins evolved independently from the opisthocoelous thoracic vertebrae of other marine birds. The Waimanu wing elements are dense (osteosclerotic, with limited cancellous bone) and moderately flattened, with a sigmoidal humerus with developed head and deep tricipital fossa, less flattened ulna with distinct olecranon, and narrow radius. Wing structure, including the coracoid, is consistent with wing-propelled propulsion in water, and a non-volant lifestyle. More-crowndown penguins show more-derived flattening of all elements and modifications to support a less mobile elbow joint. Both species of Waimanu have a pleomorphic elongate tarsometatarsus with a posterior-directed medial trochlea indicating different foot function from crown penguins; perhaps foot propulsion supplemented the wing propelled diving. The Waimanu morphology is consistent with an obligate marine habit, probably in a shallow shelf setting. Structural attributes that allowed more-pelagic habits, such as the thermoregulation-linked humeral sulcus arose later in penguin history, linked with expanding geographic range.

Technical Session XI (Thursday, November 3, 3:45 pm)

PTEROSAURS, MODULES, AND THE ORIGIN OF THE PTERODACTYLOIDEA

ANDRES, Brian, Southern Methodist University, Dallas, TX, USA; HOWERD, Lauren, Natural History Museum, London, United Kingdom; STEEL, Lorna, Natural History Museum, London, United Kingdom

Pterosaurs underwent both a massive restructuring of their bauplan and a total replacement of their basic form halfway through their extensive history. This was the origin of the Pterodactyloidea, which has consistently had the longest and most supported branch in pterosaur phylogeny. This branch has been shortened by recent findings including the discovery of wukongopterid pterosaurs with a mosaic of pterodactyloid skull and neck character states and non-pterodactyloid body and limb character states. This led to hypotheses that the skull and neck character states found pterodactyloids evolved earlier, modules are present in pterosaur evolution, and modules were the principal focus of natural selection.

Rediscovered pterosaur specimens in the Natural History Museum, London, originally identified by Sir Richard Owen are identifiable as the earliest wukongopterid pterosaurs. They lack the elongate skull and cervical vertebrae previously uniting the wukongopterids with the pterodactyloids and cast doubt on this conception of modular evolution in pterosaurs. Phylogenetic analysis of these specimens and the Pterosauria confirms this placement but also confirms the shared early evolution of the other pterodactyloid skull character states. To test the presence and importance of modules in pterosaur evolution, a Bayesian phylogenetic approach was applied to the analysis. Partitioning and analyzing the data according to these two modules does not explain the data better than without these use of these modules. However, the modules do outperform random partitions. A more defensible hypothesis would be that modules were present in pterosaur evolution but were not the principal focus of natural selection to the exclusion of all individual characters. The independent elongation of the skull and neck in wukongopterids is most consistent with a functional complex related to the aerial predator ecology originally suggested for the group.

Technical Session VII (Thursday, November 3, 1:45 pm)

FINDING FOSSILS IN NEW WAYS: A NEURAL NETWORK MODEL FOR PREDICTING THE LOCATION OF FOSSIL-BEARING DEPOSITS

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Locating productive fossil-bearing localities in the field typically requires expert knowledge in geology and anatomy, the hard work of experienced field crews, and some degree of good luck. One way to reduce the role of serendipity in increasingly expensive paleontological fieldwork is to develop predictive models for the location of productive fossil-bearing deposits. We have developed, trained, and evaluated an artificial neural network (ANN) model to identify the characteristic spectral signatures of known, productive Paleogene mammal-bearing localities in the Great Divide Basin (GDB) of southwestern Wyoming. Our model uses remote sensing imagery derived from the ETM+ sensor carried aboard Landsat 7 to identify the spectral signature of five different classes of land cover in the GDB, one of which is represented by known, productive localities. Six bands from the visible and reflective infrared parts of the electromagnetic spectrum were analyzed within a geographic...
information system (GIS) database with a spatial resolution of 14.5 meters. We used a feed-forward, back-propagated multilayer perceptron ANN model to locate other areas within the basin which shared the spectral signature of our known localities. Our algorithm identifies patterns of features that are common to fossil bearing deposits, and looks for these features in a “fuzzy” fashion throughout the entire study area. The model’s output provides a classification of all pixels within the study area into one of the five land cover classes, along with associated probabilities. Post-hoc accuracy testing based on roughly 25% of the nearly 100 known localities in the GDB resulted in a correct classification of 79% of localities, while for all five land cover classes, a correct classification of 85% was achieved. The neural network approach that we have developed in the Paleogene of Wyoming is generalizable to paleontological field research in other geographic areas or time periods wherever productive localities share distinctive sets of geospatial and spectral features.

Poster Session II (Thursday, November 3)

RAPID MICROBIALY-MEDIATED CALCIUM CARBONATE PRECIPITATION: A MODEL FOR PERMINERALIZATION OF EMBRYONIC SOFT TISSUE IN SAUROPOD EGGS

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Extraordinary preservation of the embryonic contents of sauropod eggs in the Upper Cretaceous Anacleto Formation at Auca Mahuevo, Argentina provides evidence of rapid, microbially-mediated precipitation of calcium carbonate. We develop a preservational model for the Auca Mahuevo embryonic material (embryonic skin and eggshell membrane) by characterizing mineralogical composition and microfabrics of the fossilized egg contents using optical and cathode-luminescence (CL) petrography, X-ray diffraction (XRD), and field-emission scanning electron microscopy (FEM).

Microfabirc features within the fossilized embryos include spherulites comprising radiating acicular calcite, ooids, pellets, pellets, Microcystidium, calcified filamentous, and microcrystalline calcite (micrite). Collectively, these features represent the interplay of metabolic activity and chemical factors (e.g. pH, CaCO$_3$, anoxia) proximal to and within the decaying embryonic tissue facilitated by cyanobacterial and EPS (extracellular polymeric substances) biofilms and mucilaginous bacteria (spherulites/ooids), actinobacteria and saprotrophic fungi (Microcystidium), fungi (calcified filamentous), other indeterminate soil microbes (micrite), and invertebrates (pellets/peloids/micrite).

Metabolic activity within the microbial community (biofilm) colonizing the embryonic tissue facilitated calcium carbonate precipitation leading to exceptional preservation through calcite permineralization (microbial autolithification) of the embryonic soft tissue. The pathway of events driving this included: 1) microbial colonization of embryonic tissue following drowning of a sedimentary burial under anaerobic conditions limiting autolysis, 2) embryonic tissue consumption leading to formation of biofilms that pseudomorphed the embryo form and structurally supported the soft tissue, and 3) microbially-mediated calcite biominalization of the embryonic soft tissue pseudomorph by growth of and infusion with calcite crystals (permineralization). This process does not require preservation of endogenous soft tissue components, but rather only replication of original embryonic tissue as a biofilm pseudomorph entombed within calcite.

Technical Session XV (Saturday, November 5, 8-45 am)

DICYNODONT (THERAPSIDA, ANOMODONTIA) ASSEMBLAGES FROM THE LUANGWA BASIN, ZAMBIA: TAXONOMIC UPDATE AND IMPLICATIONS FOR BIOSTRATIGRAPHY AND BIOGEOGRAPHY

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Dicynodonts were among the first tetrapods fossils discovered in the Luangwa Basin in the late 1920s. As part of our ongoing research in Zambia, we conducted a comprehensive taxonomic revision of Permian and Triassic dicynodonts reported from the basin, incorporating new data from our 2009 field season. We recognize 14 dicynodont species in the Permian upper Madumabisa Mudstone, including two new, endemic species; reports of Lystrosaurus from this formation are in error. In addition, we found no significant partitioning of dicynodont taxa in the northern and southern parts of the basin, despite substantial differences in preservation, indicating the presence of a single faunal assemblage in the Upper Permian. The Madumabisa dicynodont assemblage is best correlated with the Cistecephalus Assemblage Zone of South Africa. The shared presence of Dicynodon huenei and Katumbia in the Luangwa Basin and the Ruhuhu Basin of Tanzania suggests that the Tanzanian Usili Formation also can be correlated with the Cistecephalus zone. Interestingly, the Madumabisa assemblage from Zambia is more similar to the coeval assemblage from South Africa, despite its closer geographic proximity to Tanzania. The Karoo and Ruhuhu basins also include more endemic species in the Permian than the Luangwa Basin. The Triassic Ntawere Formation preserves four dicynodont species, which occur at two stratigraphic levels. The lower Ntawere assemblage resembles the Omingonde Formation of Namibia in the presence of Kannemeyervia lophorhinus and potentially Dichot ascus. The upper Ntawere assemblage shares the genus Sanguiosaurus with the Manda beds of Tanzania, and includes the endemic Zambezesaurus. Comparison of these assemblages to the Omingonde and Manda suggest both are best correlated with the Cynognathus suburb. When combined with data on other tetrapod taxa, our revised dicynodont assemblages contribute to an emerging picture of broad faunal similarity in southern and eastern Africa during the Late Permian, and increasing differentiation between the South African and other Karoo basins following the end-Permian extinction.

Poster Session I (Wednesday, November 2)

PLESIOSAUR STRUCTURAL EXTREME FROM THE MAASTRICHTIAN OF ANGOLA

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An elasmosaurid plesiosaur (PA103) was recovered from the Mucuo Formation, Bentiba, Namibe Province, southern Angola, and preserves the pectoral and pelvic girdles, cervical and dorsal vertebrae, and ribs. However, it is the pectoral girdle that shows several unique adaptations that are unparalleled in other plesiosaurs, including a highly atrophied dorsal process of the scapula, long longitudinal pectoral bar with extensive contacts between the coracoids anteriorly and posteriorly and between scapulae, presence of a left-right asymmetry of the coracoid ventral process, and widely expanded posterior portions of the coracoids. The reduced dorsal process indicates that the muscles required for terrestrial locomotion in other plesiosaurs were not present on this specimen.
locomotion atrophied during elasmosaur evolution. To test this hypothesis, pectoral girdle muscle topology and maximum-attachment areas were determined within a squamate and archosaur phylogenetic bracket, and the evolution of the pectoral girdle musculature among Sauropterygia was traced and homologized. A Catalano-Goloboff phylogenetic morphometries analysis (one landmark character, 14 landmarks) of forty Eosauropterygia specimens retrieved the Bentiaba specimen as a descendant within Elasmosauridae and supported the general tree topology reported previously from phylogenetic analyses based on anatomical characters other than landmarks. The myological reconstruction determined in this study serves as a basis for determining boundary conditions involved during muscle action. These results allowed construction of finite-element models derived from laser-scan data of the Bentiaba specimen. The Bentiaba specimen model results were contrasted with other basal plesiosaur pectoral girdles to determine the functional significance of the unique skeletal structure of the Angolan fossil. The Bentiaba specimen is a structural extreme; a compromise between the undesired consequences of having a large muscle attachment area and a geometry that minimizes stress within bones by also taking advantage of arthrological relationships with contiguous bones.

Poster Session I (Wednesday, November 2)

A MORPHOMETRIC ANALYSIS OF THE MANDIBULAR PREMOLARS AND MOLARS OF SOUTH AFRICAN AUSTROALPHECUS

ARBOUR, Tafile, De Moines University, De Moines, IA, USA

Considerable debate has focused on whether there are high levels of variation in size and morphology in Austroalpheidicus africanus, current taxonomic attributions of a variety of South African australopilhecine species, the number of species represented within the Makapansgat and Sterkfontein samples of A. africanus, and the phylogenetic relationships of currently recognized South African australopilhecine taxa. Analyses of mandibular premolar and molar shape variation are presented in order to assess the patterning and degree of size and morphological variation in the dentition of currently recognized South African australopilhecine taxa.

Dental landmark coordinates were digitized in TpsDig2 using occlusal photographs of the mandibular premolars and molars of South African taxa from Kromdraai, Swartkrans, Sterkfontein, Taung, and Makapansgat. Landmarks were recorded for the cusp tips for unworn specimens and semi-landmarks were recorded for the overall occlusal outlines for both moderately worn and unworn specimens. These coordinate data were imported into Morphologika where generalized Procrustes analysis and principal components analysis were performed. Analyses of the overall occlusal shape of the mandibular premolars and molars and cusp tip positioning were executed on the samples of unworn teeth. Analyses were repeated for the entire sample of worn and moderately worn specimens, excluding cusp tip landmarks, in order to further examine results with larger sample sizes. Analyses of both worn and unworn samples indicate that the occlusal morphology of mandibular premolars and molars does not pattern well with current taxonomic attributions of South African australopilhecines and reflect considerable overlap in size and morphological variation among currently recognized species. These results suggest that confident assignment of isolated mandibular premolars and molars of South African australopilhecines to a particular species is problematic and may further confound efforts to reconstruct the phylogenetic relationships of these taxa on the basis of dental morphology.

Poster Session IV (Saturday, November 5)

TAPHONOMIC FILTERS OF AGE GROUPS OF THE ANKYLOSAUR DINOSAUR PINACOSAURUS

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The ankylosaur Pinacosaurus is known from several bonebeds from Mongolia and China. These specimens largely represent juveniles, based on their small size, lack of body osteoderms other than cervical rings, and unfused neurocentral sutures. The individuals in each of these sites probably died and were buried in a short interval of time. At Bayan Mandah in China, the skeletons are preserved upright with limbs tucked under the body, and were buried during a sandstorm or by a dust-sourced alluvial fan. The presence of aligned, closely associated articulated skeletons suggests that this represents a social group. The Alag Teeg bonebed in Mongolia exhibits characteristics associated with mixing, including plunger limbs and preferential preservation of limb elements. Although this could represent an accumulation of individuals independently drawn to the same resource, the Bayan Mandah bonebed supports the interpretation that the Alag Teeg bonebed also represents a group. A new review of the Alag Teeg material shows that an individual more than twice the size of Eoauraptor mingshaensis recovered the Bentiaba specimen as derived among Elasmosauridae and supported the general tree topology reported previously from phylogenetic analyses based on anatomical characters other than landmarks. The myological reconstruction determined in this study serves as a basis for determining boundary conditions involved during muscle action. These results allowed construction of finite-element models derived from laser-scan data of the Bentiaba specimen. The Bentiaba specimen model results were contrasted with other basal plesiosaur pectoral girdles to determine the functional significance of the unique skeletal structure of the Angolan fossil. The Bentiaba specimen is a structural extreme; a compromise between the undesired consequences of having a large muscle attachment area and a geometry that minimizes stress within bones by also taking advantage of arthrological relationships with contiguous bones.

Poster Session II (Thursday, November 3)

EQUUS FROM THE MIDDLE IRVINGTONIAN FAIRMead LANDFILL LOCATION, MADERA COUNTY, CALIFORNIA

ASAMI, Rebecca, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; BARRERA, Yosenia, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, USA; DUNDAS, Robert, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA

The middle Irvingtonian Fairmead Landfill site in Madera County, California preserves a diverse fauna collected from fluvial channel, overbank, and lacustrine deposits of the upper part of the Tullock Lake Formation. The age of the locality is 0.78 Ma to 0.55 Ma. The fauna is dominated by large herbivorous mammals, with Equus representing two-thirds of identified specimens. The horses include individuals of all ontogenetic ages, from juveniles to aged adults. The considerable Fairmead Landfill collection provides ample material for comparison to other Pleistocene horses throughout North America. Metatarsals from the Fairmead Landfill were measured and compared to Equus from the following sites: Equus sp., Irvington, California; E. "occidentalis", McKitterick and Rancho La Brea, California; E. scotti, Rock Creek, Texas; Equus sp., Dalhart Horse Quarry, Texas; E. conversidens, San Josecito Cave, Mexico; E. ferus, Natural Trap Cave, Wyoming; and Equus sp., Natural Trap Cave, Wyoming. Horses from the Fairmead Landfill site fall in the low end of the E. "occidentalis" / E. scotti distribution and in the upper end of the E. conversidens / E. ferus range. In addition to postcranial metrics, mandibles were examined for the presence or absence of infundibulum, a character useful in distinguishing among horse species. The presence of infundibulum in lower incisors of Equus at Fairmead Landfill indicates that these horses are neither E. "occidentalis" nor E. conversidens, since both these species lack infundibula in the lower incisors. This suggests the horse species from Fairmead Landfill may be either E. scotti or E. ferus, both of which possess infundibula. The infundibulum of the right 3rd incisor is open posteriorly, which also occurs in both E. scotti and Pleistocene North American E. ferus.

Technical Session XII (Friday, November 4, 2:00 pm)

PHYLOGENETIC MAPPING OF TRAITS OF THE AVIAN ALTRICTAL-PRECOCCIAL SPECTRUM, AND ITS IMPLICATIONS FOR INFERRING EARLY AVIALAN LIFE HISTORY

ATTERHOLT, Jessee, University of California, Berkeley, CA, USA

Extant birds can be classified according to development of offspring along an altritical-precoecal spectrum, with fully-functional, feathered individuals at one end (precoecal) and helpless, blind, naked chicks at the other (altritical). However, evolution of the various reproductive strategies along this spectrum has been difficult to understand because few studies have placed these data in phylogenetic context. I separated the common division of the precoecal-altritical spectrum into seven character states to map life-history data onto both molecular and morphological avian phylogenies. The two trees imply different results: the former suggests that altricity was evolved independently at least four times (by Passeriformes, Coraciiformes, Cuculiformes, and Apodiformes), while the latter implies a single origin. Both outcomes underscore the need for an avian phylogeny that integrates morphological and molecular data.
I also tested the distribution of avian investment in locomotor modules (pectoral limb, pelvic limb, and tail) and its correlation when mapped against the precocial-altricial spectrum as seen in a phylogenetic context. Taxa on the precocial end tend to invest more highly in the pelvic limb module, and taxa at the altricial extreme invest more highly in the pectoral limb module. This correlation suggests that an emphasis on a particular locomotor module may provide one proxy for developmental mode in extinct birds. However, these results suggest that early avialans should not be assumed to have shared all the life-history characteristics of living birds.

Vicariance in bird lineages is well-supported by morphological and molecular evidence. However, there remains a need to establish the details of vicariance, such as the timing and extent of genetic lineages, and how it relates to geographic distributions. The phylogenetic and biogeographic analyses of extant and fossil birds can provide insights into this issue.

Poster Session 1 (Wednesday, November 2)

NEW FIND OF ENIGMATIC PIPID FROGS IN THE UPPER PLEISTOCENE OF THE SOUTH AMERICAN PAMPAS

BAÉZ, Ana, CONICET - Departamento de Ciencias Geológicas, FCEN, UBA, Buenos Aires, Argentina; GÓMEZ, Raúl, CONICET - Departamento de Ciencias Geológicas, FCEN, UBA, Buenos Aires, Argentina; TAGLIORETTI, Matías, CONICET - Centro de Geología de Costas y del Cauaredoso, Universidad Nacional de Mar del Plata, Mar del Plata, Argentina

Frogs are an enigmatic group of amphibians that have undergone significant vicariance in South America, with a number of endemic lineages. The Phippsid frogs (Pipidae) are one such group that is poorly understood. In this study, we report the discovery of a new species of Pipid frog from the upper Pleistocene of the south Patagonian region, which provides important insights into the biogeography of this group.

Preparators’ Session (Thursday, November 3, 11:15 am)

DEFORMATION IN SILICONE MOLDS AND ITS EFFECT ON THE ACCURACY OF CASTS

BAKER, Kari, Museum of the Rockies, Bozeman, MT, USA; SCANNELLA, John, Museum of the Rockies, Montana State University, Bozeman, MT, USA

Fossils are molded and cast to produce near-perfect copies of specimens for research, display, trade, or sale. There are two basic types of multi-part silicone molds: block molds and glove molds. Block molds have thick silicone walls and are self-supporting. Glove molds are thin walled molds that are supported by a rigid mother mold. The two halves of a mother mold can either be in contact along the seam line, or they can be separated by an extension of the silicone mold, forming a gasket.

A phytosaur tooth was cast in a one-part mold and re-molded using all three kinds of the multi-part mold. A grid pattern was carved into the surface of the tooth cast to provide points for measuring the amount and type of distortion. The resulting block mold and glove molds were tested to determine how the molds deform during the process of casting. The molds and casts were produced with a platinum-cured silicone rubber and polyurethane plastic. During the casting process, two-part molds were bound together using a variety of techniques: rubber bands, plywood with c-clamps, and shrink-wrap.

All three types of molds can consistently produce accurate casts when used properly. If block molds or gasket-type mother molds are bound together too tightly, the casts will compress along the seam line. Contact mother molds initially produce high-quality copies of fossils, but later casts are often distorted after plastic leaks between the silicone mold and mother mold. This problem can be solved by separating the mother mold from the silicone mold with a single layer of plastic wrap and changing the wrap between pours. Molds should be bound tight enough to prevent leaks but not enough to deform the silicone surface. The greatest amount of deformation typically occurs where a thin layer of silicone surrounds a large void within the mold. To avoid this problem, a silicone mold can be opened, filled with plastic resin, and allowed to cure before combining the two halves.

Poster Session IV (Saturday, November 5)

EARLY OSSIFICATION AND CALCIFIED TISSUES IN THE SKULL OF HYPAcropSAURUS SteRINGERI (ORNITHISCIA, LAMBEOSAURINAE): A PRELIMINARY STUDY

BAILEUL, Alida, Museum of the Rockies, Montana State University, Bozeman, MT, USA; HORNER, John, Museum of the Rockies, Montana State University, Bozeman, MT, USA

From a histological perspective, the early phases of dinosaur skull development remain poorly understood. Here we describe the different calcified tissues present in craniofacial elements from a perinatal Hyacropaurus from the Upper Cretaceous of Montana. Every element is highly vascularized and mostly composed of primary woven bone trabeculae, indicating rapid growth due to brain development and metabolism.

HORNER, John, Museum of the Rockies, Montana State University, Bozeman, MT, USA; BAILLEUL, Alida, Museum of the Rockies, Montana State University, Bozeman, MT, USA; PRELIMINARY STUDY.

BIOGEOGRAPHIC IMPLICATIONS OF A PARTIAL CERATOPSID SKELETON FROM THE LOWER TWO MEDICINE FORMATION (CAMPANIAN), MONTANA

BAKER, Kari, Museum of the Rockies, Bozeman, MT, USA; SCANNELLA, John, Museum of the Rockies, Montana State University Department of Earth Sciences, Bozeman, MT, USA; HALL, Lee, Museum of the Rockies, Montana State University Department of Earth Sciences, Bozeman, MT, USA; HORNER, John, Museum of the Rockies, Montana State University Department of Earth Sciences, Bozeman, MT, USA

In 1985, the partial skeleton of a large ceratopsid (Dinosauria: Ornithischia; MOR 390) was collected from the lower Two Medicine Formation (Campanian) in northwestern Montana. This previously undescribed specimen represents one of the oldest known ceratopsids from North America, having been found in a horizon slightly above an ash bed radiometrically dated at ~80 Ma. Diphloroceratops eottoni (~80.1 to 79.5 Ma), from the Wahweap Formation...
of Utah, and Albertaceratops nesmoi (~77.5 Ma), from the Oldman Formation of Alberta, are of comparable age. Ceratopsid material has also been reported from the Foremost Forma-
tion of Alberta (~79 to 78 Ma) and the Menelee Formation of New Mexico (~82 Ma). MOR 390 was found in the same stratigraphic zone that produced the holotype of the basal neoc-
eratopsian Ceratopsops hodgkissi. Much of the post-cranial skeleton is preserved, including a humerus, scapulocoracoid, sacrum, ilium, fibula, partial femur, vertebrae, and ribs. Several of the rib exhibits pathologies. The ilia are narrow with an accentuated sigmoidal curve, consis-
tent with referral to the centrosaurinae. MOR 390 demonstrates that ceratopsids were present in the Two Medicine ecosystem prior to the late Campanian transgression of the Bearpaw Sea. The quarry roughly contains within the maximum transgression of the Cretaceous mass extinction, and suggests that alpha diversity may have been waning just prior to the extinction event itself.

Technical Session I (Thursday, November 3, 2:00 pm)

GEOCHEMICAL AND MORPHOLOGICAL EVIDENCE OF MELANIN PRESERVATION IN THE FEATHERS OF THE EARLY CRETAUCEOUS BIRD GANUS YUMENENSIS
BARDEN, Holly, University of Manchester, Manchester, United Kingdom; WOGELIUS, Roy, University of Manchester, Manchester, United Kingdom; EDWARDS, Nicholas, University of Manchester, Manchester, United Kingdom; MANNING, Philip, University of Manchester, Manchester, United Kingdom; VAN DONGEN, Bart, University of Manchester, Manchester, United Kingdom

Recent high profile studies have purportedly demonstrated the presence of pigment contain-
ing organelles, melanosomes, within fossilised soft tissues using predominantly morphologi-
cal evidence. This study combines both morphological and geochemical analyses to examine the potential preservation of melanin pigment and melanosomes within two exceptionally preserved isolated Gansus yumensis feathers from the early Cretaceous of China. Envi-
rional scanning electron microscopy (ESEM) reveals elongate structures consistent with those identified as eumelanosomes (containing the dark pigment eumelanin) in previous studies. These structures were restricted to visibly dark areas of the feathers and were absent from both the lighter areas of the feathers as well as their respective sedimentary matrices. Fourier transform infrared spectroscopy (FTIR) of these visibly dark areas demonstrates the presence of functional group signatures indicative of eumelanin comparable to those found in extant Sepia officinalis eumelanin, including carboxylate, ketone, hydroxyl and secondary amine groups; such groups were again absent from lighter areas of the feathers and the matrix as shown by an infrared map of the ketone group in the barbules of one of the feathers. Differ-
ent organic free radical signals between one feather and its matrix are demonstrated using electron paramagnetic resonance spectroscopy (EPR), however the technique was unable to resolve the eumelanin signal within the feather. Pyrolysis gas chromatography mass spectrometry (Py-GCMS) shows a similar distribution pattern of aliphatics in both the fossil feathers that differed from that of their respective matrices, however melanin breakdown products were not observed. These techniques in combination strongly suggest the presence of eumelanin organic material in the fossil feathers, however only FTIR was successful at identifying melanin derived breakdown products. This is the first time that Py-GCMS and other organic geochemical methods have been used in conjunction with traditional morpho-
logical techniques to provide clear evidence of the preservation of original melanin pigmen-
tation in fossil feathers.

POSTCRANIAL SKELETAL PNEUMATICITY AND THE EVOLUTION OF ARCHOSAUR RESPIRATORY SYSTEMS
BARRETT, Paul, Natural History Museum, London, United Kingdom; BUTLER, Richard, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; GOWER, David, Natural History Museum, London, United Kingdom; ABEL, Richard, Imperial College London, London, United Kingdom

Extant archosaurs (birds and crocodilians) possess lungs that permit unidirectional airflow. Consequently, it has been hypothesized that unidirectional flow might have been present in the common ancestor of crown-group archosaurs and potentially present in many extinct taxa (including non-avian dinosaurs, pterosaurs, 'mammals' and some amphibians and extinct eu-
chordates). Although the soft tissues are not fossilized, they leave traces as characteristic pneumatic fossae and foramina in the postcranial skeleton. The distribution of this postcran-
ial skeletal pneumaticity (PSP) can be used to determine the extent of invasive air sacs (and potentially avian-like respiratory systems) in extinct archosaurs. Here, we summarize results from a project that used micro-CT scanning to document the presence/absence of PSP in all major Triassic-Jurassic archosaur lineages. These results support previous suggestions that avian-like respiratory systems were present in at least non-avian saurischians and pterosaurs.
Conclusive evidence of PSP is not present in any of the ornhithischians, pseudosuchians, or basalt ornithodirans examined, but some of these taxa exhibit features (e.g., the possession of deep, non-invasive fossae bounded by prominent vertebral laminae) that might be correlated with the presence of less well-developed avian-like respiratory systems in which air sacs were present but not ramifying within postcranial elements. These data suggest the possibility that the avian respiratory system might have originated earlier than is commonly accepted, and may be present in, either an incipient or secondarily reduced state, in other archosaurs. It seems likely that each major archosaur lineage acquired their own respiratory specializations, and that these may have been variations on a primitive archosaur system that might have included the development of some non-invasive air sacs and unidirectional lung airflow.

FEEDING ECOLOGY OF THE LATE PLEISTOCENE EQUIDS FROM EL CEDRAL, SAN LUIS POTOSI, MEXICO, AS EVIDENCED BY DENTAL WEAR BARRÓ-ORTIZ, Christian, University of Calgary, Calgary, AB, Canada; THEODOR, Jessica, University of Calgary, Calgary, AB, Canada; ARROYO-CABRALES, Joaquin, Instituto Nacional De Antropologia Historia, Mexico City, Mexico

Three equid species have been proposed for the Late Pleistocene deposits from El Cedral, Mexico, based on cranial and postcranial material: Equus mexicanus, E. conversidens, and E. tau. The evidence indicates that these species were sympatric and it has been suggested that they partitioned their trophic resources. We analyzed a sample of upper and lower cheek teeth with the objective of testing this hypothesis, using the extended mesowear and low magnification microwear methods. Both methods use a data set of living ungulates with known diets to infer the dietary behaviour of extinct species. A discriminant function analysis of the mesowear variables plotted the three horse species within the typical grazers (e.g., Cerasotherium simum and E. grevyi) separate from the variable grazers (e.g., Alcelaphus buselaphus and Equus elippsiprymnus). The mesowear score for E. mexicanus (1.75 ± 0.14) is lower than that for E. conversidens (2.08 ± 0.16) and E. tau (2.11 ± 0.16) suggesting a less abrasive diet; however, these differences are not statistically significant. In contrast, a discriminant function analysis of the microwear variables classified E. mexicanus within the meal-by-meal mixed feeders (e.g., Ovis moschatus), whereas E. conversidens and E. tau were classified within the grazers. E. mexicanus differs from the other equids in having a statistically higher average number of pits, but their average number and shape is not significantly different. The discrepancy between the mesowear and microwear results for E. mexicanus might indicate seasonality in its diet. This could account for the stable isotope patterns reported in a recent study which indicated a mixed C3-C4 diet. If this is the case, however, the degree of mixed feeding must not have been substantial as the long term dietary signal (mesowear) clearly corresponds to a grazer. Also, the incorporation of some C3 grasses in the diet of this and the other species (particularly E. tau) cannot be ruled out, according to the results obtained here and those from stable isotope analysis. This study supports the hypothesis that the equids from El Cedral partitioned, to some degree, their trophic resources.

SPHEROOLITHID EGGS FROM THE CRETACEOUS TIANTAI BASIN, ZHEJIANG PROVINCE, CHINA

BARTA, Daniel, Montana State University, Bozeman, MT, USA; BRUNDRIDGE, Krista, Montana State University, Bozeman, MT, USA; JACKSON, Frankie, Montana State University, Bozeman, MT, USA; VARRICCHIO, David, Montana State University, Bozeman, MT, USA; JIN, Xingsheng, Zhejiang Museum of Natural History, Hangzhou, China

Fossil eggs are abundant in the mid-Cretaceous Liangtoutang and Chichengshan formations of Tiantai basin in Zhejiang Province, China. Most previous descriptions, however, are brief and lack scanning electron microscopy. For this study we measured 196 previously undescribed eggs cataloged at the Natural History Museum of Zhejiang Province and sampled for element and isotopic analysis to ascertain their condregnologic affinities. The round to subrounded eggs range in size from 7.24 to 13.6 cm. Examination of radial thin sections by scanning electron microscopy and light microscope reveals that the 0.81 to 1.36 mm-thick eggshell consists of a single structural layer of calcite. The inner eggshell is deeply eroded and the slightly undulating outer eggshell surface lacks ornamentation, possibly due to recent weathering. Pores are sparse and often difficult to identify in radial section; however, they appear irregular in shape and distribution and more prevalent in the inner half of the eggshell. Shell units comprising the eggshell are narrow, slightly flared at the outer shell surface, and display straight accretion lines that extend across shell units. The shell units exhibit a sweeping extinction pattern under cross polars. The outer one-third of the eggshell displays parallel banding that likely results from diagenetic alteration. Differences in shell thickness among the eggs may result from intraspecific or interspecific variation, diagenetic alteration, or measurement technique. We assign the Zhejiang eggs to the oogenus Spherooolithus ooup, within the oofamily Spherooolitidae on the basis of their size, shape, micras structure, and shell thickness. This study provides a basis for future assessments of the diversity of fossil eggs in the Tiantai Basin, contributing to the understanding of the evolution and range of reproductive strategies within Dinosauria. Additionally, this knowledge may facilitate biostatigraphic correlation between basins.

Technical Session X (Friday, November 4, 12:00 pm)

UNDER PRESSURE: HOW MUCH DO FOOTPRINTS TELL US ABOUT FOOT MOTION AND PRESSURE?

BATES, Karl, University of Liverpool, Liverpool, United Kingdom; BENNETT, Matthew, University of Bournemouth, Bournemouth, United Kingdom; LEI, Ren, University of Manchester, Manchester, United Kingdom; RUSSELL, Savage, University of Liverpool, Liverpool, United Kingdom; CROMPTON, Robin, University of Liverpool, Liverpool, United Kingdom

Fossilized footprints are an important primary source of evidence about locomotor mechanisms in extinct vertebrates. In particular, track topology is routinely hypothesized to be directly indicative of foot pressure, which in turn is integrally linked with overall limb motion of the trackmaker. However, the extent to which foot motion and pressure are recorded in footprints remains poorly understood. Is track relief indicative of maximal or time-integrated pressure? How is limb motion, and its expression in footprint relief, influenced by sediment rheology? In an attempt to address these fundamental issues we have adopted an interdisciplinary approach that integrates laboratory and field experiments and computational modelling of track formation. An integrated Zebris pressure sensitive treadmill/12-camera Qualysis MOCAP system has been used to synchronously record dynamic foot pressures and whole-body and limb segment kinematics. This provides a baseline for understanding correlations between foot morphology, motions and pressures on non-compliant substrates. This kinematic and foot pressure database can subsequently be quantitatively compared with gaits and footprints recorded in naturally occurring compliant substrates. Initial results from studies carried out in beach sediments on NW coast of the UK emphasise variation in footprint form due to sediment consistency. Statistical analysis of footprint relief within individuals demonstrates great disparity and swamps the still-large inter-subject variation present in treadmill pressures. To support these experiments, a parametric computer model of footprint formation has been employed using Finite Element Analysis. The model allows parameters of interest (e.g. foot geometry, pressure, sediment strength) to be manipulated quantitatively so that their individual effects on footprint form can be assessed. Results from simulations with different foot shapes, sediment properties and dynamic pressures again emphasize variation due to substrate rheology. We discuss the implications of our results for tracking the evolution of foot form and function in hominid footprint record.
TRICERATOPS AND TOROSAURUS SYNONYM: AN EVALUATION OF TWO LARGE SPECIMENS FROM BRIGHAM YOUNG UNIVERSITY

BEACH, Andrew, Brigham Young University, Provo, UT, USA

Due to the recent controversy surrounding the synonymizing of Tuscahomys and Triceratops, two skulls from the Brigham Young University Museum of Paleontology have been evaluated. BYU 12183 initially appeared to maintain typical Triceratops morphology, and did not possess mature “Tuscahomys” features despite its exceptionally large size. However, examination of the original specimen shows extensive restoration bias, altering the original morphology. A second large, un-restored Triceratops skull (BYU 19997) possesses dorso-ventrally compressed epiparietals and epiprosopals, a sign of ontogenetic maturity. Significant thinning of the parietal occurs in areas that correspond to the parietal fenestrae observed in “Tuscahomys.” These features indicate that it is an ontogenetically transitional form between Triceratops and “Tuscahomys.”

TECHNICAL SESSION VII (Thursday, November 3, 3:45 pm)

PALEONTOLOGICAL IMPLICATIONS OF THE EARLY EOCENE RODENT TUSCAHOMYS BASED ON AN EXTRAORDINARY NEW FAUNAL ASSEMBLAGE FROM THE GREAT DIVIDE BASIN, WYOMING, USA

BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, USA; DAWSON, Mary, Carnegie Museum of Natural History, Pittsburgh, PA, USA; ANEMONE, Robert, Western Michigan University, Kalamazoo, MI, USA

The cylindrodontid rodent Tuscahomys is a dominant component of earliest Wasatchian faunas from the United States, where its range is known to have extended from Mississippi to Wyoming. Earliest Wasatchian faunas containing Tuscahomys play a pivotal role in documenting how North American ecosystems responded to the dramatic, yet short-lived episode of global warming known as the Paleocene-Eocene thermal maximum (PETM). Here, we report an extraordinary new sample of Tuscahomys currently consisting of 400 identifiable specimens representing at least 63 individuals from the newly designated Smiley Draw local fauna (L.F.) in the Great Divide Basin, Wyoming. To our knowledge, this is the largest sample of a rodent species ever collected from an early Eocene locality in North America, and possibly worldwide. The Smiley Draw L.F. correlates with the lower part of the Wa-4 faunal zone on the basis of the biostratigraphic record of the primate Tetonius. Although the new assemblage of Tuscahomys is substantially younger than those previously documented from Mississippi and the Bighorn Basin, it maintains a similar pattern of faunal association. Along with Tuscahomys, the most common mammals in the Smiley Draw L.F. are Hapalodectidae, Perissodactyla, Artiodactyla, Primates, Hyaenodontidae and Hapalodectidae. The American fossil record at the base of the PETM, alongside a suite of other immigrant taxa including Perissodactyla, Artiodactyla, Primates, Hyaenodontidae and Hapalodectidae, the affinities of Cylindrodontidae are debated, but new data from Smiley Draw will follow a trend consistent with that of horses from other regions, suggesting increasingly abrasive diets during later half of the Cenozoic. Prior to the Clarendonian NALMA, Florida horse faunas show abrasion levels most consistent with extant browsers. Therefore, horses show a more disparate array of wear patterns, indicating a mixture of high-abrasion and low-abrasion diets. Low abrasion diets became increasingly rare and by the Pleistocene, all equid diets show high levels of abrasion consistent with extant grazers. Pleistocene horses from Florida appear to have had more abrasive diets than Pleistocene horses from other regions. The significance of higher dietary abrasion to our understanding of Florida paleoenvironment is not yet clear but may indicate that horses consumed greater amounts of inci- dental sand, soil, or dust. Data from several thousands of other specimens representing other types of ungulates consistently indicate low abrasion diets prior to the Late Miocene. In the Late Pleistocene and Early Pliocene, horses develop moderately to very high abrasive diets, perhaps indicative of mixed feeding, though not as abrasive as contemporaneous horses. In Florida, the horse assemblage shows strong and predictable responses to broad paleoenvironmental changes, whereas the mesowear from other ungulates show perplexingly weaker and less predictable paleoecological trends.

DEATH, DECAY AND DISARTICULATION: RECONSTRUCTING TAPHONOMIC HISTORIES OF TRIASSIC MARINE REPTILES FROM MONTE SAN GIORGIO, SWITZERLAND

BEARDSMORE, Sue, University College Dublin, Dublin, Ireland; ORR, Patrick, University College Dublin, Dublin, Ireland; FURRER, Heinz, Palaontologisches Institut und Museum der Universität Zürich, Zurich, Switzerland

Three marine reptile taxa from Monte San Giorgio, Switzerland, were used to develop and test a new method of evaluating taphonomy: the morphologically similar pachypleurosaurs Serpianosaurus and Neusticosaurus and the protorosaur Tanystropheus. Although the Neusticosaurus originates from a younger horizon, individuals of all three taxa are preserved in similar successions of alternating black shale and dolomite, representing normal back- ground sedimentation and event beds respectively. Skeletal taphonomy was assessed for nine anatomical units (the head, neck, dorsal, tail, ribs and four limbs) scored independently for two characters (articulation and completeness). All taxa vary in their state of preservation, however the patterns of articulation and completeness indicate individuals reached the sedi- ment-water interface shortly after death and while still largely intact. Episodic deposition of event beds due to various stages of decay. Where decay reached to bone, the most advanced stages, carcasses became progressively affected by weak bottom currents, resulting in removal of skeletal elements. Removal is most pronounced in Serpianosaurus and limited in Neusticosaurus indicating subtle differences in the environmental conditions of the ba- sinal setting across two successive units. Interpretations of Tanystropheus as having a fully or partly terrestrial lifestyle in near-coastal settings are not supported. Disarticulation is often entire, however complete taxa are relatively high, which could not be achieved during the extended interval of transport necessary to reach the marginal intra-platform basin, into which individuals were deposited.
paleontological occurrences of that taxon. More importantly, those reconstructions assume that evolution does not occur in the system under study; the ecological parameters of the extant taxa are simply applied to the fossil record. In many cases such assumptions are expressed as untested assertions, although they can, in principle, be tested. Application of an extant phylogenetic bracket, or corroboration from independent data sources (e.g., sedimentary context, isotopic data) was possible in the past to test the proposed paleontological reconstructions. Those issues are well illustrated by the fossil record of mammals in the Great Basin.

Paleontological reconstructions of pikas (Ochotona) in the Great Basin were tested by use of an extant phylogenetic bracket, which revealed that assumptions of habitat specificity are unwarranted. Northern boglemmings of the genus Mictomys, however, represent a ‘worst-case’ scenario, and illustrate the limitations of both phylogenetic bracketing and traditional practices. The extant species has a limited temporal depth, and for most (perhaps all) of its history Mictomys was monotypic. Its independent evolutionary trajectory following a long separation from its extant sister taxon (Synaptomys) results in uninformative paleontological reconstructions based on a phylogenetic bracket. Traditional taxon-based reconstructions using Mictomys necessarily involved application of data from the extant taxon to extinct forms, and sometimes relied upon incomplete consideration of the published ecological tolerances of the extant species. Independent tests of the stability of ecological tolerances through time are essential in the context of interpreting vertebrate responses to climate change.

**Poster Session III (Friday, November 4)**

**SHARING ICHNOLOGICAL DATA: FROM THE THEORETICAL MODEL TO THE DEVELOPMENT OF ICHNOBASE**

BELVEDERE, Matteo, University of Padova, Padova, Italy; BAUCON, Andrea, University of Milano, Milano, Italy; FURIN, Stefano, University of Ferrara, Ferrara, Italy; MIETTO, Paolo, University of Padova, Padova, Italy; MUTTONI, Giovanni, University of Milano, Milano, Italy

Since its beginning vertebrate ichnology has based the sharing of data and morphologies on outline drawings and qualitative descriptions of tracks. Though these methods are fundamental for the definition and the understanding of vertebrate tracks, they introduce a high level of subjectivity, due both to the drawing ability and to the sharing methods (e.g., copies from old journals), which do not allow a precise quantitative approach to ichnology, as, e.g., shape analysis.

During the last decade, several research groups have started using new methods for the documentation of footprints (laser-scanners, photogrammetry) that brought to the diffusion of three-dimensional models. However, their sharing is still related to direct contact among authors, thus preventing that jump towards a quantitative approach that ichnology needs.

The ICHNOBASE project thus aims to create the first comprehensive online database on trace fossils, allowing to organize, store, and retrieve large amounts of ichnological information. The project bases on a relational database controlled by a web-interface for data input and retrieval. The architecture of ICHNOBASE consists of three interconnected levels, corresponding to bibliographic, taxonomic and morphological data. Morphological data will include updated pictures of holotypes and specimens as well as downloadable 3D models achieved through lasers-canner or photogrammetry methods.

ICHNOBASE will also include detailed stratigraphical and sedimentological data of the site/surface bearing the traces, and will introduce a quantitative estimation of the preservation rate generated by answering some simple questions directly on the website.

Once compiled and tested, the ICHNOBASE would become the reference database for ichnologists, easing the exchange of information and 3D models, and enlarging the chance for each researcher to access new objective data, thus improving the shift toward a more quantitative ichnology.

**Poster Session III (Friday, November 4)**

**MORPHOLOGICAL CONSTRAINT IN THE METATHERIAN CRANIUM**

BENNETT, C. Verity, University College London, London, United Kingdom; GOSWAMI, Anjali, University College London, London, United Kingdom

In contrast to placental mammals, in which all cranial bones are ossified at birth, marsupials have only ossified the bones of the oral region in order to commence suckling. Here, we test whether this heterochronic shift in the timing of cranial ossification has constrained cranial diversity in marsupials relative to placental. Taxa were sampled from 12 extant placental orders and 4 extant and 11 undescribed marsupials, and included extinct representatives such as Oligo-Miocene diprotodontians (Dialcataudet and Nambulae) and perameleomorph (Galadi), and Pleistocene diprotodontians (Simosthenurus and Thylacoleo). Morphology was quantified and compared using type 13D coordinate landmarks collected using an Immersion MicroScribe G2X digi-tiser. Two sets of landmarks were used for the extant material, maximising either number of homologous landmarks (18) or the number of taxa, which necessitated use of fewer (11) landmarks, due to issues of homology. A third landmark set (15) was used for the inclusion of fossil taxa. The coordinate data was subjected to Procrustes superimposition, to remove differences in size and orientation, followed by Principal Components Analysis. Results showed that the extant marsupial taxa investigated here occupy a much smaller area of morphospace than the placental taxa, with a significantly (p <0.01) smaller overall variance. The inclusion of fossil taxa did not significantly increase the variance of metatherian cranial shape. Fossil forms plotted close to or within the realm of their extant relatives, except for the perameleomorph Galadi spicicus which plotted more closely to the extant dasyuromorph and diprotodontians. No significant difference in the variance of placentalts and marsupials was found for the neurocranial region. A significantly greater variance is displayed in the viscerocranial region of placentals than in marsupials. Furthermore, there is more difference in variance within the oral region between placentalts and marsupials than within the remainder of the viscerocranum. This result may suggest that it is the viscerocranium that is a whole that is developmentally constrained, not just the early ossifying oral region.

**Poster Session III (Friday, November 4)**

**FIRST EVIDENCE OF A CRANIAL CREST IN THE PTEROSAUR RHAMPHORHYNCHUS MUENSTERI**

BENNETT, S., Fort Hays State University, Hays, KS, USA

Many pterosaurs had sagittal cranial crests that are generally interpreted as inter- and intra-specific display structures because they had varied shapes, developed late in ontogeny, and in some cases are known to have been sexually dimorphic. In recent years cranial crests have been identified in several non-pterodactyloid pterosaurs including Austriadactylus, Darwinopterus, Harpactognathus, Pierorhyconis, and Raeticadactylus. Mapping the possession of cranial crests onto a pterosaur phylogeny results in a distribution that suggests that Rhamphorhynchos probably had a crest; however, to date no cranial crest has been identified in Rhamphorhynchos. Examination of the skull roof of a large specimen of Rhamphorhynchos muenstperi, which is interpreted as fully mature based on size-independent characters reflecting the ossification and fusion of the skull, revealed a series of previously overlooked medullar features that could have formed the base of a soft tissue sagittal crest similar to that of Pierorhynchos. The anterior end of the series is a small bony crest about 2 mm high. It is followed by a median sulcus that is about 1 mm wide and bounded by low ridges, which in turn is followed by another small bony crest about 4 mm high. The overall length of the series of features is roughly 25 percent of skull length. It is surmised that the sulcus held the bottom of a sheet of fibrous and/or cartilaginous tissue that formed the core of a soft tissue crest, and that the small anterior and posterior bony crests anchored the ends of the core and crest. The fact that similar series of median features have not been found in other specimens of Rhamphorhynchos despite the fact that the taxon is represented by more than 100 specimens in museum collections presumably reflects the fact that most specimens are immature based on size-independent characters.

**Poster Session II (Thursday, November 3)**

**A TAPHONOMIC AND PALEEOECOLOGICAL COMPARISON OF ISOLATED CROCODILIFORM TEETH FROM THE WOODBINE FORMATION OF TEXAS AND THE HELL CREEK FORMATION OF MONTANA**

BENNETT, III, George, Shennandoah Valley Discovery Museum & George Mason University, Winchester, VA, USA; MAIN, Derek, Scotese Museum of Paleontology, University of Texas at Arlington, Arlington, TX, USA; PETERSON, Rachell, Scotese Museum of Paleontology, University of Texas at Arlington, Arlington, TX, USA; ANDERSON, B., Scotese Museum of Paleontology, University of Texas at Arlington, Arlington, TX, USA

The Arlington Archosaur Site (AAS) is a Cenomanian locality in the Texas Woodbine Formation containing a diverse fauna of sharks, bony fishes, turtles, crocodyliforms, and dinosaurs. It represents a marginal marine environment ranging from a brackish or fully marine coastal shelf to a low lying delta plain. At least two crocodyliforms (Woodbinesuchus sp. and Crocodileformes n. gen. n. sp.) are present at the AAS, although two additional taxa are known from the Woodbine Formation. AAS teeth were obtained by either surface collection of the region or excavation from the Crocorama quarry that contains isolated skeletal material belonging to a large, undescribed crocodyliform. Both datasets were analyzed independently for taphonomic reasons. Two crocodyliforms (Brachychamys montana and Borealsuchus sternbergi) are present in the fluvial deposits of the Hell Creek Formation study area. The Hell Creek teeth were either surface collected or screen washed. All teeth (n=332) were measured in three dimensions and the size distributions compared with two additional datasets of teeth gathered from the Oligocene Lake Eempel and the Muscove freshwater molasie of Langenau, southern Germany. The Hell Creek screen washed sample shows a similar distribution to modern Alligator mississippiensis population structure based on body size, and is interpreted to be the least taphonomically biased dataset because the screen washing process is able to sample the smallest size category of teeth from hatching or nestling individuals. Quarry excavated teeth show a similar distribution to the screen washed sample, except that the smallest size class is underrepresented. The surface collected samples incorporate the greatest collection bias and were most likely transported, thus are the least accurate approximation of the thanatocoenose. The Crocorama quarry trend toward larger teeth is likely both ontogenetic (larger body size) and collection based in nature. Surface collecting at the AAS has not revealed the range of tooth sizes seen at the quarried locality, suggesting that smaller taxa were more common than the large undescribed taxa.
Tetrapods originated in the Late Devonian (~360 Ma), but were tied to aquatic environments until the appearance of amniotes in the Late Carboniferous (~310 Ma). Amniotes, primarily basal synapsids, rapidly filled terrestrial niches, ultimately freeing vertebrate ecosystems from their dependence on aquatic productivity, and culminating in the taxonomically and ecologically diverse post-Carboniferous assemblages of the Middle-Late Permian (270-252 Ma). Amniote origins are a classic example of adaptive zone invasion. Based on a new phylogeny of basal synapsids drawn strongly on both cranial and postcranial data, this invasion was characterized by the explosive appearance of higher clades and ecotypes in the latest Carboniferous (~304 Ma), resulting in sudden increases in taxonomic diversity. This was accompanied by apparently elevated rates of morphological character evolution. However, a number of observations suggest caution interpreting this result. (1) Temnospondyls, a diverse clade of non-amniote tetrapods show a similar diversity increase that is clearly linked to a sudden increase in fossil record sampling in the latest Carboniferous; (2) stratigraphic fit of Carboniferous basal synapsids is poor, and phylogenetic ghost lineages are abundant, suggesting extremely poor lineage sampling and systematically underestimated branch durations; (3) evolutionary rates measured ‘per branch’ do not show the same elevated Carboniferous rates as those divided by time. Thus it is likely that amniote diversification occurred more gradually, origins prior to their first fossil occurrences, and currently masked by poor sampling and sparse preservation of appropriate facies. By contrast, the Permian amniote record is sampled well. Early Permian synapsids show a phylogenetically co-ordinated pattern of evolutionary rates. The branch leading to the bizarre, herbivorous caseids shows relatively high numbers of state changes. However, maximal sustained rates are evident between successive nodes on the line leading to Therapsida (i.e., within the clade Edaphosauridae + Sphenacodontia), and were key to the evolutionary diversification of early amniotes.

Symposium 4 (Friday, November 4, 8:45 am)

TETRAPOD EVOLUTION THROUGH THE PERMIAN AND TRIASSIC: ROCK RECORD, SUPERTREES, AND DETECTING EVENTS
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Studies of macroevolution depend on an adequate fossil record, and investigators should ensure that their data are sufficient to test relevant hypotheses. In such studies it is therefore appropriate to assess the data for error, whether from geological (incomplete rock record) or human (variable study effort) failings. Error is relevant only to the question in hand, so a fossil record that works well for one study may be inadequate for another; so, a statement that the dinosaur fossil record is good or bad is meaningless. Some studies of vertebrates through the Permian and Mesozoic have applied inappropriate sampling proxies (SPs) that do little to reveal whether the record in question is good, bad, or adequate. This is because many popular SPs are redundant with the signal they seek to assess or correct (e.g. ‘number of formations’ is often correlated with ‘number of contained fossils’ because the measures are linked).

A key macroevolutionary theme is clad diversifications, whether following a mass extinction, the evolution of an important novelty, or some other cause. In exploring the greatest mass extinction occurred in three phases, with rapid initial filling of ecospace by putative ecological analogs and potential competitors of early rodents based on dentition and overall of the temporally-mixed (latest Cretaceous-earliest Paleocene) fossil assemblages of the Bug Creek Anthills in McCone County, Montana. Based on an intertocthonian fossa divided into the more proximal troctohanic fossa and more distal posttroctohanic fossa, and the presence of a subtroctohanic tubercle in nearly all specimens, the femora are attributable to Mammutotheria. A preliminary analysis of functional morphology suggests the specimens tend towards terrestriality. Body mass was inferred from cortical cross-sectional area for specimens preserving diaphyses, and results suggest body masses of < 2 kg.

Poster Session I (Wednesday, November 2)

A SECOND, NEW SPECIES OF TREMATOPID AMPHIBIAN FROM THE LOWER PERMIAN BROMACKER LOCALITY OF CENTRAL GERMANY
BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, CA, USA; HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, CA, USA; MARTENS, Thomas, Museum der Natur Gotha, Gotha, PA, Germany; SUMIDA, Stuart, California State University, San Bernardino, CA, USA; ANDERSON, Jason, University of Calgary, Calgary, AB, Canada

Until recently the amphibian Trematopidae was represented at the well-known Lower Permian Bromacker locality of central Germany by a single species, Tambachia tragula, based on a large portion of the skeleton, including the skull. A second, new species, based on the greater portion of the skull with attached mandibles and associated, loosely articulated post-cranial elements has been discovered from the same locality. Both species represent the trematopid occurrences known outside of North America. The Bromacker specimen is unique among trematopids in having the entire length of the naso-oral canal exposed as a smooth, uniform channel in which the anterior half coincides with maxillary-lacrimal suture. A combination of cranial synapomorphies distinguished it also from all other well-known members of the family. A cladistic analysis of Trematopidae utilizing only cranial characters of those members of the family well represented in this field of inquiry resolves the Bromacker specimen and the North American Upper Pennsylvanian Fedexia as sister taxa of a terminal dichotomy of a clade containing the successively more basal Tremata, and the North American Upper Pennsylvanian Anacostes. This in turn forms the sister-clade to that consisting of the sister taxa Phonerpeton and Acheloma from the North American Lower Permian. The cladogram conforms to previous analyses in recognizing the same two basal sister clades. The Bromacker specimen, however, is interesting in possessing a couple of characters that represent parallel acquisitions to those defining the Phonerpeton-Acheloma clade.

Technical Session IV (Wednesday, November 2, 3:45 pm)

HIGHER-LEVEL OF EARLY CAVIOMORPHA (RODENTIA: HYSTRICOGNATHAE), PALEOGEOGRAPHY, AND EVOLUTION OF HYPSONDONTY
BERTRAND, Ornell, American Museum of Natural History, New York, NY, USA; FLYNN, John, American Museum of Natural History, New York, NY, USA; CROFT, Darin, Case Western Reserve University, Cleveland, OH, USA; WYSS, Andre, University of California, Santa Barbara, CA, USA

The origin and initial diversification of Caviomorpha, South America’s “original” rodents, are poorly understood. Given that the closest relatives of Caviomorpha are African phylomorphs (Hys-tricognathi) and South America was an island for most of the Cenozoic, mid-Cenozoic arrival via “rafting” from Africa is widely assumed. Study of the oldest reported caviomorphs, from the Tinguiririca Fauna of Chile (earliest Oligocene, 33-31 Ma), prompted our broader investigation of early caviomorph phylogeny. We carried out an extensive morphological phylogenetic analysis of fossil and living taxa from all 4 major caviomorph subclades. We analyzed 222 craniodental characters: 129 dental (79 lower, 46 upper, 4 general), 7 enamel, and 86 cranial. These were coded for 102 taxa: 20 Old World (4 extinct,16 extinct) and 82 New World (18 extinct, 64 extant).

Our analysis confirms that the Tinguiririca taxa are a dasyproctid and a chinchilloid. Most taxa traditionally classified as eterohyodonts form one of the two basal clades within Cavi-omorpha. Cavius, Cecoardiodont and octodontids are monophyletic, while 7 other “families” are not (e.g., fossils traditionally assigned to one group instead ally with another, although support for their placement or for non-monophyly is weak in some cases). Caviomorpha is monophyletic, but Octodontoidea and Chinchilloidea, as traditionally conceived, are unadulterated. Indeed, three /cephalomyids, usually considered chinchilloids, are instead allied with various octodontoids; a dinomyid is placed among cavioids; and five taxa widely considered octodontoids instead group with chinchilloids. The monophyly of crown clade Caviomorpha, Erethizontoidea, and Caviomorpha are confirmed in our analysis, consistent with molecular results. Caviomorpha form the outgroup to a clade encompassing “octodontoids” plus “chinchillo-uids.” These results indicate a single dispersal event of hystricognaths from Africa to South America, probably during the mid-late Eocene (judging from early Oligocene caviomorph diversity). Hypsodonty originated at least three times independently in Caviomorpha (among octodontoids, chinchilloids, and one of octodontoids), probably in response to environmental changes.
A NEW SPECIES OF HERPETOTHERIINAE (MAMMALIA, MARSUPIALIA) FROM THE TORREJONIAN OF NEW MEXICO
BEZOLD, Samuel, A.T. Still University of Health Sciences, Kirkville, MO, USA; KONDRASTHOV, Peter, A.T. Still University of Health Sciences, Kirkville, MO, USA; LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA
An extensive collection of isolated dental remains of small mammals was obtained from the Torrejonian interval of the Nacimiento Formation at Tsentas Quarry (San Juan Basin, New Mexico) using screen-washing. The specimens are housed at the New Mexico Museum of Natural History. Among these remains are dental specimens of a new marsupial species represented by multiple isolated M1-M4/m1-m4. The new species is characterized by dilambodont upper molars with a W-shaped ectothol and a well-developed stylar shelf. An enlarged metacone is present on M1-M4; the metacone is taller than the paracone (and both express convex labial faces) on M1-M3. The bases of paracone and metacone on M1-3 are generally separate. The M2-M3 have well-developed, deep ectoflexi. The m1-m4 metacodon is taller than the paraconid, and the cristid obliqua meets the posterior trigonid wall lingual to the protoconid notch. The trigonid angle, measured on all lower molars from entoconid to protoconid with the metaconid as a vertex, is obtuse. Twisting between the entoconid and hypoconid is well-expressed, but there remains a distinct notch between these cusps. Cladistic analysis placed the new taxon in subfamily Herpetotheriinae close to and hypoconulid is well-expressed, but there remains a distinct notch between these cusps. The trigonid angle, measured on all lower molars from entoconid to protoconid with the metaconid as a vertex, is obtuse. Twisting between the entoconid and hypoconid is well-expressed, but there remains a distinct notch between these cusps. Cladistic analysis placed the new taxon in subfamily Herpetotheriinae close to...
NEUROCENTRAL SUTURE CLOSURE IN ALLOSAUROS (Saurischia: Theropoda): SEQUENCE AND TIMING

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Growth dynamics among theropods, particularly Allosaurus, is a widely studied topic but few studies discuss the sequence or ontogenetic stage of neurocentral suture closure. The timing and progression of neurocentral suture closure could determine the ontogenetic stage while assisting in the study of growth dynamics and phylogenies. An associated Allosaurus sp. from the Chelby’s Blind (CB) Quarry of Thermopolis, Wyoming, is presented to discuss the sequence of suture closure. Currently, 20% of a single Allosaurus skeleton has been recovered, including several cervical vertebrae, a nearly complete dorsal column, one-third of a tail, and assorted appendicular bones. Of the distal caudal vertebrae, the neural arches are fully fused with no indication of a suture line (closed). Approximately mid-way on the tail, a suture line appears on the vertebrae and anterior to this the arches are completely separated (open) prior to the sacrum. The rest of the vertebral column remains open. The humerus measures 37 cm; comparable in size to the larger humeri found in the Cleveland-Lloyd Dinosaur Quarry (CLDQ).

A literature study of similarly sized allosaurs seem to follow a similar pattern of neurocentral suture closure as well. Specimens from the CLDQ commonly have fully fused dorsal caudals but remain unfused or partly fused from the proximal tail forward. USNM 8367 has fused posterior caudal vertebrae but unfused anterior caudal vertebrae and WDC-DMP-02 has fully fused dorsal and caudal vertebrae but lack full fusion in the cervical vertebrae. This information provides a very general neurocentral suture closure pattern from posterior to anterior. Vertebral fusion appears to begin early in ontogeny but anterior progression of the neurocentral closure starts later in life as the animal approaches adult size. To date, there is no evidence of concurrent neurocentral suture closure, such as cervical and caudal suture closure, in Allosaurus.
teeth with the different types of tooth-like scales deepens our understanding of ichnacanthid diversity as well as of the development and origins of early vertebrate teeth.

Technical Session III (Wednesday, November 2, 4:00 pm)

FIRST RECORD OF A LARGE INMIGRANT BEARDOG (MAMMALIA, AMPHICYONIDAE) FROM THE EARLY MIocene OF PANAMA

BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; GROSS, Matthew, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; HUNT, Robert, Department of Earth and Atmospheric Sciences, University of Nebraska, Lincoln, NE, USA; RINCON, Aldo, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; MACFADDEN, Bruce, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA

Prior to the formation of the Isthmus (ca 3.5 mya), North and South America were separated by a broad seaway that connected the Atlantic (Caribbean Sea) with the Pacific. The Las Cascadas Formation, a volcaniclastic and tuffaceous sequence outcropping in the southern part of the Panama Canal area, is the first evidence of aerial exposure of land at the southern tip of North America, in what is now Panama. The terrestrial fauna recovered so far includes the oldest records of carnivores, rodents, bats, pinnipeds, equids, anhainotheres, protoceratids, and camels from the Panam Canal. Here we report the first record of a relatively large amphicyonid carnivore, represented by a distal humerus and an upper first molar. The molar shows occlusal morphology similar to that of the amphicyonid Cynelos that first appears in deposits of Oligocene and early Miocene age in western Europe and the early-middle Miocene of North America. Specifically, the proportions suggest a Central American species paralleling late Aquitanian Cynelos lemanensis from France and southern Germany. The unassociated distal humerus preserves sufficient anatomical detail to permit identification as an amphicyonid carnivore, and to place it in the subfamily Amphicyoninae. Among North American amphicyonines it is nearly identical to those of Cynelos and to examples of C. lemanensis from Europe. If associated with the previously documented North American Large Carnivore Turnover Event, the occurrence of a relatively large-bodied amphicyonine, the southern-most occurrence of Amphicyonidae in the New World, would constrain the age of the mammal-bearing portion of the Las Cascadas Formation to approximately 20-23 million years. Alternatively, it is possible that it represents a previously unrecognized late Oligocene or early Miocene amphicyonine that reached Panama at the extreme of its biogeographic range.

Symposium 2 (Wednesday, November 2, 11:15 am)

BIOME SHIFTS WITH PALEOCLIMATE CHANGE: RECONSTRUCTING PAST BIOMES USING MAMMALS

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Global biome maps for the Last Glacial Maximum (LGM) and mid-Holocene have been developed from fossil pollen and plant-macrofossil records, but the resultant maps have gaps in areas where such records are sparse. Fossil mammal assemblages are a promising source of information about past biome distributions and they might fill these gaps. However, it is unclear which mammal species are good predictors of biome distributions, given that some associations between mammals and vegetation types today appear to be stable while others appear more variable. For mammals, we adapted the biomassation procedure of the BIOME 6000 working group for mapping past biome distributions from paleoecological data. This approach allows globally consistent definitions of biomes as assemblages of functional types, with regionally varying species composition. With a focus on North American non-volant mammals, we created a set of mammal functional types (MFTs) based on combinations of three traits: body size, locomotion, and trophic group. Taxa were assigned to a particular MFT, and MFTs were assigned to biomes. Next, the taxa x MFT and MFT x biome matrices were cross-multiplied to generate lists of taxa associated with each biome. This procedure allowed the affinity of taxa to MFTs and MFTs to biomes. This multi-proxy approach that takes into account the partitioning of dietary resources and occupied a range of microhabitats, from riparian to woodland areas.

Poster Session III (Friday, November 4)

COMPOSITION OF TYRANNOSAURUS AND BRACHYLOPHOSAURUS SOFT TISSUES AT HIGH SPATIAL RESOLUTION: NEW INSIGHTS INTO PROTEIN DIAGNOSIS

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Soft tissue ‘vessel’ structures recovered after demineralization of long bones from Tyrannosaurus (MOR 1125) and Brachylophosaurus (MOR 794) were subjected to chemical analysis to further investigate their composition and to elucidate possible pathways of protein preservation and diagenesis. Demineralized ostrich blood vessels and ostrich vessels bathed in hemoglobin were also analyzed. Micro-focused X-ray fluorescence (XRF) mapping revealed micron-scale distribution and relative concentrations of S, Ca, Mg, Fe, Zn, and As. X-ray absorption near-edge structure (XANES) spectroscopic analyses at K-edges were performed on isolated vessel and cell regions to determine chemical speciation. Micro-focused X-ray diffraction (XRD) of these isolated regions was also performed. All X-ray microprobe analyses were completed at the Advanced Light Source of the Lawrence Berkeley National Laboratory. Sub-micron spatial distribution of the elements of interest was analyzed with scanning electron microscopy and energy-dispersive X-ray spectroscopy (EDS). XRF maps and EDS revealed high spatial correlation of Mg, Fe, Zn, and As with vessel structures. In particular, Mg, Zn, and As were enriched in the fossil tissues versus the ostrich suggesting their presence reflects postmortem diagenesis. Calcium exhibited low spatial correlation with structures of interest and is likely an artifact of bone apatite demineralization. In both ostrich samples, S was of methionine character but in fossil samples S was not detected, suggesting that cleavage of S-containing functional groups from amino acid residues may be a consequence of diagenesis. K-edge XANES fitting analyses indicated that Fe in the soft tissues was primarily of oxyhemoglobin character in ostrich and entirely goethite in fossil tissues. XRD confirmed the expected amorphous character of the ostrich vessels and demonstrated the extensive crystalline goethite character of the fossil tissues.

Technical Session X1 (Friday, November 4, 3:00 pm)

COMPARATIVE SHAPE ANALYSIS OF THE NECK IN EXTINCT AND EXTANT ARCHSAURS: IMPLICATIONS FOR VERTEBRAL EVOLUTION IN SAUROPOD DinosaurS

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Archosaurs represent one of the most morphologically diverse groups of tetrapods. The variation in the axial skeleton alone displays a wide range of morphologies and vertebral

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formulae. Particularly, comparisons of the neck vertebrae yield striking numerical and os- teological differences in archosaurs. Crocodiles have 9 cervical vertebrae, whereas chicken possess 14 and some sauropod dinosaurs even reach a number of 19 neck elements.

Here, we analyse the intraspecific variation in the morphology throughout the cervical column of different archosaurs applying landmark-based geometric morphometrics. Equal predefined homologous points were digitized on the neck bones of crocodilian, avian, and di- nosaurian taxa to capture important morphological characteristics. The relative warps analy- sis summarizes the distribution of the vertebral shapes in each morphospace. Independently from the number of element in the different taxa, it is possible to distinguish between at least three morphological groups (atlas-axis complex, anterior, and posterior vertebrae). When the neck is elongated by the addition of vertebrae, the shape analysis reveals that the anterior cervical region expands and an additional distinct morphological group of middle segments forms that likewise expands further on.

The first two cervical vertebrae significantly differ from the other axial bones. They form a functional unit that carries the head. The cervico-thoracic transition represents a unique region in the spine because of its biomechanical properties. The junction from the highly mobile cervical column to the relatively stiff thoracic spine places great demands on the body plan. From a biomechanical point of view the morphological expansion of the anterior and middle segments is the only way to increase the number of neck vertebrae.

The absolute axial formula depends on the number of morphologically very similar somites that give rise to the morphologically different vertebrae. The differentiation of the individual vertebral segments is governed by Hox genes. The variation in the morphological subregions of the neck seem to be the result of an expansion of Hox gene activity.

Technical Session XVI (Saturday, November 5, 9:15 am)

INSIGHTS ON THE EVOLUTION OF THE PELVIC GIRDLER OF EARLY GNATHOSTOMES FROM THE DEVELOPMENT OF THE ELEPHANT SHARK (CALLORHINCHUS MILII) AND PRESERVED SOFT TISSUE IN DEVONIAN PLACODERMS

BOISVERT, Catherine, Monash University, Melbourne, Australia; TRINAJSTIC, Katherine, Curtin University, Perth, Australia; CURRIE, Peter, Monash University, Melbourne, Australia

Two sets of paired fins and their supporting girdles are defining characteristics of gnathos- tomes. However, pelvic girdles have a patchy distribution in early gnathostome phylogeny, lacking altogether in some placoderms, and having an origin that is still poorly understood. Elephant sharks (Callorhinchus milii) are extant chimaeroids (Holocephali) with a fossil re- cord extending back to the Devonian. Growth series were obtained from eggs laid in captiv- ity and analysis of the developing girdle was conducted through histology and dissection of adults. The morphology of the pelvic girdle is very similar to that of arthrodire placoderms such as Inciscocutum and Compagopiscis. Exceptionally preserved material from the Late Devonian of the Gogo Formation (Western Australia), containing three-dimensionally pre- served musculature, allows for comparison with Callorhinchus. In specimens of Inciscocutum and Compagopiscis, musculature following most of the length of the posteroventrallater- al plate extends transversally relative to the trunk myomeres and extends to the pelvic girdle. This is similar to the condition in adult Callorhinchus and suggests that in both groups, these muscles lie ventral to the ‘lateral somitic frontier’, a region where the interaction of somiti- cally derived tissue is influenced by lateral plate mesoderm to form appendicular bones and muscles, confirming a derived developmental pattern for placoderms. The development of Callorhinchus shows that the fins develop first followed by the migration of mesenchymal cells to the region where the pelvic girdle will later develop. Muscles extending from the fin to the girdle migrate dorsally and anteriorly after the formation of the fin, suggesting that the girdles could have originated after paired fins by an extension of the mesenchymal migration field. This suggests that true fins could have originated prior to their supporting girdles.

Poster Session I (Wednesday, November 2)

FROG TAPHONOMY IN A HIGH ELEVATION LAKE BASIN ON THE NEVADAPLANO, LATE CRETACEOUS TO EOCENE, SHEEP PASS FORMATION, EAST-CENTRAL NEVADA

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Here we report on differential preservation of frogs remains of the Sheep Pass Formation type section in the south Egan Range, Nevada. A diverse fauna is known from other sections of the formation; however in the Sheep Pass type section the only vertebrate identified to date are frogs. The Sheep Pass Formation represents sedimentary units of the Sevier retroarc hinterland. The formation is divided into 5 members. Of interest to this study are members B and C. Member B represents a calcareous lacustrine system, while Member C represents a lacus- crime fan delta. Absolute age control from the base of member B is latest Cretaceous, while member C straddles the Paleocene-Eocene boundary. Results of a recent stable isotope pa- leosatimetry study support a high elevation setting for the Sheep Pass basin.

Member B frogs are preserved in 3 taphonomic modes. Mode 1 is frogs fully articulated and accumulated under attritional processes, as no two frogs are in close association. These frogs settled on microbial mats, as evidenced by crinkle fabric of the limestone. Mode 2 frogs also accumulated as a result of attritional processes, as no two frogs are found in close association. These frogs are found mostly articulated. Some of these frogs, especially those partially articulated, are thought to have been scavenged. Possible scavengers are gastro- pods, ostracods, and decapods. Mode 3 is the isolated reworked remains of frogs as a result of storm activity, supported by the association of elements with disarticulated bivalves and mud rip-up clasts.

Member C preserves frogs in 2 taphonomic modes. Mode 1 is articulated frogs accumulated under attritional processes. Mode 2 is a frog bonebed. Given similar preservation of elements we interpret that the organisms died in a short period of time (perhaps a single season). Mas- sive, irregular matrix, and lack of orientation of elements suggests transport by a debris flow. Variability in size of elements suggests this was a non-selective event. Modern examples of frog die-offs, mostly the result of pathogens, exist.

Poster Session IV (Saturday, November 5)

BOVID HORNS AS MODELS FOR CERATOPSID CRANIAL HORN

BORKOVIC, Ben, University of Calgary, Calgary, AB, Canada; RUSSELL, Anthony, University of Calgary, Calgary, AB, Canada

The functional significance of the prominent cranial horns of ceratopsid dinosaurs remains poorly understood. They have been hypothesized to have been weapons, used in predator de- fense or intra-specific combat, or both, or to have been signalling structures that functioned in species recognition or signalled the attainment of sexual maturity. The horns of bovid mammals have often been considered as potential analogues of the horns of ceratopsids. The factors that influence horn form and dimorphism in extant boids can be studied, and bovid horn morphology has been shown to be correlated with function and with the intensity and nature of selection pressure. However, boids show a wide range of sexual dimorphism in horn form, something that has not been observed or demonstrated for ceratopsids. We have performed a comparative morphometric study of boid and ceratopsid horns. Measure- ments relating to horn dimensions and skull size were recorded from several Centrosaurus apertus and Triceratops horridus specimens in collections at eight institutions. Suites of similar measurements were also recorded from two sexually-dimorphic species of two sexually dimorphic boids, the mountain goat (Oreamnos americanus) and North American bison (Bison bison), as well as the pronghorn (Antilocapra americana). Morphological variation related to sexual dimorphism and ontogeny was demonstrated in the boid horns, and then assessed in a comparative manner in the ceratopsid samples. This revealed high variability in horncore form in ceratopsids and did not demonstrate informative signals attributable to sex or func- tion. Extended 2D Eigenshape analysis was demonstrated to successfully distinguish sexual differences in horn shape, but not horncore, shape in O. americana; and then applied to investigate the points of greatest variation in horn curvature in Triceratops. With reference to our bovid dataset, we also discuss the power of the ceratopsid fossil record for demonstrating intraspecific variation in horncore form.

Technical Session XVII (Saturday, November 5, 2:00 pm)

ENVIRONMENTAL INFLUENCES ON THE EVOLUTION AND GEOGRAPHIC DISTRIBUTION OF CAMELIDAE (ARTIODACTYLA, MAMMALIA)

BORMET, Allison, Indiana University, Bloomington, IN, USA

The effects of climate change on organismal populations is an important issue facing con- servation efforts concerning endangered species. By studying the effects of climate change on extinct populations, the ecology of current populations can be better understood. The emergence of C4 grasses during the Cenozoic brought about a shift in habitats, from closed, wooded areas to open, flat expanses. Due to this change in habitat cover, organisms evolved new ecological niches. The family Camelidae was selected for this study because it consists of a total of 43 genera, but only three are extant (e.g. Lama, Camelus and Vicugna), with one species, Camelus ferox, critically endangered. In order to understand extant camelid morphology and distribution, the effects of Cenozoic grasslands on extinct camels are analyzed using phylogeny, genus diversity, PCO limb clustering, fossil occurrence data and ecological niche modeling. The data show that although cameldid diversity does not appear to be affected by cooling events, as indicated by oxygen 18 isotopic levels, both limb morphol- ogy and genus diversity are affected by the appearance of C4 grasses. Limb morphology patterns of the last half of the Cenozoic change from earlier Cenozoic patterns. Camelid genus diversity decreases during the interval when grasslands emerged. Current ecological niche models and models projected into the future, with carbon dioxide levels twice that of today, demonstrate that potential niches for Camelus ferox do not exist outside of Asia, while Vicugna and Lama have potential niches on other continents.
CRANIAL VARIATION IN "CREODONT" AND IMPLICATIONS FOR CONVERGENCE IN PLACENTAL AND MARSUPIAL CARNIVORES

Borths, Matthew, Stony Brook University, Stony Brook, NY, USA; Goswami, Anjali, University College of London, London, United Kingdom; Milne, Nicholas, University of Western Australia, Crawley, Australia; Wroe, Stephen, University of New South Wales, Sydney, Australia

Carnivory has evolved independently in multiple lineages of mammals. Three-dimensional geometric morphometric techniques were used to explore the relationship between cranial morphology, diet and dentition in a broad sample of carnivorous mammals and their closest relatives. Seventy-five landmarks were collected from the dorsal and ventral aspects of the skulls of extant carnivorans, and extant marsupials. In contrast to previous analyses, this dataset also included an extensive sample of the two extant "creodont" families Hyaenodonta and Oxyaenidae, diverse eutherian carnivores that filled terrestrial carnivore niches across the Northern Hemisphere and Africa during the Paleogene. A principal components analysis was used to identify major axes of variation in the sample. A MANOVA using the first five PCs as independent variables and group membership as the dependent variable was used to compare variance between groups. Post-hoc tests were used to evaluate significant differences between groups on each PC axis. The results indicate that cranial variation in hyaenodontid creodonts and marsupials is not significantly different on PC1. Hyaenodontid and marsupial skulls, with long rostra and posteriorly-placed temporomandibular joints, occupy one end of the carnivorous mammalian morphospace, with species of Carnivora occupying the opposite end of the axis, with shorter rostra and more rostral-placed temporomandibular joints. Oxyaenids are placed in an intermediate position, near taxa with moderately shortened rostra including Crocuta crocuta and Sarcophilus harrisii. A canonical function analysis demonstrates that the second and third principal components, describing palatal and zygomatid breadth, basi-cranial flexion and temporal crest height, are more significantly correlated with diet than PC1. The DFA also demonstrated that Hyaenodontidae and Oxyaenidae fall within the variation expected for extant carnivorous mammals. Hyaenodontidae and carnivorous marsupials share a similar carnassial arrangement and occupy similar areas of morphospace, suggesting that cranial morphology is more directly influenced by dental morphology than development.

POSTER SESSION I (Wednesday, November 2)

DISTAL FIBULAR REDUCTION AND ITS REVERSION IN EVOlUTION AND DEVELOPMENT

Botelho, João, Universidad de Chile, Santiago, Chile; Palma, Verónica, Universidad de Chile, Santiago, Chile; Soto-Acuña, Sergio, Universidad de Chile, Santiago, Chile; Vargas, Alexander, Universidad de Chile, Santiago, Chile

A narrow fibula evolved several times in the archosaur clade, often related to bipedal posture, and was the ancestral condition for Ornithodira. Within at least four different clades of Ornithodira, (Pterosaurus, Alvarezsauridae, Oviraptorosauria and Aves), the fibula lost its distal epiphysis and became shorter than the tibia, losing its articulation to the tarsus. Remarkably, reversion to a fibula as long as the tibia and articulated distally to the tarsus has occurred in some modern birds such as the Pelicaniformes. Parallelism and reversal reinforces the importance of understanding the developmental factors involved in the evolution of the avian crus. Here we present evidence that the reduction of the distal fibula is related to the disruption of a molecular feedback between the diaphysis and the distal epiphysis. In chicken embryos the distal end of the fibula is in contact with the tarsus until day 7, expressing typical epiphyseal genes such as Sox5 and Pihp. At embryonic day 8 the distal end of the fibula loses the expression of epiphyseal genes and expresses markers of chondrocyte hypertrophy usually found near the diaphysis such as collagen type X and Indian hedgehog. We demonstrate that the loss of the distal epiphysis can be avoided by application of Cyclopamine, a down-regulator of Ihh signaling, resulting in a long fibula that articulates with the tarsus and closely resembles that of non-avian theropods.

OSEOHEMIOLOGY OF TRIASSIC ARCHOSAURIOMORPHS FROM THE KAROO BASIN OF SOUTH AFRICA

Botha-Brink, Jennifer, National Museum, Bloemfontein, South Africa; Smith, Roger, Iziko South African Museum, Cape Town, South Africa

The South African non-archosauriform archosauromorph Prolacerta and the archosauriforms Proterosuchus, Erythrosuchus and Euparkeria were important constituents of the Early to Middle Triassic Karoo ecosystem following the end-Permian mass extinction. We present new data on the osteohistology of these stem archosaurs and provide insight into their paleobiology. Bone tissues of the Early Triassic Prolacerta contain a poorly defined fibro-lamellar complex, with parallel-fibered bone in some regions, whereas the contemporaneous Proterosuchus exhibits rapidly forming uninterupted fibro-lamellar bone early in its ontogeny, which becomes slow and cyclical with increasing age. The early Middle Triassic Erythrosuchus deposited highly vascularized, uninterupted fibro-lamellar bone throughout ontogeny, whereas the growth of the contemporaneous Euparkeria was relatively slow and cyclical. While our data are combined with those of previous studies, preliminary results reveal that Early and Middle Triassic non-crown group archosauromorphs generally exhibit faster growth rates than many of those of the Late Triassic. Early rapid growth and rapid attainment of sexual maturity are consistent with life history predictions for taxa living in the unpredictable conditions following the end-Permian mass extinction. Further research with larger sample sizes will be required to determine the nature of the environmental pressures on these basal archosaurs.

Technical Session II (Wednesday, November 2, 3:00 pm)

GASTORNIS IS A TERROR BIRD: NEW INSIGHTS INTO THE EVOLUTION OF THE CARIAMEAE (AVES, NEORNITHES)

Bourdon, Estelle, Natural History Museum, London, United Kingdom; Cracraft, Joel, American Museum of Natural History, New York, NY, USA

Gastornis (which includes the junior synonym Dietramys) comprises several species of giant ground birds from the Lower Paleogene of Europe and North America. This enigmatic taxon of flightless birds has been considered as related to various groups, including Ratitae, Gruiiformes and the extinct South American Phorusrhacidae. More recently, it was proposed that Gastornis is sister to the Anseriformes, but this conclusion was reached on the basis of a very limited sampling.

Here we present a new phylogenetic analysis to assess the phylogenetic position of Gastornis within modern birds (Neornithes). The character/taxon matrix includes representatives of most neornithine clades and is based on morphological characters. Our results strongly reject the hypothesis that Gastornis is related to anseriforms. We provide the best evidence so far that living seriemas (Cariamae) are related to terror birds (Phorusrhacidae). Most importantly, we show that Gastornis is nested within the Phorusrhacidae. The small long-legged Pilosorumus is basal within the Phorusrhacidae, and Gastornis is regarded as a highly specialized phorusrhacid, closely related to the giant graviportal species included in the Brontornithidae.

The inclusion of Gastornis within the terror birds is based on postcranial as well as cranial features including a stout, high and laterally compressed maxilla and a very long mandibular symphysis. Most features shared between Gastornis and Brontornithines are linked to the massive, graviportal hindlimb. Gastornis differs from all other phorusrhacids in the non-hooked maxilla and in the stronger reduction of the flight apparatus. Unlike most Phorusrhacidae, Gastornis was not a strong runner and was likely a scavenger or an herbivore.

The crown position of Gastornis implies that the age of diversification of the Cariamae is older than Late Paleocene and that this clade originated in the Late Cretaceous, as has been hypothesized for major neornithine divergences. It is compatible with the hypothesis that Cariamae originated and diversified in South America and expanded to North America, and then Europe, in the Paleogene.

Technical Session III (Wednesday, November 2, 3:15 pm)

COMPARISON OF NASAL AIRFLOW IN TERROR BIRDS AND EXTANT AVIAN CARNIVORES

Boorske, Jason, Ohio University, Athens, OH, USA; Witmer, Lawrence, Ohio University, Athens, OH, USA

Dinosaur respiratory anatomy has received a great deal of attention recently, which is appropriate in that it can provide insight into metabolic status and activity levels. Much of this recent work focused on reconstruction of hypothetical lung and air sac conformations, while the upper respiratory tract—specifically the nasal cavity—has been relatively unexplored. Recent work focused on reconstruction of hypothetical lung and air sac conformations, while the upper respiratory tract—specifically the nasal cavity—has been relatively unexplored. The conformation of the nasal cavity affects respired air on its way to the lungs. The degree of convolutions in the nasal cavity, coupled with the extent and placement of vasculature, will affect the conditioning of the air field, which in turn plays a key role in systemic heat and water balance. As an initial step in assessing how this soft-tissue anatomy would affect dinosaurs, we turned to their extant avian descendants. 3D models of a turkey (Meleagris gallopavo) and an ostrich (Struthio camelus) were reconstructed from microCT scan data using Avizo 6.3. Models were then input into the computational fluid dynamic (CFD) software Fluent. Results of these analyses were compared to our prior CFD work on Alligator mississippiensis. Although shorter in relative length than that of the alligator, airflow through the nasal capsules of the birds exhibited notable spiraling due to the presence of the extensive nasal conchae. This cycloic motion increased the amount of time that air remained in the nasal passage, as well as the amount of surface area with which the air came in contact. Physiological data have shown that the extensive vasculature in the nasal conchae allow this area of the nasal cavity to function as a counter-current heat exchanger associated with reducing respiratory evaporative water loss in endotherms. The role of conchae on airflow was assessed by digitally removing the conchae and re-running the CFD analyses, resulting in a dramatic effect on the dynamics of the airflow. Results from these comparative analyses were incorporated into a 3D model of the nasal capsule for the Cretaceous abelisaurid theropod Majungasaurus to ascertain possible flow regimes based on varying nasal conchae conformations.

Technical Session XIV (Saturday, November 5, 9:15 am)

COMPUTER MODELING OF NASAL AIRFLOW IN TWO EXTANT AVIAN DINOSAURS (TURKEY AND OSTRICH), WITH IMPLICATIONS FOR MODELING AIRFLOW IN EXTINCT THEROPODS

Bourke, Jason, Ohio University, Athens, OH, USA; Witmer, Lawrence, Ohio University, Athens, OH, USA

Modeling airflow in extinct theropods.
Quantifying historical trends in the completeness of the avian fossil record

BOYD, Clint, The University of Texas at Austin, Austin, TX, USA; KSEPKA, Daniel, North Carolina State University, Raleigh, NC, USA

Estimating the completeness of the fossil record has long been a central area of research in paleontology. Improvements in the perceived completeness of the fossil record may be driven both by new discoveries and by reinterpretation of known fossils, but the impact of these processes on our understanding of the fossil record has never been quantitatively explored. Here, we evaluate trends in observed patterns of relative completeness of the avian fossil record over the past century using a new methodology that clarifies the differential impact of the discovery of new fossils versus phylogenetic revision of known material. Dates of discovery and recognition for the oldest fossil representatives of 75 major avian lineages were collected for the historical period between 1910 and 2010. Using a comprehensive phylogeny, we calculated minimum implied stratigraphic gap (cMIG) across these lineages. Our results show a reduction in both relative and absolute MIG values of about 50% over the past century in avian paleontology. A pronounced increase in the average rate of global MIG reduction is noted post 1970 compared to pre 1970 (290.5 Ma versus 31.9 Ma per decade, respectively). While the majority of improvement in the avian fossil record has come from new discoveries, substantial improvement (~22.5%) has resulted from restudy and phylogenetic revision of previously described fossils over the last 40 years. A minimum estimate of MIG indicates that at least 1.38 Ga of gaps remain to be filled between the predicted and observed first appearances of major lineages of crown Aves, implying much progress is needed. However, a notable tapering of the rate of global MIG reduction occurs between 1990 and 2010, suggesting we may be approaching an asymptote of oldest record discoveries for birds, though only future observations can determine whether this is a real pattern or a historical anomaly. Either way, barring the discovery of fossils that greatly push back the minimum age for the origin of crown Aves, future discoveries cannot continue to reduce global MIG values at the average post 1970s rate over the long term.
preserved in finer-grained deposits. This suggests a common paleoenvironmental setting for chasmosaurine bonebed formation.

**Poster Session III (Friday, November 4)**

**ECOLOGICAL DIVERSITY OF A LARGE MAMMALIAN COMMUNITY FROM THE LATE PLEISTOCENE OF HIDALGO, CENTRAL MEXICO: A PRELIMINARY APPROACH**

**BRAVO-CUEVAS, Victor, Museo de Paleontología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico; BAÑOS-RODRÍGUEZ, Rocío, Licenciatura en Biología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico; OLVERA-BADILLO, Pablo, Licenciatura en Biología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico**

This research describes the ecological diversity of a mammalian community from the late Pleistocene of Hidalgo, central Mexico. The assemblage preserves 17 species from 13 families of large mammals (body mass > 500 g), including Glaphyromyidae (Glyptothorium floridanum), Mylodonidae (Paramylodon cf. hurianus), Sciuromyidae (Spermophilus varius), Leporidae (Sylvilagus floridanus), Canidae (Canis dirus), Felidae (cf. Lynx sp.), Antilocapridae (Capromeryx mexicana, Stockoceros sp.), Bovidae (Bison sp., Ovis canadensis), Cameliidae (Camelops hesternus, Hemiauchenia gracilis), Cervidae (Odocoileus virginianus), Equidae (Equus conversidens), Elefantidae (Mammuthus sp.), and Gomphotheriidae (Cervicerotidae sp., Mammut americanum). The presence of Bison is indicative of a Rancholabrean Mammal Age. Ecological diversity was measured as the relative proportion of trophic and locomotor behaviors within the community. These adaptations were assigned on the basis of diet, observed information and/or electronic databases of extinct and extant mammalian species. The mammalian ecological diversity of the community is characterized by a high percentage of animals with terrestrial locomotion (88.25%), and low percentages of those that move on the ground and/or trees (5.88%) (e.g., cf. Lynx sp.), as well as fossorial mammals (5.84%) (e.g., S. varius). On the other hand, a similar proportion of omnivores (e.g., G. floridanum), browsers (e.g., O. virginianus), and grazers (e.g., E. conversidens) was observed (17.64% for each trophic category). Mixed feeders were well represented (35.29%) and to a lesser extent, carnivores (11.76%). The locomotor adaptation pattern suggests areas dominated by open vegetation and scarce tree coverage, whereas a heterogeneous trophic pattern would be related to the presence and availability of diverse resources. The ecological mammalian diversity of the Pleistocene of Hidalgo is closely comparable with that observed in extant grassland areas of the Serengeti ecosystem. However, further implementation of ecomorphology studies and ecological diversity analysis will lead to accurate reconstruction of vegetation types.

**Technical Session XVI (Saturday, November 5, 1:45 am)**

**THREE-DIMENSIONAL GILL ARCH STRUCTURE IN A STEM GNATHOSTOME REVEALED BY SYNCHRONOTOMOGRAPHY**

**BRAZEAU, Martin, Netherlands Centre for Biodiversity, Naturalis, Leiden, Netherlands; FRIEDMAN, Matt, University of Oxford, Oxford, United Kingdom**

Although jaws are considered to have a special anatomical relationship to gill arches, remarkably little is known about the branchial skeletons of crownward members of the gnathostome stem. What is known of articulated gill skeletons in these taxa is incomplete owing to diastiractulation or the absence/incompleteness of mineralization. Variation in gill arch structure has had a critical role in the placement of fossil fishes (e.g., Acanthodes) on either the chondrichthyan or osteichthyan stems. However, the polarities of these characters are biologically significant. Though the appearance and function of gill arches is well evidenced in North America, the history of the mouse tribe (Alceinae) is more enigmatic and requires work to determine which characteristics are more significant than others for use in systematics. Morphometric approaches have successfully provided a phylogenetic signature in other extant deer groups, and linear ratios have suggested that quantitative differences exist between the dentaries of modern mouse (alces alces) and Cervidae spp. of Pleistocene Europe. To date, no statistically robust morphometric analysis has been performed on North American Alceina skeletal material. Here, an expanded sample of A. alces cranial and post-cranial skeletal morphology provides a framework for morphospace comparison with other North American members of the tribe, including species of the genus Cervus.

**Preparers’ Session (Thursday, November 3, 8:15 am)**

**PHOTOGNOMETRIC ICHNOLOGY: STATE-OF-THE-ART DIGITAL DATA ANALYSIS OF PALEONTOLOGICAL RESOURCES IN NORTH AMERICA, EUROPE, ASIA, AND AFRICA**

**BREITHAUP, Brent, BLM Wyoming State Office, Cheyenne, WY, USA; MATTHEWS, Neffra, BLM National Operations Center, Denver, CO, USA**

Vertebrate trace fossils reflect the complex interrelationship between an animal and the substrate. Digital data collection provides an excellent tool for capturing an incredible wealth of information provided by ichnofossils. Close-range photogrammetry is one of the easiest and most cost-effective digital data collection techniques and forms the basis for photogrammetric ichnology. Three-dimensional image datasets created from digital photography can provide a permanent digital record of fossil tracks (including the creation of digital type specimens) and trackracks and is a non-invasive method to obtain 3D data for assessment. Photogrammetry is an objective recording and analysis method, which provides a visual, quantifiable baseline to evaluate track-bearing surfaces. It has been especially useful in remote locations of Korea, Tanzania, and the United States. Not only do these datasets support accurate visualization of the fossils, they can also be used to make accurate measurements, as well as highly accurate solid, three-dimensional models of the surface. As 3D terrain surfaces or point clouds created from photogrammetric documentation may contain thousands of very accurate x, y, and z coordinates, researchers can measure various track and trackway dimensions at a submillimeter level. In addition to traditional ichnological measurements, higher-level mathematical analyses may be conducted on the 3-D data. These calculations can automatically quantify areas of surface curvature, roughness, slope and other morphometric characteristics. Because these calculations are conducted by algorithms within the software, human bias is greatly removed if not eliminated. Utilizing this type of data analysis, unbiased morphological correlations of various ichnofaunas (e.g., Jurassic tracks from Wyoming, Utah, Scotland, and England) can be made and footprint data normalized (e.g., converting convex hyporelief forms to concave epirelief) for comparison purposes. Digital datasets are stored easily, provide a permanent record, are readily shared, and are currently helping to unravel numerous ichnological complexities in Permian-Pliocene sites throughout the world.

**Poster Session III (Friday, November 4)**

**THE EFFECTS OF VARIOUS ENVIRONMENTS AND SEDIMENTS ON THE DECAY OF SOFT TISSUE WITHIN ODODOCEILUS VIRGINIANUS PHALANGES**

**BRIDGES, Tyler, Montana State University, Bozeman, MT, USA; EVANS, Thomas, Montana State University, Bozeman, MT, USA; NOVAK, Ben, McMaster University, Hamilton, ON, Canada; VARRICCHIO, David, Montana State University, Bozeman, MT, USA**

Recent discoveries proposing the persistence of soft tissue in Late Cretaceous fossils challenged long-held views concerning the persistence of soft tissues and mechanisms of fossilization and biomolecular degradation. An alternative hypothesis proposes that biofilm production within vascular cavities and lacunae has more recently generated organic tissues. There is a wealth of knowledge to be gained from bacteria endogenous to the fossil environment – an environment yet unexplored by microbiologists. A distinct lack of noticeable taphonomic data on the molecular level of the internal structures of bones has largely led to the ambiguity of the origin of the proposed soft tissue structures found. This project has worked to establish a foundation in the taphonomic processes that occur within the histological vascular cavities at the tissue level in modern deer (Odocoileus virginianus) bone in different environments, each with varying sediment types. Two deer phalanx samples were collected from each environmental sediment type. The analysis consists of an in depth review of Field Electron Microscope images taken over the period of twelve months and the relationship between the observed decay and the potential for original soft tissue to survive in fossils. While it was concluded that decay needs to be assessed over a longer period of time from consistent reproductive results, surprising evidence of early mineralization and the occurrence of an unknown parasite, illustrating evidence of invertebrate activity at the microscopic level, provide insight into new avenues of still more undiscovered aspects of how tissues decay and fossils form. Such tantalizing beginnings warrant further analysis and attention to a broader interdisciplinary scientific community.

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ONTOGONY AND TAXONOMY OF A NEW SPHENACODONTID SPECIMEN FROM THE EARLY MELANASIAN OF TEXAS
BRINK, Kirstin, University of Texas at Mississauga, Mississauga, ON, Canada; REISZ, Robert, University of Toronto at Mississauga, Mississauga, ON, Canada; SCOTT, Diane, University of Toronto at Mississauga, Mississauga, ON, Canada
Sphenacodontids are the most speciose and abundant non-mammalian synapsids recognized from the Early Permian of Texas, known from hundreds of specimens. However, the ontogeny of sphenacodontids remains poorly understood and morphologic variation as a result of growth may confound the delineation of discrete characters useful for taxonomic and phylogenetic identification. Here, we describe a juvenile skull and vertebrae column of a sphenacodontid (MCZ 2028) from the Archer City Formation, Texas, with an unusual combination of features present in both Dimetrodon milleri and Secodontosaurus obtusidens. The cranium is typically sphenacodontid, with a well-developed supracranial buttress and maxillary precaniniform step. Characters shared between this new specimen and D. milleri include a laterally expanded frontal orbital process, an extensive postorbital-squamosal contact, spatulate marginal teeth, three premaxillary teeth, and elongate neural spines that are nearly circular in cross-section.Characters shared between this new specimen and S. obtusidens include the absence of ectopterygoid teeth, no expansion of the caniniform tooth root into the choana, jaw articulation above the level of the dentary tooth row, a low axial neural spine, and an elongated skull. A new phylogenetic analysis of Sphenacodontidae recovers Secodontosaurus as the sister taxon to an unresolved clade of short-nosed sphenacodontids (Sphenodon, Chirophthalmus, ChiroPTYlA), Dimetrodon, and MCZ 2028. Based on this result, we can interpret MCZ 2028 as a juvenile of D. milleri, suggesting that many of the synapsomorphic characters that unite the new specimen to S. obtusidens are ontogenetic, and the morphology of juveniles of these two taxa may be convergent. Alternatively, MCZ 2028 can also be interpreted as a new species, intermediate in morphology between D. milleri and the younger S. obtusidens. This study illustrates the importance of recognizing ontogenetic characters in phylogenetic analyses and the role that juvenile specimens play in understanding the early evolutionary history of synapsids.

Symposium 3 (Thursday, November 3, 9:00 am)
LATITUINAL DIFFERENTIATION OF FISH ASSEMBLAGES FROM THE LATE CRETAEOCENE OF WESTERN NORTH AMERICA—EVIDENCE FROM VERTEBRATE MICROFOSSIL LOCALITIES
BRINKMAN, Donald, Royal Tyrrell Museum, Drumheller, AB, Canada; EATON, Jeffrey, Weber State University, Ogden, UT, USA; NEWBREY, Michael, Royal Tyrrell Museum, Drumheller, AB, Canada; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; NEUMAN, Andrew, Royal Tyrrell Museum, Drumheller, AB, Canada
Studies of vertebrate microfossil assemblages from the Late Cretaceous of Alberta, Utah, and Mexico, together with high-precision correlation of formations from these areas, allow patterns of latitudinal distribution of fish assemblages to be recognized and tracked through time. Northern assemblages are characterized by the presence of sturgeon, Belonostoma, and unarmored fish referred to as Holosteo and Holostea, plus a high abundance of the teleost Coriognathidae. Southern assemblages are characterized by the presence of the elasmobranch Lod cond i ch i d a and a high abundance of teleost centra microfossil type B/D (vb), which is tentatively identified as an osteostracan. Taxa that are typically southern occur in the late Santonian and late Maastrichtian, times of relatively high temperatures, but do not occur in Alberta or Montana in the Campanian or early Maastrichtian. Similarly, taxa that are restricted to more northern regions are more abundant in the late Campanian and early Maastrichtian, times of relatively cool temperature. These stratigraphic patterns are interpreted as a result of shifts in distribution pattern in response to climatic change. A similar latitudinal shift in the Late Maastrichtian is characterized by the first appearance of many taxa that have a southern distribution in North America. This faunal event may be correlated with high global temperatures that have been proposed on the basis of a Turonian occurrence of turtles and other ectothermic mesosoreptiles in the high Canadian Arctic.

Poster Session I (Wednesday, November 2)
TAPHONOMY OF COELOPHYSOID THERIOPH SEVED BONEBEDS PRESERVED ALONG THE SHORELINE OF AN EARLY JURASSIC LAKE IN THE NUGGET SANDSTONE OF NE UTAH
BROO KS, Brooks, Brigham Young University, Provo, UT, USA; CHAMBERS, Mariah, Brigham Young University, Provo, UT, USA; ENGELMANN, George, University of Nebraska, Omaha, NE, USA; CHURE, Daniel, Dinosaur National Monument, Jensen, UT, USA; SCHIE T Z, Rodney, Brigham Young University, Provo, UT, USA
The Saints & Sinners quarry in northeastern Utah has produced >3000 bones and bone fragments from two ~30 cm thick, superimposed bonebeds in the middle of the Nugget Sandstone. The bonebeds are located within a wet-phase horizon above and below by eolian sandstones. The bonebeds are lateral to 10-20 cm thick lacustrine beds with associated ~10 cm long tridactyl theropod tracks.

With the exception of sphenodontid bones plus teeth of a medium-sized theropod, all bones pertain to a new coelophysoid diagnosed by a splint-like metatarsal II. The coelophysoid assemblage is dominated by juveniles and subadults with rare adults. Plants are limited to probable cycadeoid frond impressions.

Data was compiled separately for the upper and lower bonebeds but differences between the layers are insignificant. Excavation of 5.5 m2 of the lower and 2 m2 of upper bone beds yields a MN1 (Minimum Number of Individuals) nine and ten, respectively. Except for fused bones, all bones are disarticulated but associated skulls/skeletons are present and common. Among the 41 individual bone beds, 58% are isolated, 26% are fragmentary (23% complete and 33% fragmentary), and 16% are connected (13% complete and 3% fragmentary). Fragmentation is limited to delicate bones. Weathing evidence is rare. Insect/vertebrate traces on bone are absent.

The bones are lying flat and 87% of arcuate bones (e.g., scapulae) are in stable positions. Elongate bones are preferentially oriented NNE-SSW in the upper bed and NW-NE in the lower bed. Flow direction indicators (i.e., dorsal ribs, fibulae) are, however, randomly oriented within these parameters, indicating that hydraulic action was oscillatory. Shape-sorting data indicates that winnowing was minimal.

The similarity of both bonebeds indicates that they were subject to identical taphonomic conditions. Total disarticulation indicates complete maceration in a wet environment. Breakage is attributed to trampling prior to reworking, while close associations and absence of winnowing and indicates hydraulic action was short-lived. The proximity to lacustrine deposits, combined with strong bone orientation indicates reworking by wave action along the shoreline of an ephemeral lake. The large numbers of individuals is speculated to be due to two episodes of mass death near an ephemeral, possibly non-potable, water source.

Technical Session XV (Saturday, November 5, 8:15 am)
THE MYTH OF THE LIVING FOSSIL: BASAL CROWN GROUP RELATIONSHIPS, REVERSING POLARITIES, AND RESTORATION OF THE ANCESTRAL CROCODYLIAN
BRUCH, Christopher, University of Iowa, Iowa City, IA, USA; TURNER, Alan, Stony Brook University, Stony Brook, NY, USA; ALLEN, Eric, University of Iowa, Iowa City, IA, USA; WILBERG, Eric, University of Iowa, Iowa City, IA, USA
Most living crocodilians have long, broad snouts associated with a wide-ranging diet and habitat tolerance – the so-called “generalized” morphotype. This was presumed to have been ancestral for Crocodylia, with more specialized forms (e.g. tube-snouted or small-bodied) arising from generalized ancestors, but underlying morphological data sets were optimized to express variation within Crocodylia itself. Analyses with expanded sampling from noncrocodilian neosuchians suggests that proximate outgroups of Crocodylia were predominantly small-bodied forms (~2m total length) with cranial features reminiscent of derived alligatoroids. Depending on how relationships are resolved, ancestral conditions for Crocodylia might approximate the small putatively durophagous alligatorines of the Paleogene. The generalized morphotype appears to have arisen at least five times independently from more specialized ancestors within Crocodylia, generally following a drop in crocodyliform diversity that eliminated earlier unrelated generalized lineages. Living “generalized” forms are actually highly (and independently) specialized, and caution is needed when applying functional or behavioral observations from one lineage to all. It also shows that descriptive terms for crocodylian cranial morphology depend on context; the American alligator (Alligator mississippiensis) is not long-snouted when compared with other living crocodilians, but is profoundly long-snouted compared with its closest extinct relatives. Similar patterns can be inferred mesosuchian Mesoeucrocodylia, calling into question the widespread perception that short-crocodile forms diverged from a stable generalized palaeogenetic core that persisted with little change in overall body or head shape from the Middle Jurassic through the Recent.

Symposium 3 (Thursday, November 3, 11:15 am)
NEW EVIDENCE CONCERNING DIVERSITY AND ABUNDANCE OF SMALL-BODIED ORNITHOPODS FROM THE BELLY RIVER GROUP (CAMPANIAN) OF ALBERTA
BROWN, Caleb, University of Toronto, Toronto, ON, Canada; RUSSELL, Anthony, University of Calgary, Calgary, AB, Canada; EVANS, David, University of Toronto/ Royal Ontario Museum, Toronto, ON, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; BRINKMAN, Donald, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada
The diversity of large bodied dinosaurs from the Belly River Group is well established, but that of small bodied taxa remains poorly understood. Small-bodied ornithopods have been recognized from the Oldman (OF) and Dinosaur Park (DPP) formations on the basis of teeth and a few isolated elements, but associated or articulated skeletons have not been reported. Here, we document the first articulated remains of basal ornithopods, as well as the first cranial bones, from these well sampled formations. The oldest specimen, from the middle OF along the Milk River, southern Alberta, consists of the articulated posterior half of skeleton that shares numerous features with the contemporaneous Orodromeus makelai from Montana: ossified axial tendons on the dorsal and sacral vertebrae, but not the caudal vertebrae; a strongly down-curved precatapetal process of the ilium. A second, less complete, specimen from the upper OF time equivalent to DPP of the same and presumably morphologically distinct from that of any other ornithischian, and likely represents a new taxon. The fibula is flattened distally and fused to the anterior surface of the tibia for the distal third of its length. Numerous elements from the DPP are also of basal ornithischian origin.

Although basal ornithopod material is rare, taphonomic comparison with contemporaneous pachycephalosaurs suggests considerable undiscovered diversity in the former. The two groups are similar in size and taphonomic properties postcranially, but the abundance of basal ornithopod postcranial material from DPP greatly exceeds that of pachycephalosaurs, © 2011 by the Society of Vertebrate Paleontology
although the opposite is true for cranial elements. The record of robust pachycephalosaur frontalparietal domes suggests a diverse assemblage of at least four taxa, with relatively high abundance. Based on comparison of taphonomically-equivalent postcranial elements, basal ornithopods may be more abundant than are pachycephalosaurids in these formations, and may display similar, although currently unrecognized, taxonomic diversity. These findings highlight biases against preservation of small taxa, and suggest that small taxa may have been an important component of the fauna.

Preparers’ Session (Thursday, November 3, 11:00 am)

IMPROVING THE SCIENCE OF PALEONTOLOGY THROUGH EFFECTIVE COMMUNICATION IN THE LABORATORY
BROWN, Matthew, The University of Texas at Austin, Austin, TX, USA

The ability to conduct research on fossil vertebrates is typically predicated on exposure of morphology. This exposure often takes place in preparation laboratories, and is conducted by laboratory staff that usually do not have as extensive an understanding of specific morphological features or their relevance as the primary researchers requesting the work. Likewise, laboratory and collections staff may have concerns about long-term effects of treatments that conflict with the goals of short-term research projects. Misunderstandings can have dire consequences due to loss of information through damage to specimens, increased labor costs, and potential risk to specimens. These risks can be mitigated by improving communication between members of the research team. Expectations and concerns must be clearly stated throughout the project, and can be communicated consistently using common technology, e.g., email, digital photos, CT scans, and digital maps, as well as through the use of tools like dual-head teaching microscopes and computer monitors. This information should be maintained, along with detailed records of materials and techniques applied, within the collections database or laboratory archives and included in the methods section of resulting publications.

Poster Session III (Friday, November 4)

FOSSIL EGGS FROM ZHEJIANG PROVINCE, CHINA: EVIDENCE OF A REDUCING ENVIRONMENT FACILITATED BY ORGANIC DECOMPOSITION
BRUNDIDGE, Krista, Montana State University, Bozeman, MT, USA; BARTA, Daniel, Montana State University, Bozeman, MT, USA; JACKSON, Frankie, Montana State University, Bozeman, MT, USA; VARRICCHIO, David, Montana State University, Bozeman, MT, USA; JIN, Xingsheng, Zhejiang Museum of Natural History, Hangzhou, China

Fossil eggs from the Middle Cretaceous, Tiantai Basin in Zhejiang Province, China, occur in fine-grained quartz-rich red sandstone, of alluvial fan origin. These rounded to subrounded eggs are referable to the oogenus Spheroolithus, within the oogenus Sphaeroolithidae. Nearly every egg of the 196 specimens examined at the Zhejiang Natural History Museum, exhibits a white halo (0.2-17.8mm in width) immediately adjacent to the eggshell on the interior and exterior surfaces. Similar halos in fine-grained deposits surround Sinornithomimus skeletons from an Inner Mongolia bonebed and fossil eggs at the Ava Mauheuo (Argentina) suggesting a common origin.

To investigate these halos, we characterized the mineralogical composition of the halo and surrounding sandstone using light microscopy and X-ray diffraction. Petrographic thin sections show white halos that closely outline the eggshell, and their composition and texture are identical to that of the surrounding red sandstone matrix. Six thin sections of eggshell reveal round dark rimmed spherical structures (160µm in diameter) that occur exclusively in the eggshells. These eggshells display multiple generations of sparry calcite fill and are interpreted as pedotubules. X-ray diffraction analyses of sediment samples show no quantifiable difference in the overall sedimentology and clay mineralogy between the halos and red sandstone. In contrast, iron staining of a Zhejiang thin section revealed the presence of Fe2+ and Fe3+ associated with the white halo and red sandstone, respectively. The greater abundance of Fe2+ suggests limited dissolved oxygen immediately surrounding the eggshell, therefore, indicating a reduced state immediately adjacent to fossil specimens. Decay of organic associated with the fossils may have decreased the amount of oxygen in sediments resulting in iron reduction. The halos provide potential evidence for interactions between organisms and eggs during early diagenesis. However, halos also occur in secondary rock structures, therefore alternative explanations may include microbial activity and the capacity of fossils to attract or repel ions as mechanisms for the displacement of Fe2+ and Fe3+. 

Symposium 4 (Friday, November 4, 8:15 am)

COPIING WITH ROCK RECORD BIAS IN STUDIES OF MORPHOLOGICAL EVOLUTION: NEW METHODS FOR ANALYZING DISPARITY AND EVOLUTION
BRUSATTE, Stephen, American Museum of Natural History, New York, NY, USA; LLOYD, Graeme, Natural History Museum, London, United Kingdom; WANG, Steve, Svarthmore College, Svarthmore, PA, USA; MONTANARI, Shaena, American Museum of Natural History, New York, NY, USA; YI, Hong-yu, American Museum of Natural History, New York, NY, USA

The fossil record is imperfect and it is widely recognized that sampling biases (differential preservation and collection of fossils) can distort patterns of taxonomic diversity (species richness) over deep time. Intervals that appear more diverse may merely be better sampled than other intervals, and therefore, quantitative techniques such as subsampling and modeling are used to ameliorate sampling bias in paleodiversity studies. Species richness, however, is only one measure of biodiversity; others include morphological disparity and rates of evolution. Comparative little work has focused on how these measures are affected by sampling bias, or on the development of methods that may correct these measures for differential sampling. Here we describe two new techniques for assessing morphological rates and disparity over long time scales, which take into account information on the age uncertainty of fossil specimens and help fill gaps in the fossil record. Our rates method uses a likelihood ratio test to determine whether individual branches or clades on a phylogeny have significantly different rates of discrete character evolution from the remainder of the tree. A sensitivity analysis allows rates to be calculated using permutations of the range of possible ages for each taxon. In this way, temporal curves can be constructed by permutations which allow each character change to occur at any point in time along the duration of the branch it is optimized on. Using lungfish as a test case, we find that morphological rates are highly heterogeneous across phylogeny and recover a general slow-down in character change from the Devonian to the present. Our disparity method fills some gaps in the fossil record by including reconstructed ancestral morphologies that are predicted to be present in older time intervals by reference to a phylogeny (analogous to ghost ranges), but are currently unamplified in the fossil record. Using Triassic archosaurs and two mammoth clades as test cases, we show that including “ghost morphologies” often results in elevated disparity in earlier time bins, a result that would be unobtainable by taking the fossil record at face value.

Technological Session XV (Saturday, November 5, 12:00 pm)

LOCALIZATION OF THE DIAPHRAGM AND AXIAL PATTERNING IN MAMMALS
BUCHHOLTZ, Emily, Wellesley College, Wellesley, MA, USA; YANG, Jennifer, Wellesley College, Wellesley, MA, USA; BAILIN, Hannah, Wellesley College, Wellesley, MA, USA; LAVES, Susan, Wellesley College, Wellesley, MA, USA; DROZD, Lucie, Wellesley College, Wellesley, MA, USA

The nearly uniform sequence of vertebrae that articulate with moveable ribs in ancestral aquatic vertebrates was replaced by a column with distinct morphological series in tetrapods. Although the column is of somitic origin and therefore patterned primarily, the borders of its component series often coincide with the antero-posterior locations of structures with abaxial patterning, suggesting the presence of developmental integration. Chief among these structures are the limbs, which subdivide the column into cervical, dorsal, and caudal units. The secondary subdivision of the dorsal series into thoracic and lumbar subunits in synapsids occurs coincident with osteological proxies for the origin of a muscular diaphragm and mammalian physiology. In living mammals the diaphragm develops by secondary investment of the transverse septum by striated muscle cells of somitic origin, and is anchored to both somitic (vertebral) and lateral plate (sternal) structures. Reorientations of these anchor points are displaced when the location of the thoracolumbar boundary shifts homoeotically, when the total count of the thoracolumbar unit deviates from its conserved count of 19-20, and/or when there is a patterning shift in the location of primaxial relative to abaxial structures. We used dissection and CT scanning to reconstruct the locations of the diaphragm in fluid preserved specimens of Bradypus variegatus, Cholepus didactylus, Oristhonrychus anatius, Dasyurus novemcinctus, and Anomalurus derbianus, and a DICOM data set of Trichechus manatus provided by the Florida College of Veterinary Medicine’s Aquatic Animal Health Program. Our results indicate that the location of the diaphragm varies in the thoracolumbar boundary except in taxa with primaxial/abaxial shifts. In these taxa, the diaphragm retains its traditional lateral plate, but not its somitic, anchor points, supporting molecular studies that identify the patterning of the diaphragm as abaxial.

Poster Session I (Wednesday, November 2)

TESTING FOR TOOTH WEAR RESISTANT MEASURES OF DIET IN PRIMATES
BUNN, Jonathan, Stony Brook University, Stony Brook, NY, USA; ZOHIDY, Sarah, University of Helsinki, Helsinki, Finland; KING, Stephen, University of Massachusetts, Amherst, MA, USA; WRIGHT, Patricia, Stony Brook University, Stony Brook, NY, USA; JERNVALL, Jukka, University of Helsinki, Helsinki, Finland

Dental topographic analysis (DTA) is a set of methods for quantifying topographic variables of molar occlusal surfaces to infer dietary adaptations in living and fossil species. DTA offers a number of advantages over other methods of quantifying dental dietary variation (e.g., shearing quotients) primarily in its ability to quantify shape in both pristine and worn teeth. As fossil assemblages are dominated by worn teeth, the capability to include worn specimens in analyses greatly increases the probability of correctly inferring paleodiets. Relief indices (RI), a topographic variable measuring surface relief, has been shown to exist extant species with different diets in samples of variably-worn molar teeth. Little is known, however, of how RFI changes through the process of wear in an individual animal over time. Further, Dirichlet Normal Energy (DNE), a topographic variable quantifying surface curvature that has advantages over RFI, has never been examined relative to molar wear. Known how molar shape, as measured by RFI and DNE, is modified by the process of progressive molar wear may aid our ability to infer diets in fossil species. Here we address these top- ics by measuring RFI and DNE on a longitudinal sample of second mandibular molars of Propithecus edwardsi and Microcebus rufus from Ranomafana National Park, Madagascar. This sample consists of repeatedly captured wild animals, allowing examination of molar shape over the lives of individuals. Large dietary differences exist between these species.
with P. edwardsi being primarily folivorous and M. rufus consuming fruits and insects. RFI and DNE were calculated from 3D digital models of laser-scanned molar casts and compared between species and through wear. Results show that RFI and DNE decrease as teeth wear, consistent with prior non-longitudinal studies. Additionally, RFI and DNE each individually separate these species by diet across a wear gradient. These results suggest that RFI and DNE both capture elements of primate molar shape that are obliterated over time through wear, but that these variables can nonetheless be used to infer diets of extinct species in samples of variably-worn teeth.

Poster Session III (Friday, November 4)

GIANT PTEROSAUR REMAINS FROM THE CAMPAIGN OF THE MORONDAVA BASIN, WESTERN MADAGASCAR
Burch, Sara; Stony Brook University, Stony Brook, NY, USA; SERTICH, Joseph, Denver Museum of Natural History and Science, Denver, CO, USA

The global distribution of pterosaurs during the Cretaceous includes representatives from most Gondwanan landmasses including South America, Afro-Arabia, Australia, and New Zealand. The only putative evidence of pterosaurs from Madagascar is limited to teeth from Middle Jurassic deposits; no pterosaur material has been recovered from Cretaceous deposits despite extensive fieldwork in the Mahajanga and Ambilobe basins of northern Madagascar. Recent fieldwork in the Morondava Basin of Madagascar targeting Cretaceous sediments has yielded the first definitive non-dental skeleton remains of a pterosaur from Madagascar. These remains were recovered from deposits biostratigraphically dated with ammonites (e.g., Eubostyttchocras otsukai) to the Campanian. The Morondava Basin is the largest of the three major sedimentary basins of Madagascar, encompassing much of the western and southwestern portions of the island. Extensive transgressive and regressive sedimentary deposits in the basin range in age from the Albian to the Maastrichtian and have remained intact from 41 to 36 mya indicating a significant gap in the fossil record that will require future discoveries to fill. Toward the end of the Eocene, diversity patterns is correlated to a gradual global cooling trend rather than a sudden event. However, during the Early Eocene Climate Optimum (50 mya) small arboreal mammals became highly diverse, culminating in the radiation of the Carnivora families Viverravidae and Miacidae are replaced by the modern Felidae and Canidae. The purpose of this study was to generate broad categories of diet that can be used to study extinct marsupials. Low magnification microwear studies have been shown to be a reliable medium for studying the diets of mammals both extant and extinct. In this study, 546 specimens representing 10 genera and 25 species of didelphid marsupials have been included for the purpose of studying the relationship between the enamel microwear and diet categories. Marsupial microwear was counted on high dynamic range images using Image J on all samples of variably-worn teeth. The data obtained in this study, the Carnivore-Invertebrates group has a coarse wear signature of many large pits, coarse scratches, and hypercoarse scratches. A coarse wear signature

Poster Session IV (Saturday, November 5)

NEW ASSOCIATED SKULL MATERIAL OF A VARANID LIZARD, SANIWA CF. ENSIDENS, FROM THE EOCENE UNTA FORMATION OF THE UNTA BASIN, UTAH, USA
BURK, Daniel, Intermountain Paleo-Consulting, Vernal, UT, USA; SANDAU, Stephen, Intermountain Paleo-Consulting, Vernal, UT, USA; ALDERKS, David, Intermountain Paleo-Consulting, Vernal, UT, USA

We report the remarkably preserved skeleton of a varanid lizard from the Uinta B (Upper Wagonhound Member) of the Eocene Uinta Formation of the Uinta Basin, in Eastern Utah. The skeleton was found in 2010 during a paleontological reconnaissance survey in the Natural Buttes Oil and Gas Field, preserved in a block of fine grained light green sandstone in the bottom of a small canyon wash. The specimen closely resembles, in size and morphology, the well documented Bridgerian species Saniwa ensida, from the Eocene Green River Formation of Wyoming. The cranial skeleton is represented by: the right maxilla with two teeth, right dentary, and supraoccipital. The axial skeleton is represented by: two articulated cervical vertebrae, twelve articulated dorsal vertebrae (six of which with articulated ribs), and ten articulated caudal vertebrae. The appendicular skeleton is represented by: a clavicle, left coracoid, articulated right coracoid and scapula, partial right humerus, partial right radius, partial right ulna, right femur, partial right tibia, five right metatarsals, and five phalanges from the right pes. Also associated with the specimen are a number of small, fragmented, and unidentified bones. Other Saniwa cf. ensider material previously recovered from the Uinta Formation consist of three individuals recovered during earlier paleontological reconnaissance surveys in the Uinta Basin. One is represented by a few associated vertebrae belonging to an individual of a size comparable to Saniwa ensider. The other two specimens are much larger individuals, which may represent a separate species. The first is represented by a total of 23 vertebrae (eight articulated) and associated fragments. The second consists of a single partial vertebra.

Poster Session III (Friday, November 4)

NEW FOSSIL BOX TURTLES FROM THE PALEOGENE OF WEST TEXAS: A NEW TAXON WITH CRITICAL INSIGHTS INTO THE EVOLUTIONARY HISTORY OF BOX TURTLES
BURROUGHS, Robert, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX, USA

Two new fossils of functional box turtles from the Vieja Formation of Texas provide insights into the evolutionary history of North American box turtles. The formation is latest Eocene/early Oligocene (Chadronian) in age. The specimens are immediately recognizable as functional box turtles, by the separation of the plastron into two distinct lobes, the presence of a well-developed kinetic plastral hinge, and the reduction of the plastral-bride to bony projections similar to those seen in the extant box turtle genera Terrapene and Cuora. These specimens are the most complete specimens of box turtles from the North American Paleogene to date and are slightly younger in age than a previously described extinct box turtle Planetochelys. The specimens are mostly obscured by hard matrix. The specimens were scanned with an X-ray computed tomography scanner and were digitally prepared. Digital preparation exposed the nuchal bone, which is otherwise completely obscured by matrix and allowed the mostly complete anterior lobe of the plastron to be visualized and studied. The entoplastron of the specimen is roughly oval in shape and more similar to that of extant Terrapene than Cuora; the entoplastron of Planetochelys has never been described. The nuchal bone does not have features of Cuora, but does have features similar to those described for Planetochelys and Terrapene, such as elongate costiform processes and intruded contact of the first neural. The carapace is highly domed, similar to that of extant Terrapene, but distinct from Planetochelys. The specimens have more neural bones than extant Terrapene, but have a suprapygal consistent shape with that of Terrapene and have post neural elements similar to those described for Planetochelys. These fossils appear at this time to be more closely related to Emydids than any other group, based on the characters present in the nuchal, plastron, neural and pygal series, and the external shell morphology. These fossils provide insights into the evolutionary history of Emydids and box turtles. I provide the first anatomical description of this material and a discussion of the phylogenetic implications of the fossils.
of many large pits and small puncture pits is expected for didelphids in the Carnivore-Invertebrate group. The Omnivore-Insectivore group has a mixed microwear signal: high large pit and fine scratch amounts with various small pit and small puncture pit counts, due to the variation of insectivory/frugivory within the group. Deltidid frugivores have a highly pitted microwear signal. Our analysis for the Omnivore-Generalist group indicates that large pits and small puncture pits are the most frequent microwear features for this group; however, the species in this group also have varying amounts of small pits, gouges, and all types of scratches.

Biting Off More Than They Could Chew: A Geometric Morphometric Approach to Theropod Feeding Ecology
BYKOWSKI, Richard, Indiana University, Bloomington, IN, USA
Non-avian theropod dinosaurs represent a case of evolutionary tinkering: while the overall body plan is conserved, the amount of skull morphological diversity suggests a possible selective force. In theropods, there is an apparent trade-off between skull robustness and the importance of forelimbs. In extant mammalian predators, there are correlations between skull morphology and the ability to subdue various types of prey. If changes in theropod skull morphology are a direct result of interactions with potential prey, then we should observe a relationship between the different morphologies and the changes in relative abundances of prey. The maxilla is a large bone along the lateral margins of the skull and contains the teeth that would be important in subjugating potential prey and absorbing bite forces needed for predatory behavior. Maxillary shape is quantified across multiple taxa using sliding semilandmarks. Relative abundances of coexisting sauropterygians, theropods, margoninacephalians, ornithopods and thyreophorans are estimated and a multivariate linear regression is performed to test for correlations between maxillary deformation taxa abundances. Preliminary results indicate that a small amount of variation (r^2=0.2, p<0.05) in maxillary shape is correlated with the changing abundances of coexisting taxa. The most striking correlation is with the abundance of sauropterygians, where trends indicate a more elongate skull and flatter ventral border (r^2=0.14, p=0.009) and thicker ascending ramus of maxilla (r^2=0.2, p<0.002). Other trends observed include an elongation of the snout with higher abundances of margoninacephalians (r^2=0.1, p=0.04) and thyreophorans (r^2=0.1, p<0.03) and deeper, more robust skulls with higher abundances of other theropods (r^2=0.21, p<0.001) or ornithopods (r^2=0.1, p<0.03). More robust skulls may have been stronger and better suited to biting and holding on while more elongate skulls were better suited to a ‘slash and run’ technique. This diverse morphology suggests that specific approaches may have evolved in response to the relative abundances of coexisting organisms and potential prey.

Poster Session III (Friday, November 4)
CENOZOIC FOSSIL TURTLES FROM THE PANAMA CANAL BASIN
CADENA, Edwin, North Carolina State University, Raleigh, NC, USA; BOURQUE, Jason, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; RINCON, Aldo, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Panama, Panama
Based on extensive collections made over the past 50 years, three distinct fossil turtle assemblages are recognized from the Panama Canal area that span the Eocene through Middle Miocene. The first, from the middle to late Eocene Gatunillo Formation, is composed of panpseudocnemid pterosaurids. The second, from the Early Miocene Culebra Formation, is also composed of panpseudocnemids, as well as trionychid and testudinid cryptodires. The third, from the Early to Middle Miocene Cucaracha Formation, is composed of a new species of the geoemydid Rhinoclemmys, a new species of the kinosternid Staurotmys, a testudinid, trionychid, and panpseudocnemid. Analysis of these turtle assemblages indicates an early interaction between North-Central American and South American herpetofauna at the east-ernmost tip of the Central American Peninsula, before the emergence of the Panama isthmus. Specifically, we document North American cryptodires in the same assemblage with pleurodirans and Ornithodira, in the new world tropics. These fossils further document some of the earliest occurrences of Rhinoclemmys in Central America, a wider past distribution for Staurotmys, and an earlier occurrence of giant tortoises into the new world tropics than previously known.

Technical Session XIII (Friday, November 4, 3:00 pm)
FRUIT PROPORTION AND CONSUMPTION OF HARD ITEMS IN THE DIETS OF PRImates CORRELATE WITH MICROTEXTURES
CALANDRA, Ivan, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; SCHULZ, Ellen, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; PINNOW, Mona, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; KAISER, Thomas M., Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany
The 3D dental microtexture analysis is powerful in reconstructing the diets of extinct primates. This method is based on the comparison of fossils with extant species with known diets. The diets of primates are highly diversified but fruits remain the main component. Two methods of microtexture analysis, the Scale-Sensitive Fractal Analysis (SSFA) and the Dental Surface Texture Analysis (DASTA) are applied. Besides of revealing the presence of hard diets, DASTA is highly useful to describe tooth function. Eight extant primate species (Alouatta seniculus, Gorilla gorilla, Lophocebus albigena, Macaca fascicularis, Pan troglodytes, Papio cynocephalus, Alouatta seniculus, Theropithecus gelada) are included. These species largely differ in the mean annual fruit proportions (from 0 to 90%) in their diet, as well as in their consumption of other hard items (seeds, bark, and insects) and of grass. First we tested if the proportion of fruits consumed can be estimated by microtextures and second how the other components in the diet impact the microtexture. The complexity and their heterogeneity (SSF) correlate with the proportion of fruits in the diet. However, the ingestion of all hard items (fruits, seeds, bark, and insect cuticles) contributes to an increase in the textural fill volume (SSF). Moreover, the anisotropy (SSF) reflects the consumption of grass. ISO/
FDIS 25178-2 parameters (DASTA) valley height, density of peaks, and closed hill and dale areas refer to specific dental functional characters. Combining all six parameters allows for a comprehensive representation of surface microtextures and their functional integrity. Food items containing large hard particles (e.g., fruits) indent enamel facets more heavily producing a surface with more relief, whereas items with comparatively smaller hard particles (e.g., grass) tend to flatten surfaces. Therefore, ISO/FDS parameters (DASTA) provide insights into the functional interface that dental surfaces represent in respect to environment. SSFA and DASTA are thus complementary and can reconstruct diet, function, and environment of extinct primates with a higher resolution.

Symposium I (Wednesday, November 2, 9:45 am)

380 MILLION YEARS OF TETRAPOD EVOLUTIONARY TRANSFORMATIONS: CONVERGENT EVOLUTION AND THE COUPLING OF AXIAL ELONGATION WITH LIMB AND GIRDLE REDUCTION AND LOSS
Caldwell, Michael, Univ. of Alberta, Edmonton, AB, Canada

A phylogenetic perspective on the evolutionary history of tetrapods, suggests that the loss and reduction of limbs and girdles appears to have been tightly linked to axial elongation. In other words, multiple groups of limbed tetrapods appear to become long and skinny while at the same time displaying loss and reduction of their limb and girdle elements. This apparent linkage between limbloss and body elongation is observed in all major groups of tetrapods throughout the 380 million year history of the group. A threshold number of 35–40 presacral vertebrae appears linked to minor reductions in digit number and phalangeal count. Presacral vertebrae numbers do not increase gradually, rather, but rather appear to salutate from 35–40 vertebrae to 60-70. At higher vertebral numbers, limb loss is extreme, with the forelimbs being reduced to tiny appendages, or lost altogether. Higher presacral counts (>90) are linked to total forelimb and girdle loss and radical rear limb reductions culminating in total loss. A pattern of this sort is recognized in Paleozoic lepospondyls and Mesosauria to modern squamates. Less severe modifications are observed in aquatically adapted reptiles (e.g., ichthyosaurs, mossaurs, plesiosaurs) and mammals (e.g., archaeoceans). A recently proposed developmental genetic models identifies homeobox gene complexes associated with body axis morphogenesis that may be linked homeobox-regulated development of the limb. Axial elongation and limb reduction/loss follows regular patterns regardless of the tetrapod lineage and may well reflect underlying constraints on developmental processes and patterns that are common to all vertebrates, including tetrapods.

Technical Session VII (Thursday, November 3, 2:30 pm)

THE LAST SUPPER BEFORE THE IMPACT: MAMMALIAN DIETS ACROSS THE CRETACEOUS-PALEOGENE BOUNDARY
Caledon, Jonathan, University of Washington, Seattle, WA, USA; Wilson, Gregory, University of Washington, Seattle, WA, USA

The Cretaceous-Paleogene (K-Pg) mass extinction that marked the end of non-avian dinosaurs had a critical impact on mammalian faunas. It has been suggested that the K-Pg event triggered an ecological release, in which small-bodied, mostly insectivorous mammals were able to ecologically diversify into a variety of niches during the Paleocene. Previous studies have addressed quantitative changes in taxonomic diversity of the mammalian fauna leading up to and across the K-Pg, but few have quantified changes in ecological diversity across this boundary. We used low-magnification microwear analysis of fossil specimens from the Hell Creek and Tullock formations of northeastern Montana to delineate diets in latest Cretaceous (Lancian) and earliest Paleocene (early Puercan) mammals and test whether the range of diets expanded across the K-Pg boundary, in particular towards increased herbivory. Lancian mammalian herbivores and their microwear microwear patterns correspond to insectivores and insect-dominated omnivores. However, Didelphodon, which is a large-bodied metatherian, an omnivore with a microwear comparable to the daphn角sh North American river otter. Lancian multituberculates show a broad range of microwear patterns, corresponding to insectivorous to omnivorous diets and, among larger-bodied species, diets with an increased plant component. Early Puercan eutherians, in particular arachnoryctine ungulates, show microwear patterns indicative of increased plant consumption and possibly browsing behavior. Patterns of early Puercan multituberculates suggest increased herbivorization, corroborating results based on gross morphology. The teeth of multituberculates in part support the traditional view: during the latest Cretaceous, most theriens were largely insectivorous, though Didelphodon and large-bodied multituberculates may have explored a broader range of food sources; then a distinct shift in mammalian ecology occurred immediately across the K-Pg boundary, when diverse arachnoryctine ungulates began to exploit high-fiber plant material as a food source.

Poster Session IV (Saturday, November 5)

FIRST MOLLUSC DATA AND PALEOENVIRONMENTAL IMPLICATIONS IN “HO LUECO” VERTEBRATE SITE (UPPER CRETACEOUS, CUENCÁ, SPAIN)
Callapez, Pedro, Universidad de Coimbra, Coimbra, Portugal; Barroso- Barcenilla, Fernando, Universidad de Alcalá de Henares, Alcalá de Henares, Spain; Cambria-Moo, Oscar, Universidad Autónoma de Madrid, Madrid, Spain; Segura, Manuel, Universidad de Alcalá de Henares, Alcalá de Henares, Spain

The “Lo Hueco” vertebrate site includes a succession in “Garumn” facies of versicolor marly mudstone levels, partially cut by a sandy channel structure and two sulphated intervals. It is known from at least two species of Melanopsidae (Faunus), which suggest some influence of moderately brackish conditions. All bivalves were found disarticulated, a fact that can be related to some energetic flooding episodes in the palaeoenvironment. These systematic and palaeoecologic data on molluscs are in accordance with an upper Campanian-lower Maastrichtian near-coast continental muddy flood plain crossed by distributary sandy channels, exposed intermittently to brackish or marine tidal influx, freshwater flooding, and partial or total desiccation.

Technical Session XV (Saturday, November 5, 9:00 am)

THE TAXONOMY AND CRANIAL MORPHOLOGY OF CHINESE LYSTROSaurus
Camp, Jessica, University of Iowa, Iowa City, IA, USA; Li, Jun, Institute of Vertebrate Paleontology and Palaeoanthropology, Beijing, China

The taxonomy of Gondwanan Lystrosaurus species has undergone major revision over the past 60 years, with a decrease from 29 to four valid species. Nine additional species have been named in Laurasia, seven of which are found in China. One of these, L. weidenreichi, is only known from non-diagnostic postcranial material. The validity of the remaining six, L. broomi, L. hedini, L. latifrons, L. robustus, L. shichuangouensis, and L. youngi, has only been briefly addressed in the literature and is the focus of this study. Inspection of all available specimens of Chinese Lystrosaurus reveals minimal variation between L. broomi, L. hedini, L. robustus, and L. shichuangouensis. Variable features, such as snout depth and the development of ornamentation, can be attributed to ontogeny. The paratype of L. latifrons, though distorted, is also similar to these species. Lystrosaurus youngi has a longer snout and minimal ornamentation, giving it a more plesiomorphic appearance such as that observed in the Chinese species Lystrosaurus robustus. The size range of L. hedini-L. robustus-L. shichuangouensis and L. youngi overlaps and differences are visible in juveniles, making sexual dimorphism unlikely. Geometric morphometric analyses reaffirm these two morphotypes, with L. youngi separate from a group consisting of L. hedini, L. robustus, and L. shichuangouensis. These results support the presence of two species in China: L. hedini (=L. broomi, L. latifrons, L. robustus, L. shichuangouensis) and L. youngi. Additionally, these species are morphologically distinct from Gondwanan Lystrosaurus in several ways. Laurasian Lystrosaurus have a much higher degree of intraspecific variation in preparital size and shape. The shape of the lacrimal and expression of the nasol-frontal and transverse frontal ridges also vary geographically. Both Chinese species share these traits, suggesting a single dispersal event from Gondwana to Laurasia in the Late Permian prior to the appearance of L. youngi in the stratigraphic record.

Poster Session I (Wednesday, November 2)

PLIO-PLISTOCENE PALEOENVIRONMENTAL CHANGE IN THE CRADLE OF HUMANKIND, SOUTH AFRICA: AN APPLICATION OF MODERN RODENT NICHE MODELS TO FOSSIL BEARING LOCALITIES
Campbell, Timothy, Texas A&M University, College Station, TX, USA

Paleoenvironmental reconstructions utilizing small mammal faunas to assess past conditions are based on the principle of actualism in which the environmental and ecological tolerances of fossil taxa are assumed similar to the modern taxa that they resemble. It follows that an accurate assessment of modern environmental tolerance limits is a prerequisite for any actualistic approach. When the tolerance limits of modern taxa are defined, these parameters can then be applied to fossil-bearing localities where the taxa have been reported. This study utilizes modern rodent niche models developed using a Geographic Information Systems (GIS) based analysis of 19,567 specimens obtained from the electronic databases of the Transvaal Museum, South Africa, and the Division of Mammals, Smithsonian Institution National Museum of Natural History. Genus level ecological and environmental tolerance limits are defined using a two-dimensional representation of range level identification and a Frank and Rosenblatt-based defined dental morphologies for many rodent taxa. Modern niche model parameters are applied to Plio-Plistocene fossil-bearing localities within the Cradle of Humankind, South Africa, including the hominin bearing sites of Makapansgat, Sterkfontein, Drimolen, Gondolin, Swartkrans, Gladysvale and Plovers Lake. In doing so, this study examines environmental change for an area of approximately 470 square kilometers over the last 5 million years. Results from this analysis suggest that in the Early Pliocene the study area was more arid than in later times. Subsequently, this model suggests a general increase in precipitation along with more wooded environments during the Late Pliocene. Throughout the Pleistocene a general
trend of reduction in the amount of wooded cover concomitant with an increase in savanna grassland habitats is observed. As most Plio-Pleistocene rodent genera in South Africa have extant representatives, this study provides a conservative analysis of environmental change for the study area. With improvements in species level identification of rodent taxa, greater precision can be obtained through the application of lower level niche model parameters to fossil-bearing localities.

Poster Session II (Thursday, November 3)
OSTEOARTHRITIS IN AN AMPHICYONID FROM THE EARLY BARSTOVIAN, YELLOW HILLS FAUNA, NORTHWESTERN NEVADA
CAMPBELL, Tina, Sierra College Natural History Museum, Rocklin, CA, USA; BRAMM, George, Sierra College Natural History Museum, Rocklin, CA, USA; HULT, Richard, Sierra College Natural History Museum, Rocklin, CA, USA
A disarticulated partial skeleton of an amphiycinon displaying severe osteoarthritis was recovered from the basalt portion of a relatively fine-grained lahar that was deposited within the High Rock Caldera in northwestern Nevada. The lahar is part of the High Rock Sequence and hosts the majority of the mammalian taxa of the Early Barstovian Yellow Hills Fauna (~16Ma). The amphiycinon (Sierra College VMC 199) post-cranial elements that show osteophytes are: the axis on the ventral side of the caudal articulation surface; interior and exterior surfaces of the distal ends of the tibiae; metacarpals; and possible carpal fragments so distorted by osteophytes that they cannot be identified. Although all of the metacarpals show a varying degree of osteoarthrosis adjacent to the proximal articulating surfaces, the 3rd and 4th show the most severe osteoarthrosis with osteophyte development adjacent to the articulating surfaces. The 4th metacarpal has osteoarthrosis growth on the ventral side of the central shaft forming a continuous ridge of osteophytes to each terminal. The type of arthritis shown on these elements is primary osteoarthrosis - a condition normally found in older animals. Amphiycinons are believed to be ambush predators that use their front feet to grab and bring down their prey. Thus, it is difficult to comprehend how this animal was able to survive as long as it did in order to develop such an advanced stage of osteoarthrosis. Possible hypotheses could be that this animal was supported and protected by a pack, or that it somehow avoided being the victim of predators, and scavenged during its remaining days of life. Since a relatively high percentage of skeletal elements of this animal have been recovered from a localized area and that there is a lack of obvious evidence of scavenging, it may be concluded that there was little disturbance and distribution of the carcass prior to its incorporation into the lahar. One could hypothesize that the animal was too crippled to avoid the flow or that its carcass was protected from scavengers. In any case, it is a rare occurrence within the fossil record to find osteoarthrosis in an amphiycinon.

Symposium 4 (Friday, November 4, 10:45 am)
DIVERSITY DYNAMICS IN THE LATE CRETACEOUS OF NORTH AMERICA: SAMPLING AND BODY SIZE BIASES
CAMPIONE, Nicolau, University of Toronto, Toronto, ON, Canada; HSIEH, Shannon, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada
The pattern of dinosaur diversity leading up to the end-Cretaceous extinction event is highly debated, and conflicting hypotheses centre on either a catastrophic demise or a gradual decline in the Maastrichtian. However, existing studies employ different sampling bias correction methods on independently derived datasets, making comparisons difficult, and most approach the problem on a global scale, which suffers from highly uneven geographic sampling through time. Here, we compile an up-to-date database of Cretaceous dinosaur species focusing only on North America, an essentially isolated, well-sampled continent. We apply the development of a rainshadow. Prior to geochemical analysis, the structure and composition of the osteoderms was assessed by several methods (loss-on-ignition analysis, XRD and thin-sections) to confirm the integrity of the specimens. The average ±18O values of the osteoderm bioapatite is -6.5 ± 0.9‰, suggesting shallow burial conditions for these glyptodont fossils. This is consistent with slow sedimentation rates in the San Felipe Fm. ranging from 3 to 16 mm/yr. The 013C values of enamel from coeval rodent teeth (-3.4 ± 1.0‰) suggest the vegetation cover at the time was mostly C4 or CAM plants, in accordance with the onset of aridity in the region. The average ±13C value of the osteoderm bioapatite is 7.4 ± 1.2 ‰. If osteoderms are archives of unaltered carbon from diet, than glyptodonts were mixed-feeders, incorporating some C3 and C4 and potentially CAM plants.

Poster Session IV (Saturday, November 5)
GROWTH PATTERNS AND PALAEOECOLOGY OF PAREIASAURS (PARAREPTILIA; PAREIASAURIDAE) INFERRED FROM LONG BONE HISTOLOGY AND MICROANATOMY
CANOVILLE, Aurore, University of Cape Town, Cape Town, South Africa; CHINSAMY-TURAN, Ansuya, University of Cape Town, Cape Town, South Africa
Fossil bone histology and microanatomy is known to provide insight into various aspects of tetrapod paleobiology (ontogeny, individual age, growth patterns, and lifestyle). Although bone histology has been extensively applied to the diverse and abundant nonmammalian therapsids from the vertebrate fossil-bearing sequence of the Karoo Basin (South Africa), few studies have been conducted on pareiasaurs, such as the pareiasaurs which were fairly abundant in the Late Permian terrestrial ecosystems. These herbivorous pareiasaurs remain enigmatic because of their phylogenetic affinities (hypothesized to be the sister group of turtles), and also in terms of their growth strategies and lifestyle habits. Earlier research based on anatomical and taphonomical studies have suggested that pareiasaurs had a rather short juvenile period as compared to adulthood, and that juveniles and adults occupied different habitats. Moreover, it has been often proposed that these animals were semi-aquatic or at least water-dependent for feeding. Through an extensive survey of pareiasaurian long bone histology and microanatomy, here we assess these hypotheses. The main sampling method by coring using high pressure water cutting used in this study preserves the overall anatomy of the skeletal elements and provides the opportunity to examine a larger number of specimens. The use of standard cross-sectioning protocol. In order to document growth patterns, paleoecological adaptations and intra and inter bone variability of these animals, our study examines more than 70 long bones (humeri, radii, femora, tibiae, fibulae, ribs) of 35 specimens of different ontogenetic stages. The whole taxonomic and stratigraphic spectrum of South African pareiasaurs is covered by our sample, from the early, large and less armoured genera such as Bradysaurus and Embrithosaurus (Tapinocephalidae and Pristerognathus assemblage zones) (n=9), to the latter forms such as Pareiasaurus and the dwarf, well armoured Anthodon (Tropidostoma to Di-cynodon assemblage zones).

This research present fresh insights about the life history and paleoecology of anapsid Permian tetrapod communities.

Poster Session II (Thursday, November 3)
STABLE ISOPE COMPOSITION OF GLYPHODONT OSTEOERMS: A TOOL FOR INTERPRETING PALEO-ENVIRONMENT
CANAVAN, Robin, University of Wyoming, Laramie, WY, USA; CLEMENTZ, Mark, University of Wyoming, Laramie, WY, USA; BYWATER-REYES, Sharon, University of Wyoming, Laramie, WY, USA
Glyptodonts were large, herbivorous xenarthrans that inhabited South America for most of the Cenozoic. Like all xenarthrans, glyptodonts lacked enamel, but are still assumed grazers based on the possession of large, hypsodont cheek teeth, which are estimated to have grown fast enough to compensate for the wear of abrasive grasses. Stable isotope analysis offers a means of testing this interpretation, but the lack of enamel makes stable isotope analysis of their dentition less reliable for interpreting paleo diet. An alternative may be analysis of the interlocking osteoderms that form the protective carapace of these animals. Due to the resiliency of osteoderms and their exceptional preservation in the fossil record, we hope to develop a more robust tool for the investigation of paleo diet and ecology from the stable isotope composition of this dense dermal tissue.

Glyptodont osteoderms were collected from multiple levels of the San Felipe Formation in the Angastaco Basin, northwestern Argentina. These Pliocene age fluvial and alluvial deposits mark the transition from humid conditions to sustained aridity. From 4 Ma associated with the development of a rainshadow. Prior to geochemical analysis, the structure and composition of the osteoderms was assessed by several methods (loss-on-ignition analysis, XRD and thin-sections) to confirm the integrity of the specimens. The average ±18O values of the osteoderm bioapatite is -6.5 ± 0.9‰, suggesting shallow burial conditions for these glypto- dont fossils. This is consistent with slow sedimentation rates in the San Felipe Fm. ranging from 3 to 16 mm/yr. The 013C values of enamel from coeval rodent teeth (-3.4 ± 1.0‰) suggest the vegetation cover at the time was mostly C4 or CAM plants, in accordance with the onset of aridity in the region. The average ±13C value of the osteoderm bioapatite is 7.4 ± 1.2 ‰. If osteoderms are archives of unaltered carbon from diet, than glyptodonts were mixed-feeders, incorporating some C3, C4 and potentially CAM plants.

Poster Session II (Thursday, November 3)
MORPHOMETRIC ANALYSIS OF RANCHO LA BREA FELID ILIA
CARLON, Burcu, Northern Illinois University, Dekalb, IL, USA; HUBBARD, Chris, Northern Illinois University, Dekalb, IL, USA
We have performed a morphometric analysis on the ilia of the Rancho La Brea Smilodon fatalis (n=9), Panthera (Felis) atrox (n=4), and Lynx rufa (n=4). Our goal was to visualize the ilium shape changes among the three species and to determine if size has an influence on the iliac shape. Generalized Procrustes Superimposition and principal components analysis techniques allowed us to examine the landmark-based variation. PC1 accounted for 33.4% of the total variance to be in the width of the ilium. L. rufa, with a positive PC1 score, has a
narrower ilium than *S. fatalis* and *P. atrox*, with negative PIC scores. There was no significant difference between *S. fatalis* and *P. atrox*. The width of the ilium has a major effect on the muscle attachment site areas of gluteus medius and gluteus profundus, possibly influencing their force output and function. There is some positive relationship between size and shape for the ilium inferred by the regression between PC1 and its centroid size. The ilium becomes wider as body size increases, from *L. rutila* to *P. atrox* and *S. fatalis*. However, *S. fatalis* has a more robust ilium although its body size is considerably less than that of *P. atrox*. This suggests that size is not the only determinant for the ilium shape. More feld species of different sizes should be included in this type of study to come to a better conclusion about the relationship between body size and ilium shape.

Technical Session VI (Thursday, November 3, 1:45 pm)

**BLACK FEATHER COLOR IN ARCHAEOPTERYX**

CARNEY, Ryan, Brown University, Providence, RI, USA; VINTHER, Jakob, Yale University, New Haven, CT, USA; SHAKEY, Matthew, University of Akron, Akron, OH, USA; D’ALBA, Liliana, University of Akron, Akron, OH, USA; ACKERMANN, J Carl Zeiss NTS GmbH, Oberkochen, Germany

Archaeopteryx has been regarded as an icon of evolution ever since its discovery 150 years ago from the Late Jurassic limestone deposits of Solnhofen, Germany. The anatomical mosaic of plesiomorphic and derived traits evidenced by these fossils has prompted a rich scientific literature on *Archaeopteryx* and the origin of birds, yet the color of this animal has remained only speculative. Here we report the first evidence of color from *Archaeopteryx*, based on scanning electron microscopy and energy-dispersive x-ray analyses that reveal the presence of fossilized color-imparting melaninomes in the isolated feather (MB.Av.100). Using a phylogenetically diverse database of 115 extant bird feathers (representing 87 taxa from 27 orders), quadratic discriminant analysis of five properties of melanosome morphology predicts that the original color of the *Archaeopteryx* feather was black, with 95% probability. Furthermore, based on the reexamination of its morphology we interpret the feather to be an upper primary covert. The specimen is also preserved as an organosulfur residue and reveals a barbule microstructure similar to that of modern bird feathers. In modern birds, melanin is also known to increase feather strength, thickness, and resistance to abrasion from the aerodynamic demands of flight, and the extensive melanization observed in the *Archaeopteryx* wing feather may have provided similar mechanical advantages during this early evolutionary stage of avian flight. Ultimately, our results demonstrate how modern imaging techniques and statistical analyses can be coupled to reconstruct and further the understanding of plumage color and function in extinct dinosaurs.

**POSTER SESSION IV (Saturday, November 5)**

**BIOSTRATIGRAPHY OF EARLY HEMPHILLIAN BEAVERS (RODENTIA: CASTORIDAE) FROM THE PACIFIC NORTHWESTERN UNITED STATES OF AMERICA**

CARPENTER, Nathan, The College of Idaho, Orma J. Smith Museum of Natural History / Paleopublications, Caldwell, ID, USA

*Castor* is the sole remaining genus of a once diverse group of beavers, Castoridae, which roamed across the northern hemisphere from North America, Europe and Asia since the Oligocene. In the early Hemphillian of western North America, three genera are represented: *Castor*, *Hystricops* and *Dipoides*. *Hystricops* and *Dipoides* are native to North America while *Castor* is an invader. *Castor* appears in the European fossil record after 11.2 Ma and *Dipoides* after 9.0 Ma. The two genera of beavers, *Hystricops* and *Dipoides*, are found together in North America in the early Hemphillian, after 8.5 Ma. However, between 8.6-7.5 Ma, the relationship changes with *Castor* invading North America from Europe, appearing in association with either a medium or small sized species of *Dipoides*. *Castor* appears in the fossil record of Asia at 7 Ma and *Dipoides* a little later at 6 Ma. *Dipoides* beavers of the western United States are similar to specimens from Asia. The oldest North American specimens assigned to *Castor* come from the Hemphillian Chalk Hills Formation of Idaho and southeastern Montana. Some specimens of *Dipoides* and *Hystricops* associated with *Castor* are evident. The youngest reported occurrence of *Hystricops* is from the Hemphillian Burtlett Mountain local fauna of southeastern Oregon that also contains *Dipoides*. *Castor* appears to have displaced *Hystricops* during the early Hemphillian while the other native genus, *Dipoides*, seems to flourish. Changing environmental conditions apparently favored the combination of *Dipoides* and *Castor* over *Hystricops*. A primary difference between the three genera is the development of ever-growing cheek teeth in *Castor* and *Dipoides* and not in *Hystricops*.

**POSTER SESSION III (Friday, November 4)**

**WHY THE LONG FACE? DENTAL MICROWEAR COMPARISON OF LONGIstroemerx AND Blastoemerx (ARTIODACTYLA, MOSCHIDAE)**

CARR, Jason, South Dakota School of Mines & Technology, Rapid City, SD, USA; PAGNAC, Darrin, South Dakota School of Mines & Technology, Rapid City, SD, USA

The North American Miocene moschid *Longistroemerx* shows several unique cranial characteristics. *Longistroemerx* is distinguished from other small North American artiodactyls by an elongate rostrum and dentary synphysis, an increase in the length of the diastema between the canines and the anterior-most premolar, an increase in molar hypsodonty, and a reduction in premolar size. Combined, these characters paradoxically suggest both selective browsing and increased grazing.

**Dental microwear analysis was performed on specimens of Longistroemerx and Blastom- erx from localities in the Valentine (Barstovian-Clarendonian), and Ash Hollow (Clarendo- nian) formations of Nebraska. Results yielded mean pit and scratch counts that placed both genera within the range associated with browsing taxa. The difference in mean microwear values between the two genera was tested using Wilk’s lambda and found not statistically significant (p=0.13); while the difference in distributions of scratch counts was significant (p=0.003) using a two-tailed F-statistic test.**

Previous analysis of microwear has focused on comparing mean values between taxa to determine feeding type; however, the difference in distribution of pit and scratch values between *Longistroemerx* and *Blastomeryx* suggests that statistical analysis of wear value distributions may provide further insight into feeding behavior. The greater range of scratch counts observed in *Blastomeryx* suggests that it had a more varied feeding style, while a narrower distribution of scratch counts observed in *Longistroemerx* implies that it had a preferred diet with less variety. This is consistent with the elongate rostrum and increased premolar-canine diastema characteristic of *Longistroemerx*. *Blastomeryx*, however, does not accommodate the increase in molar hypsodonty or reduction of the premolar row.

**Technical Session XIV (Saturday, November 5, 10:30 am)**

**A COMPARATIVE STUDY OF ONTOGENY BETWEEN DERIVED TYRANNOSAUROIDS: EVIDENCE FOR HETEROCRONY**

CARR, Thomas, Carthage College, Kenosha, WI, USA

Tyrannosauroids are exemplar fossil taxa, given the excellent quality of their fossils, well- resolved and robust phylogeny, extensive temporal and geographic distribution, and densely sampled fossil record. In particular, the fossil record of the subclade Tyrannosauridae is exceptional, where many species are represented by growth series. Taken together, ontogeny and phylogeny can provide a framework for hypothesizing the developmental processes that produced the character changes during their evolutionary history. The objective of this study was to identify the alterations in the sequence of development (heterochrony) that produced the evolutionary novelties (synapomorphies and autapomorphies) that arose during later stages of ontogeny. This goal was achieved by first reconstructing growth series using cladistic methods (parsimony analysis) for several species, namely *Albertosaurus libratus*, *A. sarcopogoneus*, *Daspletosaurus torosus*, *Tyrannosaurus bataar*, and *T. rex*. Two complementar- ry approaches, “event-pair-cracking” and a novel approach termed “end points” were used to compare the growth series in a cladistic context, where the non-tyrannosaurid tyrannosaurid *Bistahieversor sealeyi* was the outgroup. Evidence of heterochrony was found: for example, the size of the maxillary fenestra had a complex evolutionary history, where the isomorphic process termed pre-displacement produced the enlarged maxillary fenestra seen in derived tyrannosaurine adults. The greatly enlarged condition seen in *Tyranosaurus* was produced by the peramorphic process of acceleration or hypermorphosis; and, in contrast to *D. torosus* and *T. rex*, the peramorphic process of pre-displacement produced the enlarged condition that is seen in juveniles of *T. bataar*, which is an autapomorphic process (and morphology) seen in that species. Therefore, tyrannosauroids provide an effective case study, in a fossil vertebrate, for identifying the heterochronic processes that produced morphological novelties from their ancient antecedents.

**Symposium 4 (Friday, November 4, 10:15 am)**

**THE IMPORTANCE OF VERTEBRATE MICROFOSSIL BONEBEDS IN UNDERSTANDING THE FOSSIL RECORD: EXAMPLES FROM THE CLOVERLY FORMATION**

CARRANO, Matthew, Smithsonian Institution, Washington, DC, USA; ORESKA, Matthew, Smithsonian Institution, Washington, DC, USA; CARNEY, Ryan, South Dakota School of Mines & Technology, Rapid City, SD, USA

Vertebrate microfossil bonebeds (VMBs) are commonly sought for their ability to preserve elements of small-bodied taxa, often mammals. They have been used more recently to assess paleodiversity and paleoecology, but remain under-utilized as a means to broadly study these features of the vertebrate fossil record. Here, we present the results of eight years of fieldwork in the Early Cretaceous Cloverly Formation of Wyoming and Montana that illustrate the importance of VMBs for intra- and inter-formational studies.

Seventy-five years of fieldwork in the Cloverly Formation has been dominated by traditional prospecting and collection methods, resulting in a numerically significant (N > 500) but taxonomically depauperate (Nc=20) sample of large vertebrates. New VMBs add >30 taxa to these totals. Rarefaction curves for these two methods differ significantly at equivalent sample sizes, suggesting that traditional collecting is both impractical and unsuccessful at recovering total available diversity here. Added taxa include several species of freshwater sharks, crocodilians, and mammals, among others. Bony fishes and crocodilians are the most abundant, followed by dinosaurs, amphibians, and turtles. These patterns remain after adjusting for proportional differences in element numbers between groups. The few taxa not recovered in VMBs are either rare or dif- ficult to identify from isolated elements. Cloverly vertebrate diversity is now much closer in number and content to diversities of coeval neighboring formations (e.g., Antlers). Its fauna has a strong aquatic and semiaquatic component, but dinosaurs are abundant and represented by a dozen species.

These results underscore the critical role of VMBs in recovering the highest possible frac- tion of available vertebrate diversity. Methodologically, it is important to obtain sufficient, consistent samples in order to maximize potential comparisons. Although it is impossible to
know how accurately any single VMB reflects its original paleoenvironment, VMBs offer a standardizable, statistically supportable benchmark that can be measured across formations and long stretches of geologic time.

**Poster Session IV (Saturday, November 5)**

**IMPORTANCE OF THE JUCHIPILA FAUNA (LATE EARLY HEMPHILLIAN, HH2), STATE OF ZACATECAS, IN THE BIOSTRATIGRAPHIC CORRELATION OF THE HEMPHILLIAN FAUNAS OF CENTRAL MEXICO**

CARRANZA-CASTAÑEDA, Oscar, Centro de Geociencias, Campus UNAM-Juriquilla, Querétaro, Qro. México, Juriquilla, Mexico; WANG, Xiaoming, Los Angeles County Museum of Natural History, Los Angeles, CA, USA; ARANDEA-GÓMEZ, José Jorge, Centro de Geociencias, Campus UNAM-Juriquilla, Querétaro, Qro. México, Juriquilla, Mexico

Sedimentary basins located between central México and the Great Plains are crucial to understand the biostatigraphy, dispersal, migration routes, and extinctions of late Tertiary mammals in North America. Most published information is based on vertebrate fossil localities in the San Miguel Allende (SMAB) and Tecolutlán (TB) basins, which contain the most diverse Hh3 & Hh4 and early Blancan faunas in México. Additional information came from other sites. Recent work at the Juchipila basin (JB, Zacatecas) documented the oldest Hh2 mammalian assemblage in México. Based on the youngest record in North America of the merycodont Cosotherium and the occurrence of the megalonichid Plometanastes, the horses Calippus (Grammohippus) hodonarensis, Neohippotherium eurypristle, Astrohippus ansae and Dinohippus mexicanus, the antilocaprids Ploceros and Sphenophalus, and the camel Afnoljas taylori, the JB fauna is considered Hh2. Two ages obtained from interbedded ashes yield a reliable age bracket (U-Pb, zircon, 6.95±0.29 – 5.58±0.10 Ma) consistent with the fauna’s NALMA.

**SYMPOSIUM 4 (Friday, November 4, 11:30 am)**

**COMPARING EXTANT MAMMALIAN SPECIES DIVERSITY TO PALEOSPECIES RICHNESS: PROBLEMS AND SOLUTIONS**

CARRASCO, Marc, University of California, Berkeley, Berkeley, CA, USA

Recent analyses of current extinction rates in extant animals have suggested that we may be in the midst of a sixth mass extinction. However, assessment of the true size, rate, and timing of this extinction has been made difficult because of the lack of a comparison between the natural paleodiversity baseline and extant species diversity. Here I use the NEOMAP distributed database of mammalian occurrences to create and compare a baseline, as assessed by species-area curves, for the past 30 million years to modern mammalian species diversity. Species-occurrence data was subjected to rarefaction and other standard modernization techniques and, in combination with the Berkeley Mapper software, was used to derive species-area curves by geographic region for distinct time slices from the late Oligocene through the Modern. Preliminary results indicate that mammalian species diversity, while severely depressed during the Holocene, appears to increase during the Modern time interval. Upon closer inspection, it appears that this rise in diversity is a result of a large increase in the diversity of small mammals (Rodentia, Lagomorpha, and Insectivora), primarily members of the rodent families Heteromyidae, Geomyidae, and Sciuridae – groups whose species are often difficult to diagnose in the fossil record. I suggest that this anomalous modern diversity shift is likely an artifact caused by the different taxonomic standards used by paleontologists and neontologists. Therefore, any attempt to assess the magnitude of the current extinction in mammals needs to account for these fundamental differences by employing alternative methodologies such as more detailed taxonomic studies of problematic fossil groups and reassessments of extant species using palaeontological techniques.

**Poster Session III (Friday, November 4)**

**A THIRD AZHDARCHARID PTEROSAUR FROM THE TWO MEDICINE FORMATION (CAMPANIAN) OF MONTANA**

CARROLL, Nathan, Montana State University, Bozeman, MT, USA; POUST, Ashley, Montana State University, Bozeman, MT, USA; VARRICCHIO, David, Montana State University, Bozeman, MT, USA

New material of an azhdarchid pterodactyloid pterosaur was recovered from Jack’s Birthday Site (JBS) in the Two Medicine Formation of northwestern Montana. With few exceptions (e.g. *Quetzalcoatlus, Montanadactylus*), reported members of this group are represented by few or partial elements, or, as in the case of *Zhejiangopterus*, are two-dimensionally preserved which prevents evaluation of most morphological and osteological details. Taphonomic modification of the Birthday Site material includes disarticulation, some lithostatic compaction, and possibly trampling-induced breakage. Nevertheless, the new material is generally well-preserved and three-dimensional. The broad range of observable elements allows evaluation of newly recovered post-cranial characters of the humerus, antebrahium, pelvis, and tarsus. The new form shares several elements in common with the two previously described Montana azhdarchids of similar age (including syncarpals and proximal humerus) and character analysis demonstrates their close relationships. Previous functional arguments for land-based feeding strategies have emphasized the anatomy of the skull and cervical vertebrae. The preservation of the several carpal, manus and tarsal elements now allows consideration of these elements. The robust nature of the carpus and manus and the unique expanded morphology of the proximal phalanges suggests weight-bearing, further supporting the hypothesis that azhdarchids were well adapted to terrestrial locomotion. Jack’s Birthday Site represents a small floodplain pond far inland, perhaps 200 km from the Western Interior Cretaceous Seaway. The JBS azhdarchid provides additional evidence for the proposed biogeographic and ecological associations of this group with open environments decidedly far from marine sediments.

**Poster Session IV (Saturday, November 5)**

**EVOLUTIONARY TRAJECTORIES OF EARLY EOCENE PRIMATE EVOLUTION**

CARTER, Katherine, Harvard University, Boston, MA, USA

Many Eocene primate radiations show the parallel evolution of many dental features, including the development of a quadrate upper molar and the loss of a paraconid on the lower molar. These innovations have often been linked to expanding dietary niches as an adaptation to the rapid changes in early Eocene floral and faunal composition. However, fossil evidence suggests highly constrained evolutionary pathways where the evolution of novelty is not directly linked to change in the climate. To determine the magnitude and extent of environment on dental morphology, it is necessary to examine the shape and size of several trajectories of microevolutionary sequences of early Eocene primegrate groups. Photographs of upper and lower M2s across adapid and omomyid primates were measured using coordinates and linear measurements. The resulting metrics were analyzed using a combination of multivariate multiple regression and pairwise contrasts. Trajectories were generated from the linear measurements, and the covariance between trajectory size, shape and orientation was assessed from a comparison of the data to empirically-derived random distributions. Environmental data was collected from published reconstructions of fossil sites, and standardized into a set of seven variables. Trajectory size was highly variable among lineages, likely an artifact of differential evolutionary rate. However, almost no lineage differed significantly in either trajectory orientation and trajectory shape, indicating that the evolutionary pathways were highly constrained. In addition, levels of variability in individual traits corresponded well with position on the evolutionary trajectory, with the protocone increasing in variability over the evolutionary sequence and the distal talonid cusps decreasing in variability. Overall, the correlation between tooth shape and climatic variables was not high, implying that environment is not a large determining factor in Eocene primate tooth morphology. The level of environmental variables previously linked to high seasonality and instability showed the highest level of correspondence with tooth morphology.
RARE EARTH ELEMENT FINGERPRINTING AND 87Sr/86Sr RATIOS SUPPORT A LATE MAASTRICHTIAN AGE FOR ANTARCTICA’S FIRST DISCOVERED CRETACEOUS BIRD, POLARORNIS GREGORII

CASE, Judd, Eastern Washington University, Cheney, WA, USA; PATRICK, Doreena, Richard Stockton College of New Jersey, Pomona, NJ, USA; NEZAT, Carmen, Eastern Washington University, Cheney, WA, USA; CLARKE, Julia, The University of Texas, Austin, TX, USA

New evidence from 87Sr/86Sr ratios in fossil bone and Rare Earth Element (REE) analyses of matrix identifies the controversial, first-discovered Antarctic bird, *Polarornis gregorii*, as from the latest Maastrichtian deposits of the Lopez de Bertodano Formation, Seymour Island, Antarctic Peninsula. The 87Sr/86Sr ratios in six samples of bone from the *Polarornis* holotype specimen and REE fingerprinting of the specimen matrix were evaluated. The 87Sr/86Sr ratios are indicative of a latest Maastrichtian age (between 65.8 and 65.5 Ma). Resulting REE patterns were compared to samples from the Late Maastrichtian informal stratigraphic unit Kfb 9 of the Lopez de Bertodano Formation and the Telm 2 unit of the Eocene, La Meseta Formation, which are both exposed in the area of collection of the *Polarornis* holotype specimen on Seymour Island. While the recovered values of REE from the fossil matrix samples are consistent with a Kfb 9 provenance, these values are significantly different from the La Meseta REE values. The REE analysis also supports previous interpretations on water depths for each formation; the Lopez de Bertodano Formation and fossil samples yield a signature consistent with a deep water, mid-shelf environment, while the La Meseta Formation signature is consistent with a shallow water, near-shore environment.

**Preparators’ Session (Thursday, November 3, 9:45 am)**

**LESSONS LEARNED FROM “DEAD SHEEP 148”, OR THE FINE ART OF DEALING WITH BIG PLASTER JACKETS**

CAVIGELLI, Jean-Pierre, Tate Geological Museum, Casper College, Casper, WY, USA

Because of their size and weight, collecting large dinosaur specimens can be a logistical challenge. From 2005-2007, crews from the Tate Geological Museum at Casper College collected a hadrosaur known as “Dead Sheep 148” from the Lance Formation in eastern Wyoming. The pelvic region of this animal was well articulated and collected as one jacket eight feet long, three feet wide and two feet thick. Over the next few years the jacket was opened in the museum’s prep lab and the specimen were prepared by museum volunteers. Since the bones were well articulated, including many ossified tendons, they were left in situ in the jacket. The jacket contains a series of 22 articulated vertebrae, each of the pelvis and one femur. After opening the jacket, three cracks developed in the specimen. It is uncertain if the cracking was due to structural issues in the jacket, or to drying out, or to other factors. The cracks were stabilized using glues and epoxy putty. We had planned to move the specimen using a tripod, chain hoist, and two-inch wide nylon webbing, but the cracks were almost exactly above where the nylon straps would be suspending the jacket, raising fears that in moving it, the cracks would re-activate and the specimen would fall apart. We came up with a technique to move the specimen into the museum galleries while minimizing the chances of its breaking. The jacket was lifted using the same tripod set-up plus a scissors jack under each end of the jacket to prevent the jacket from buckling. A custom fit piece of plywood was slid in underneath the jacket, and then the jacket was lowered onto the plywood. While the jacket was still suspended, two-part foam was injected into the space between the jacket and the plywood, making a rigid support for the jacket. This rigid support makes the specimen easily movable in the future should we need to move it again. Many lessons were learned dealing with big jacket and unforeseen problems, and will influence how we will deal with future large jackets.

**Poster Session II (Thursday, November 3, 9:45 am)**

**A TEST OF THREE SOLVENT-BASED CONSOLIDANTS FOR FIELD USE IN THE RAIN**

CAVIN, Jennifer, John Day Fossil Beds National Monument, Kimberly, OR, USA

An experiment was undertaken to determine which of three solvent-based consolidants would hold up best in a field situation wherein a fossil is discovered, consolidated, and left in situ in an extreme climate for collection at a later date. Locally obtained road gravel was dry sieved and washed to obtain a sample of very coarse sand, between 1 – 2 mm in grain size. The dried sand was glued to wooden dowels using one of the following consolidants: polyvinyl acetate (PVAC, B-15), methyl methacrylate (B-72), and polyvinyl butyral (B-76). The glue was allowed to dry overnight, and the sand encrusted dowels were weighed. Each of the dowels was positioned over a cheesecloth covered sieve and placed in a shower to simulate rain. After one hour, the dowels were removed from the shower and allowed to thoroughly dry. The dried dowels were then weighed to determine the percentage of material that was lost due to the falling water. A quick visual analysis suggested that the consolidants performed similarly, and detailed analysis supported this finding. For all test dowels, approximately 2% of the sand grains were washed away after an hour of simulated rain, dem- onstrating no significant difference between consolidants. The process was then repeated, with the dowels subjected to two more hours in the shower. Very few sand grains on any of the dowels were washed away in this second wetting, thus showing no significant difference, in this experiment, between PVAC, methyl methacrylate, or polyvinyl butyral. This suggests the consolidants are relatively impervious to precipitation, and weathering may be a result of other factors. Future experiments will include allowing sand encrusted dowels to soak for various periods of time submerged in water and examining the effects of temperature fluctuations. It is suggested that plastic dowels, or PVC pipe, should be used in additional experiments to reduce the drying time required.

**Poster Session II (Thursday, November 3, 9:45 am)**

**THE FIRST RECORD OF SAUROPOD DINOSAURS FROM ANTARCTICA**

CERDA, Ignacio, CONICET-INIBIOMA, Neuquén, Argentina; PAULINA CARABAJAL, Aranzadi, CONICET-Museo Carmen Funes, Puerto Madryn, Argentina; SALGADO, Leonardo, CONICET-INIBIOMA, Neuquén, Argentina; CORIA, Rodolfo, CONICET-Museo Carmen Funes, Plaza Huincul, Argentina; MOLY, Juan, Museo de La Plata, La Plata, Argentina

Sauropods were one of the most widely distributed group of dinosaurs for most of the Mesozoic Era, although this clade has not been previously recorded in Antarctica. Here we report the first record of a sauropod dinosaur from Antarctica, represented by an incomplete caudal vertebra from the Late Cretaceous of the James Ross Island (Antarctic Peninsula). The vertebra was collected from marine sediments assigned to the Gamma Member of the Santa Maria Formation (Campanian), constituted mainly by fine-grained to mid-size grained sandstones. The specimen consists of a strongly procumbent middle caudal central lacking the neural arch. The centrum length (excluding the posterior ball) is 170 mm and its height is 105 mm. There is no pleurocoels, and a sagittal fracture has exposed the internal bone structure, which is not pneumatized. The morphology and size of the specimen allow it to be identified as a caudal vertebra of a derived sauropod dinosaur. The anterior position of the neural arch indicates referral to Titanosauriformes. The prococely of the middle caudal vertebra has been proposed to have a diagnostic feature of liothrotian titanosauras. The biogeographical history of sauropods and the interrelationships amongst titanosauras from southern landmasses remain obscure and controversial. The specimen is notable for representing the first Antarctic sauropod record, but also the most southern record of the clade, adding new data in the process of resolving the affinities of South American titanosauras and the understanding of Gondwanan paleobiogeography.

**Poster Session I (Wednesday, November 2)**

**THE VIRTUALIZATION OF A LARGE TIRANNOSAURUS REX SPECIMEN (SUE) FROM SOUTH DAKOTA**

CHAPMAN, Ralph, New Mexico Virtualization, LLC, Los Alamos, NM, USA; ANDERSEN, Arthur, Virtual Surfaces, Inc., Glenview, IL, USA; MAKOVICKY, Peter, Field Museum of Natural History, Chicago, IL, USA; DECK, Linda, New Mexico Virtualization, LLC, Los Alamos, NM, USA; SIMPSON, William, Field Museum of Natural History, Chicago, IL, USA

The huge size of many dinosaurs and prehistoric mammals can make it very difficult to work on them scientifically. A solution to this is to digitize a skeleton to provide a copy we can experiment with in virtual space, where size is irrelevant. This approach was used to virtualize the large tyrannosaur FMNH PR 2081 often referred to as SUE. The work was done in three phases. The first was the 3D capture of the mounted skeleton using an area laser scanner. The construction of a modern museum mount for a large animal uses scientific principals combined with the feedback provided by the skeletal elements. As such, the final product is a perfect starting point for constructing a virtual skeleton that can be the basis for animations, functional analyses, and a great variety of products for museum outreach and marketing. The second phase was to scan in each of the individual elements at high resolution to provide maximum flexibility downstream during the project. This was done using three different scanners: a high-grade, medical CT scanner for those skeletal elements capable of fitting in the aperture of a standard system; a light-source surface scanner for the sacrum and pubes; and a large industrial CT scanner for other large bones, including the massive skull. In all cases, bones from a research-grade cast were used to avoid not only stressing the actual fossil, but also taking them off exhibit. The CT results were converted to surface files. The final phase was to take these individual models and place them over their corresponding element in the area scan from Phase 1. Once in place, the area scan itself was removed and a final product produced of a whole skeleton made up of independent elements that can now be used for detailed functional work, animation, and those other products. This virtual skeleton is made up of models that are greatly reduced in resolution from the scanned models to facilitate the composite work. However, the high-resolution models are more useful for more detailed scientific study and reproduction using prototyping.

**Poster Session III (Friday, November 4)**

**THE SKULL OF THE SOLEMYDIDS TURTLE *HELOCHELIDIA NOPSCAI* FROM THE EARLY CRETACEOUS OF THE ISLE OF WIGHT, UNITED KINGDOM, AND THE GLOBAL BIOGEOGRAPHY OF SOLEMYDIDS TURTLES**

CHAPMAN, Sandra, The Natural History Museum, London, United Kingdom; JOYCE, Walter, University of Tubingen, Tubingen, Germany; MOODY, Richard, Kingston University, Kingston-upon-Thames, United Kingdom; WALKER, Cyril, The Natural History Museum, London, United Kingdom; CERDA, Ignacio, CONICET-INIBIOMA, Neuquén, Argentina; PAULINA CARABAJAL, Aranzadi, CONICET-Museo Carmen Funes, Puerto Madryn, Argentina; SALGADO, Leonardo, CONICET-INIBIOMA, Neuquén, Argentina; CORIA, Rodolfo, CONICET-Museo Carmen Funes, Plaza Huincul, Argentina; MOLY, Juan, Museo de La Plata, La Plata, Argentina

Solemydidae is a poorly understood clade of fossil turtles known from the Late Jurassic to Late Cretaceous of North America and Europe. Remains of these turtles have traditionally been so fragmentary that the close relationship between European and North American forms was only recently recognized. A beautifully preserved skull referable to *Helochelyda nopscai* from the Barremian Wessex Formation of the Isle of Wight, England, represents the first known skull of a European solemyd and provides first insights into the cranial anat- omy of solemydid turtles. The cranium is characterized by a unique combination of traits,
including a greatly reduced dorsal exposure of the prefrontal, pterygoids that ventrally cover the basisphenoid, and fully confluent inner and middle ear cavities. A phylogenetic analysis places Heloclychyla nocpsae close to Mongolocyclus efremoni, Meloania platyceras and Kallollobodon baji. jazid just outside crown Testudines, but the interrelationships of these four taxa cannot be resolved with confidence. A review of the literature and of fossil material housed in public collections indicates that solenemydids are known from the Late Jurassic (Tithonian) to Late Cretaceous (Maastrichtian) of Europe. The holotype of the North American taxon Naomichelys speciosa was erroneously reported from the Late Jurassic (Tithonian) Morrison Formation of Montana, but actually originates from the Lower Cretaceous (Aptian) Kootenai Formation. The known record of North American solenemydids is therefore restricted to the Aptian to Campanian.

Technical Session X (Friday, November 4, 9:00 am)

ABROREALITY IN PALAECHTHONID PLESIADAPIFORMS (MAMMALIA, PRIMATES): NEW EVIDENCE FROM A PARTIAL SKELETON OF EARLY PALEOCENE TORREJONIJA WILSONI FROM LATE EOCENE MARINE STRATA OF FAYUM, EGYPT, AND A REEVALUATION OF CORDICHELYS ANTIQUA

CHERNEY, Michael, University of Michigan, Ann Arbor, MI, USA; GINGERICH, Philip, University of Michigan, Ann Arbor, MI, USA; WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA; ZALMOUT, Iyad, University of Michigan, Ann Arbor, MI, USA; ANWAR, Mohammed, Egyptian Environmental Affairs Agency, Cairo, Egypt

Podocnemidid side-necked turtles are represented by only three living genera, Podocnemis and Pelomedusidae from South America, and Erymnochelys from Madagascar. Fossil members of the group are significantly more diverse and widespread and include the Shwebe- my Group taxa, which are known from the Tertiary of northern Africa, southern Asia, north- ern South America, southeastern North America, and the Caribbean. Shwebemys-group podocnemids possess a secondary palate structure that is unique among turtles. It consists of small flaps, each formed by the maxilla and palatine, that are separated by the parasymphysis, a thin layer and the large hollow spaces (bigger than normal osteocytes) in the deepest lamellar bone. With high-resolution synchrotron data, the three-dimensional architecture of Shwebemys tooth cushions can be reconstructed. The absence of the enamel layer and the large hollow spaces (bigger than normal osteocytes) in the deepest lamellar layer, confirms the assignment of the scanned specimen to Shwebemys. The denticles look more or less irregularly distributed in external view, but internally there are large parallel vessels running along rows of denticles, which can be used to trace their mode of growth. The histological reconstruction of vascularization presented here, therefore, provides insight into early gnathostomes tooth patterning and can be further incorporated into a more comprehensive analysis of early gnathostomes phylogeny.

Technical Session VIII (Thursday, November 3, 2:30 pm)

A PHYLOGENETIC EVALUATION OF SEQUENCE HETEROCHRONY IN AMPHIBIAN SKULL DEVELOPMENT

CHEN, Donglei, Uppsala University, Uppsala, Sweden; BLOM, Henning, Uppsala University, Uppsala, Sweden; AHILBERG, Per, Uppsala University, Uppsala, Sweden

Lophosteus superbus from the Late Silurian of Estonia is one of the oldest and most basal osteichthyan taxa known so far. Unfortunately, it has exclusively been documented by detached and fragmented dental microremains, and the affinity of Lophosteus has been controversial. It has been placed basal to both actinopterygians and sarcopterygians, as well as ambiguously linked to either placoderms or acanthodians. Recently, however, the diagnostic characters of actinopterygians and sarcopterygians have been questioned, and even the monophyly of placoderms and acanthodians have been challenged. As a possible stem osteichthyan, Lophosteus is in a central position to increase our understanding of early gnathostome evolution and the origin of the osteichthyan body plan. Tooth cushions are among the best-preserved elements of Lophosteus, even though they have not been described properly. These tooth-bearing arched ossicles could arguably be homologous with the parasymphysis of both whorls in chondrichthyan, acanthodians, sarcopterygians and even the pararapophysial tooth plates in tetrapodomorphs. With high-resolution synchrotron data, the three-dimensional architecture of Lophosteus tooth cushions can be reconstructed. The absence of the enamel layer and the large hollow spaces (bigger than normal osteocytes) in the deepest lamellar layer, confirms the assignment of the scanned specimen to Lophosteus. The denticles look more or less irregularly distributed in external view, but internally there are large parallel vessels running along rows of denticles, which can be used to trace their mode of growth. The histological reconstruction of vascularization presented here, therefore, provides insight into early gnathostomes tooth patterning and can be further incorporated into a more comprehensive analysis of early gnathostomes phylogeny.

November 2011—PROGRAM AND ABSTRACTS
biased by variation in (1) the total spatial extent of samples, (2) the size of sampling units (in
the case of sample-based rarefaction) and (3) time-averaging. Spatially constrained rarefac-
tion (SCR) was recently proposed to mitigate the effects of spatial variation on sample-based
rarefaction. In this method, adjacent sampling units are combined within standardized areas.
We adopted this method of rarefaction by using Geographic Information Systems (GIS) and
apply it to both types of rarefaction analysis. We used GIS to arrange 439 digitized fossil
mammal localities (>33000 specimens, 142 species) from the Willwood FM of the central
Bighorn Basin in Wyoming. The localities were grouped into 17 100Kyr intervals, six of
which fell within a cool period, followed by 11 intervals from an immediately subsequent
warm period (5-8°C warmer MAT) divided into early (6) and late (5) warm intervals.
Clusters of localities within a 3Km area in each interval were identified as subsamples for
rarefaction. Previous analysis of all data had identified an increase in richness from the cool
to the warm period and a subsequent decline related to increasing dominance of the
fauna by a few taxa. The individual-based SCR analysis found little change in richness
from the cool to the warm period, although the subsequent decline is still present. We interpret
the present (all-data) pattern as an artifact of the species-area relationship (richness estimate-
interval area correlation coefficient=0.58, p=0.016). Although there is no consistent shift in
locality richness, the sample-based SCR analysis may yet be influenced by random variation
in sampling unit size. Large-scale differences between sample-based and individual-based
rarefaction estimates show that beta diversity (species distribution heterogeneity) increased
during the early part of the warm period, whereas overall richness did not.

Poster Session IV (Saturday, November 5)
TAPHONOMY OF A NEW CENTROSAURUS BONEBED FROM THE OLDMAN
FORMATION (CAMPUSSAURUS) OF SOUTHERN ALBERTA, A COMPARI-
ON ACROSS FORMATIONS AND TIME

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Yoshitugu, Hokkaido University Museum, Sapporo, Hokkaido, Japan; RYAN, Michael,
Cleveland Museum of Natural History, Cleveland, OH, USA; EVANS, David, Royal Ontario
Museum, Toronto, ON, Canada; BROWN, Caleb, University of Toronto, Toronto, ON,
Canada
High-density monodominant bonebeds of Centrosaurus apertus are common in the Dino-
saur Park Formation (DFP) of Alberta, occurring in nearshore, low coastal plain environ-
ments, but are extremely rare in the underlying, relatively drier, Oldman Formation (OF)
of the South Lethbridge Group. The Dino- saur Park Formation is the most completely known and thoroughly described Palaeozoic actinopteryg-
ian of the world, providing a unique window into Late Devonian vertebrate anatomy and diversity due to exquisite fossil preservation
with multiple ontogenetic stages represented (approximately 50% shows juvenile and subadult stage).

The remaining 10% include theropod teeth (mostly tyrannosaurid), freshwater vertebrates,
and hadrosaurid bones, in descending order of abundances. All ceratopsian specimens are
dissected; tooth-marks and the presence of shed theropod teeth suggest that the
carcasses were scavenged. Dominance of slightly abraded specimens (stage 1 ~ 60%)
and poorly-oriented alignments of long bones, indicate that these elements were transported
and deposited by a low velocity current. Ubiquitous wet rot features, with a lack of subaerial
weathering, indicate that the bones were deposited in humid or subaqueous conditions before and/or after the final burial event.
Regardless of the different depositional environments of the OF and DPF under which they were
formed, the sedimentological and taphonomic features (e.g., age classes and abrasion)
of the Centrosaurus bonebeds from both formations are very similar suggesting that similar
taphonomic processes occurred within a tightly constrained time interval over a regional
scale, independent of formation. Although the bonebeds were probably derived from the local
flooding events, Centrosaurus can be inferred to have to have moved in large herd-like
groups across a regional scale.

Poster Session III (Friday, November 4)
LIFE HISTORY OF THE EARLY CRETACEOUS BIRD CONCUFICUSORNIS: A
HISTOLOGICAL PERSPECTIVE

CHIANGSANSY-TURAN, Anusuya, University of Cape Town, Cape Town, South Africa;
MARUGAN-LOBON, Jesus, Unidad de Paleontologia, Madrid, Spain; CHIAPPET, Luis,
Natural History Museum of Los Angeles County, Los Angeles, CA, USA
Over the past decade hundreds of the basal pygostylian bird Concu ficusornis sanctus have
been recovered from the Early Cretaceous of Northeastern China. The specimens exhibit
remarkable variation in size and plumage. Traditionally specimens with long, ornamental
rectrices were interpreted as males and those without them as females. Morphometric data has suggested a lack of correlation between the presence/absence of these feathers and
size—they occur in specimens belonging to the two size clusters demarcated by morpho-
metric data. While such distribution did not exclude the possibility of these feathers being a
sexual trait, such variation suggests a more complex phenomenon. Here we investigate the
microstructure of long bones (e.g., femora, tibiae, humeri and ulnae) of ten different sized
individu als of Concu ficusornis to assess life history patterns. In addition we examine multiple
bones from single skeletons of C. sanctus to assess skeletal variation, as well as multiple
bones from individuals which show obvious differences in plumage. Our results demonstrate
variations in terms of histological characteristics such as bone texture, extent of vasculari-
zation, presence of growth marks, and endosteal resorption and bone deposition. We document these histological features across the different age-classes to assess how they relate to ontog-
ey, as well as sexual variation within C. sanctus. On the basis of the histological
data derived from this study of multiple individuals of different sizes we deduce a growth
trajectory for Concu ficusornis. Our results also address the question of whether the presence
of osteoderms underscores sexual dimorphism or different (cryptic) species.

Technical Session XIV (Saturday, November 5, 11:15 am)
THE ANATOMY OF THE PARVICURSORINE BRAINCASE AND ITS
IMPLICATIONS FOR ALVAREZSAUROID SYSTEMATICS AND EVOLUTION

CHINIERI, Jonas, American Museum of Natural History, New York, NY, USA; NORELL, Mark, American Museum of Natural History, New York, NY, USA; DYKE, Gareth, University College Dublin, Dublin, Ireland
The relationships of the theropod clade Al ve razsauroidae have been contentious, with early
research suggesting a derived position for the group within Avialae and more recent research
suggesting a position for alvarezsauroids outside of Avialae as the basal taxon in Mani-
raptorina. Members of the Parvicurinae, a derived group of alvarezsauroids, are becoming
increasingly well-known from Late Cretaceous deposits of North America and Asia. Parvi-
curinae are remarkable in sharing many features of the skull and postcrania l skeleton with
avialans. These features are explained as homoplasies in hypotheses that posit a basal position for alvarezsauroids within Maniraptorina. Relatively little is known about the comparative
anatomy of the parvicursorine braincase, even though this is a rich area for phylogenetic
data. We examined the anatomy of the parvicursorine braincase by taking high-resolution
CT scans of three of the five known skulls for the group. Digital reconstructions of endo-
casts and the braincase bones from these scans, coupled with information from a partial skull
that preserves the braincase roof, reveal many features that are potentially homologous with
those of more derived maniraptorans, especially birds and troodontids. These features in-
clude an enlarged fl occular recess, medial expansion of the vertical semicircular canal, infla-
tion of the ventral surface of the basioccipital, and position of the vestibulocochlear nerve
openings within a bowl-shaped recess that is located proximal to the fl occular recess. These
data suggest either a more derived position for parvicursorines within Maniraptorina, such that
Alve razsauroidae is polyphyletic, or that the homomorphic features shared by parvicursorines
and avialans extend to characteristics of the braincase, in addition to the dental bones of the
skull and the postcranial skeleton.

A TALE OF TWO “MIMIA’S”, A NEW BASAL ACTINOPTERYGYIAN FROM THE
LATE DEVONIAN GOGO FORMATION, WESTERN AUSTRALIA

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Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing,
China
The famous Gogo Formation of northwestern Western Australia provides a price less window
into Late Devonian vertebrate anatomy and diversity due to exquisite fossil preservation
within calcareous nodules. “Mimia” toombsi (currently a preoccupied genus) from the Gogo
Formation is the most completely known and thoroughly described Palaeozoic actinopteryg-
ian, with the anatomy of this taxon underpinning many recent analyses into the interrela-
tionships of early o stechin thians. During the 2005 Museum Victoria expedition to the Gogo Formation, the author discovered a
nearly complete fossil fish at Bugle Gap (Mount Pierre Station) that closely resembled
“Mimia” toombsi, but with clear differences in squamation and body shape. A subsequent
examination of fossil actinopterygians within Australian and British collections produced
additional examples of the new form. It has become apparent that material previously figured as
M. toombsi incorporates two distinct species of basal actinopterygian, although similar
enough to be considered congeneric.
The new species of “Mimia” is known from at least 13 prepared specimens. It differs from
M. toombsi in details of the snout, skull roof, parasphe noid, squamation and body shape. However, the anatomy of the neurocranium, branchial chamber and lower jaw are indis-
tinguishable between the two species. A phylogenetic analysis of early actinopterygians
resolves Gogosarda as the sister taxon to the two “Mimia” species. The discovery of the
new “Mimia” species, along with other higher diversity basal actinopterygians in the Gogo assemblage than in any other Devonian fauna and indicates that northwest-
ern Australia was an early centre of diversification for the ray-finned fishes.

MAMMALIAN COMMUNITY CHANGE IN THE PALEOCENE OF NORTH
AMERICA

CHRISTENSEN, Hilary, The University of Chicago, Chicago, IL, USA
The extinction event at the K/T boundary was responsible for the demise of most terrestrial
vertebrates larger than a kilogram. The subsequent radiation of mammals into herbivorous
niches recently vacated by the dinosaurs is a well-known phenomenon, reflected in a general
body size increase and the adaptation of dentitions to the shearing forces that the breakup

Poster Session III (Friday, November 4)

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of tough plant matter requires. However, the timing and nature of this transition has not yet been evaluated: tooth morphology has been used to suggest fruit feeding, but that is at odds with the body sizes and would suggest ecosystems radically different from anything found today.

The implication of this hypothesis is that body sizes increased prior to the invasion of mammals into high-fiber dietary niches, resulting in communities that have no modern analogs before this transition occurred. The timing and nature of mammalian dietary evolution in the Paleocene was investigated using low-magnification microwear techniques and geometric morphometrics to identify fragmentary specimens of other fossil taxa, therefore a pilot project was initiated to change from closed-canopy Paleocene rainforests to more open vegetation. These results suggest that Paleocene mammalian communities were strongly influenced by their environment, not resorting to browse consumption until the Paleocene rainforest fruit-fall became unavailable.

Technical Session II (Thursday, November 3)

IDENTIFICATION OF FRAGMENTARY LATE PLEISTOCENE MUSTELOIDS THROUGH MORPHOMETRIC ANALYSES

CHRISTINE, Joel, Department of Biological Sciences, Don Sundquist Center of Excellence in Paleontology, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, Department of Geosciences, Don Sundquist Center of Excellence in Paleontology, East Tennessee State University, Johnson City, TN, USA

Previous studies of Guy Wilson Cave (GWC) in Sullivan County, Tennessee revealed an abundance of late Pleistocene large mammal fossils, mostly herbivores such as deer and the evaluation of an animal’s herbivorous guild (grazer, browser, hard-object feeder) more precisely than is usually possible by analyzing tooth shape alone. Although the Paleocene saw a huge radiation of mammalian diversity in terms of taxonomy, results show that this trend did not extend to their diets. There was an initial transition from predominantly insectivorous communities in the Cretaceous to hard-object-feeding dominance in the Puercan; communities remained hard-object dominant through the Paleocene, however, even as both taxonomic breadth and size diversity increased. Evidence of prominent leaf-browsing does not appear until the Wasatchian, when a general drying trend in the Western interior triggered a change from closed-canopy Paleocene rainforests to open evergreen vegetation. These results suggest that Paleocene mammalian communities were strongly influenced by their environment, not resorting to browse consumption until the Paleocene rainforest fruit-fall became unavailable.

Posters Session I (Wednesday, November 2)

NEW INFORMATION ON TRIBOSPHENIC MAMMALS FROM THE CLOVERLY FORMATION, MONTANA AND WYOMING

CIFELLI, Richard, University of Oklahoma, Norman, OK, USA; GORDON, Cynthia, University of Oklahoma, Norman, OK, USA

In North America, the best-represented Aptian-Albian (Early Cretaceous) mammalian fauna is that of the Trinity Group, Texas and Oklahoma. Occurrences have been reported from other units, most notably the Clovery Formation, Wyoming and Montana, which has previously yielded remains of Gobiconodon, an undescribed large mammal, two triconodontids, a spalacotheriid symmetrodont, and the tribosphenidan Montanalestes. Herein we report additional tribosphenic mammals from the Clovery Formation, known by a mixture of fragmentary and relatively well preserved specimens obtained through surface prospecting, quarrying, and underwater sand-washing. At least four taxa of stem tribosphenidans are represented by fragmentary teeth that add to known diversity but are not otherwise informative. We provide additional details on Montanalestes, which we regard as a stem tribospheni- dan, including contralateral variation in molarization of premolars, presence of a large labial mandibular foramen, and unusual development of the angular process. Two metatherians are represented by partial dentaries. One, almost edentulous, provides earliest documentation of the full metatherian dental formula (i4, c3, p3, m4); the other, known by p2-m3, has rather advanced molars morphologically, including reduced height differential between trigonid/ talonid and full twinning of hypocoelid-entoconid. Eutherians may have been present in the Early Cretaceous of North America but are not readily identified as such; by contrast, metatherians appear to have been well established on the continent by the Aptian-Albian.

Technical Session II (Wednesday, November 2, 2:00 pm)

A PROCOLOPHONID PARAREPTILE FROM THE TRIASSIC OF AUSTRALIA

CISEROS, Juan, Centro de Ciências da Natureza, Universidade Federal do Piauí, Teresina, Brazil; HAMLEY, Tim, University of Queensland, Brisbane, Australia; DAMIANI, Rossano, Department of Zoology, La Trobe University, Melbourne, Australia

Parareptiles are one of the most diverse groups of terrestrial amniotes that lived during the Peramian and the Triassic periods. The Procolophonidae is the most speciose clade within the Parareptilia, and their members are known from all continents. Despite being reported in Australia in the 1970s, the remains of procolophonids from this continent have not been described yet. The specimens under consideration were collected from two localities, namely Duckworth Creek and ‘The Crater’, both in the state of Queensland, in rocks of the Arcadia Formation, a geological unit that produces a Lyrostaurus age fauna (Lower Triassic). The Australian taxon is known from some 40 individuals comprising both cranial and postcranial material, and even a few articulated skeletons. All of the remains can be ascribed to a single, new species. The new taxon is rather small (skull length < 35 mm) and relatively gracile in comparison with well known forms like Procolophon trigonceps or Hypognathus fen- neri. It also lacks the quadratojugal spines that are characteristic of these species. The new procolophonid features six to seven upper blunted monicuspid teeth that are circular in basal cross-section; a very low number in comparison with other procolophonids and owenettids that possess monicuspid teeth. A phylogenetic analysis places the Australian taxon within the recently recognized clade Thelodectinae, composed by Thelodectes perforatus from South Africa and Euomomops dongensis from north China. The new taxon is the only tetrapod shared between Duckworth Creek and ‘The Crater’ sites in Australia, thus, providing evidence for a direct correlation between these localities. The relationships of the Australian procolophonid suggest that procolophonid dispersal took place between South Africa and China through Australia during the Triassic.

Posters Session I (Wednesday, November 2)

WHAT THE HAKE? NEW SPECIMEN OF AN EXTINCT GADIFORM FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTICA

CLAESON, Kerin, Ohio University, Athens, OH, USA; EASTMAN, Joseph, Ohio University, Athens, OH, USA; MACPHEE, Ross, American Museum of Natural History, New York, NY, USA

An isolated partial left dentary (BAS D515.2) collected by the British Antarctic Survey prompted a reevaluation of gadiform remains from the La Meseta Formation (conventionally Middle Eocene) of Seymour Island (Antarctic Peninsula). Modern gadiforms range from the Arctic to the Antarctic, inhabiting deep or shallow, benthic, pelagic marine, and fresh waters. Included among these fishes are the hakes (e.g., Merluccius) and cods (e.g., Gadus). Based on a fossil record primarily composed of otoliths, they are known to extend back to the Eocene (hakes) and Oligocene (cods). The new specimen was recovered on the eastern side of the island, thus in the uppermost part of the La Meseta. It is characterized by a single row of sharp, ankylosed teeth set upon robust bony pedicels, consistent with the type-1 tooth replacement found in Merluccius. Between each tooth is a deep cavity that is marked by several small pores. The symphysial process is smooth on the articular surface and it is irregularly lingual to the articular facet. There is minimal sculpturing on the lateral surface of the dentary; how- ever, the surface anterior to the mental foramen exhibits ascending and descending ridges with slightly rugose texture. The ascending ridge is fractured, but partially covers the lateral November 2011—PROGRAM AND ABSTRACTS
aspect of the tooth row. The rest of the lateral wall is convex and increases in dorsoventral extent from anterior to posterior. A smooth medial wall projects past the ventral margin of the lateral wall. A deep mandibular sensory canal is located between the walls on the ventral surface of the dentary. BAS D515.2 is unlike the dentary of macroradial gastids, a feature recently recovered from the Eocene of Antarctica. BAS D515.2 does preserve several features similar to previously published accounts of the gastid “Mesostomites” from Seymour Island. These species are likely the same taxon and their combined character suite indicates it is a member of Merluccidae. Thus, these are the only non-otolithic skeletal specimens of an Eocene hake known outside of the London Clay taxon Rhinocephalus.

Poster Session I (Wednesday, November 2)

A REEVALUATION OF THE GENUS ORNITHOMIMUS BASED ON NEW PREPARATION OF THE HOLOTYPE OF O. VELOX AND NEW FOSSIL DISCOVERIES

CLAESSENS, Leon, College of the Holy Cross, Worcester, MA, USA; LOEWEN, Mark, Utah Museum of Natural History, Salt Lake City, UT, USA; LAVENDER, Zachary, College of the Holy Cross, Worcester, MA, USA

The theropod genus and species Ornithomimus velox was erected in the late 19th century based on a distal tibia and partial pes (YPM 542) and a partial manus (YPM 548) from the Maastrichtian Denver Formation in Colorado. The family Ornithomimidae was erected at the same time, based on O. velox and two other extremely fragmentary specimens now considered a nomen dubium (O. tenuis) and a tyrannosaurid (O. grandis). Currently only one other valid species is recognized in the genus Ornithomimus: O. edmontonensis. The original description of O. velox differs from the preserved material, in which reconstructed the metatarsals were figured, and manual phalanges were not described. Further preparation of the holotype, fully freeing pes and manus from the matrix for the first time in over a century, allowed the examination of bone surfaces that were previously obscured. Similar to O. edmontonensis, but different from other ornithomimid genera, metacarpal (MC) I of O. velox is slightly longer than MC II, which in turn probably was slightly longer than MC III, based on our reconstruction of the missing proximal end of MC III. Both the manus (YPM 548) and the pes (YPM 542) of O. velox are about two-thirds the length of the type specimen of O. edmontonensis NMC 8632. The pes of O. velox is relatively robust, however, a condition usually not observed in juvenile theropods, which tend to have a relatively thin and elongate metatarsus. In addition, metatarsal (MT) II is longer than MT IV, a condition that is usually not observed in juvenile theropods, which tend to have a relatively thin and elongate metatarsus. The rest of the lateral wall is convex and increases in dorsoventral extent from anterior to posterior. A smooth medial wall projects past the ventral margin of the lateral wall. On the proximal tail, the largest tubercles are dorsal, whereas they are ventral on the distal tail. These tubercles are nearly identical to other hadrosaurid skin impressions from the Neslen and Kaiparowits formations of Utah, but scollop tubercle edges are absent in Edmontosaurus from Montana and Wyoming.

Poster Session I (Wednesday, November 2)

CHEMICAL AND MORPHOLOGICAL REINVESTIGATION OF THE DINOSAUR HEART

CLELAND, Timothy, North Carolina State University, Raleigh, NC, USA

In 2000, computed tomographic (CT) data were used to suggest the preservation of a four chambered heart in the thoracic cavity of a well preserved specimen of Thescelosaurus neglectus (NOMC 15723). This diagnosis was challenged by others without direct access to the specimen; but it was clear this claim needed further investigation. The specimen was re-investigated to test competing hypotheses of a biological (e.g. heart) or geological (e.g. concretion) origin to this structure. I coupled a full body and ‘heart’ specific morphological examination, using a 5x greater resolution CT, with additional techniques including histology and elemental analyses. These new data reveal structural features of the thoracic structure that do not support the original identification of a cardiac origin, and x-ray diffraction (XRD) analysis on a small block of the ‘heart’ showed that the composition of the structure was typical of a goethite-cemented immature sandstone. X-ray photoelectron spectroscopy (XPS) analyses on a powdered sample taken from the ‘heart’ wall showed no nitrogen or carbon associated with this sample, ruling out the presence of any organic material. Light microscopy and scanning electron microscopy (SEM) were congruent with the XRD and XPS data, and favored the diagnosis of an iron-cemented sandstone of geologic origin. However, intriguingly, several small, non-geologically derived polygonal structures, that resemble either plant cuticle or vertebrate endothelial cells, were identified between sand grains. These patterns are not consistent with a strictly geologic origin, but require further investigation to determine their origin. These polygonal microstructures also show microscale chemical differentiation, determined using energy dispersive x-ray spectroscopy under SEM, from the ‘membrane’ to the ‘nucleus’ that suggest chemical sequestration and microchemical differences that support a biological origin for these structures. Overall, the data support a geologic origin for the thoracic structure.

Technical Session XIX (Saturday, November 5, 3:45 pm)

REDUCED MERIDIONAL GRADIENT IN EOCENE SEA WATERS INFERRED FROM THE STABLE ISOTOPE COMPOSITION OF FOSSIL SIRENIAN TOOTH ENAMEL

CLEMENZ, Mark, University of Wyoming, Laramie, WY, USA; SEWALL, Jacob, Kutztown University, Kutztown, PA, USA

The Early to Middle Eocene was an interval of extreme climatic warmth. Though mean sea surface temperatures (SST) were elevated globally at this time, temperature proxies suggest that high latitudes warmers more than the tropics, producing a reduced meridional SST gradient. However, due to variation in tropical temperature proxies and numerical simulation results, debates regarding this inter-tropical gradient exists. Stable oxygen isotope values from sirenian fossils can be used to reconstruct latitudinal temperature gradients as enamel δ13C values for sirenians reflect the carbon isotope composition of their diet, which, for individuals favoring marine habitats, consists largely of seagrasses. Due to the increased solubility of CO2 at lower temperatures, modern seagrasses δ13C values are negatively correlated with latitude; given this relationship, sirenian enamel δ13C values should decline more rapidly with latitude during times with a large meridional SST gradient and less rapidly with a reduced gradient. Here we test this hypothesis by comparing enamel δ13C values for Palaeogene and Neogene sirenian species (manatees, dugongs) recovered from part of the Atlantic Ocean and former Tethys Sea (paleolatitudes from 10 to 55°N).

Enamel δ13C values for 148 fossil and modern sirenian specimens were compiled from published and newly analyzed data. Eocene-aged specimens (n = 28) were sampled over paleolatitudes from 10.6 to 42.5°N, but showed no significant difference in enamel δ13C values for specimens sampled from low (≤ 30°N) or higher (> 30°N) latitudes (Student t
Dental patterning was compared between small-sized criteria of the dental elements has been used to hypothesize developmental stages. Although partial developmental sequence composed of “hatchlings” and adults; however, only the size dentary tooth plates) of the Late Devonian sil taxa, disarticulated dental material (rostral, vomerian, entopterygoid, prearticular and Neoceratodus dipnoans (of patterning events for the dental system of dipnoans has been partly described for living SST gradients were reduced during the Eocene and did not approach present conditions until at least the Oligocene.

Poster Session I (Wednesday, November 2)

DEVELOPMENTAL CONSERVATISM IN THE DENTAL SYSTEM OF THE LATE DEVONIAN DIPNOAN, SCAMENENACIA CURTA (SARCOPHYTIDIUM) CLOUTIER, Richard, Université du Québec à Rimouski, Rimouski, QB, Canada; BÉCHARD, Isabelle, Université du Québec à Rimouski, Rimouski, QB, Canada Dipnoan dentition is characteristic among gnathostomes and corresponds to a unique combina- tion of odontogenic and odontoclastic developmental processes. Developmental events of patterning events for the dental system of dipnoans has been partly described for living dipnoans (Neoceratodus and Protopterus) and some rare Paleozoic taxa. Among these fos- sil taxa, disarticulated dental material (rostral, vomerian, entopterygoid, prearticular and dentary tooth plates) of the Late Devonian Andreyeviceichthys has been used to reconstruct a partial developmental sequence composed of “hatchlings” and adults; however, only the size criteria of the dental elements has been used to hypothesize developmental stages. Although dental patterning was compared between small-sized Andreyeviceichthys and larval Neocerato- dus, little is known on the early and transitional ontogenetic stages and the precise identifica- tion of respective life cycle stages [i.e., embryonic, larval (hatching), juvenile, adult and senescent]. A relatively complete fossilized ontogeny (including larval, juvenile, adult and senescent stages) based on complete specimens of the Late Devonian Scamenenacia curta al- lowed us to reconstruct a developmental sequence of dental events as well as to calibrate this sequence with the development of the remaining anatomy of the fish. Larval Scamenenacia bear entopterygoid and prearticular tooth plates. Teeth associated to the premaxillae, vomers and dermopalatines are added at the juvenile stage. As expected odontogenic patterning proceeds by tooth and row addition without resorption from larval to senescent stages. Rela- tive simultaneity of tooth addition in the rows of the tooth plates is documented allowing the identification of growth profiles. In contrast to Andreyeviceichthys, peripheral bands of enamel are absent in all stages, but peripheral denticles of enamel are added in juvenile, adult and senescent stages. Developmental events associated to the dental system of dipnoans are re- framed and developmental conservatism is pushed backward some 20 million years (from the Famennian to the Frasnian).

Technical Session IX (Friday, November 4, 9:15 am)

RE-EXAMINATION SHOWS THAT SINEOAMPHISBAENA HEXATABULARIS IS A MICRO-TEIID (GYMNOPTHALMIDAE, SQUAMATA), NOT AN ABERVANT AMPHISBAENIAN DIPNOAN ANATHEUS-DIONTI CONRAD, Jack, New York College of Osteopathic Medicine, Old Westbury, NY, USA Sineoamphisbaena hexatabularis, a Late Cretaceous squamate from Inner Mongolia, was originally identified as the basal member of Amphibienia. Subsequent re-appraisal of Si- neoamphisbaena revealed support for its inclusion in the teiid clade Polyglyphanodontidae based, in part, on the perceived presence of a large postorbital extending posteriorly beyond the supratemporal fenestra, and a frontal with subequal anterior and posterior border widths. Importantly, all analyses of Sineoamphisbaena interrelationships have been based on the morphological interpretations put forth in the original description. Re-examination of the type specimen of Sineoamphisbaena hexatabularis revealed that many previously identified suture are actually cracks; the actual cranial sutures are very subtle and the species is less aberrant than previously thought. The lacrimal is similar to that of most squamates, being relatively small and limited to the orbital margin rather than extending onto the dorsal skull roof. The maxilla possesses a dorsal snout exposure and underlies the jugal postcranially. The postorbital is absent, and the postfrontal is limited to the orbital margin, whereas the supratemporal is expanded anteriorly with a broad jugal contact. Preliminary analysis of 258 lepidosauromorph taxa (along with nine outgroups) scored for 813 morpho- logical characters indicates that Sineoamphisbaena hexatabularis is a member of Gymn- ophthalmidae (TNT analysis; New Technology Search of 50 replications recovered 4 most parsimonious trees) based on the shared presence of blunt, rounded snout, bipartite occipital condyles, and a postlaterally expanded frontal. Gynnothalamidinae previously had no fossil record and the fossil record of Teiidae proper (exclusive of Polyglyphanodontidae) is very limited. Sineoamphisbaena demonstrates that gynnothalamids had begun to diversify by the Late Cretaceous and were present in Laurasia.

Poster Session II (Thursday, November 3)

NEW DINOSAUR-DOMINATED TRACKSITES IN LATE JURASSIC AND EARLY CRETACEOUS OF SOUTHERN TUNISIA CONTESSI, Michela, Alma Mater Studiorum Bologna University, Bologna, Italy; FANTI, Federico, Alma Mater Studiorum Bologna University, Bologna, Italy; BATTINI, Gabriele, Office National des Mines, Tunis, Tunisia Three new dinosaur-dominated footprint assemblages are found in the Continental Inter- calaire deposits of Southern Tunisia. All footprints occur in calcareous strata representing coastal environments where early dolomitization initiated preservation of the footprint. Late Jurassic (Oxfordian) strata exposed near the village of Ghomrassen preserve approximately 200 footprints, the oldest evidence of a dinosaur fauna in Tunisia. Footprints occur over an area of approximately 130 square meters. Although the majority of impressions are poorly preserved, most are tridactyl (average 28 cm long and 20 cm wide) and can be referred to theropods. The second locality, near the village of Chenini, is early Cenomanian; 21 manus (less than 20 cm long) and pes (less than 30 cm long) impressions attributable to mid-sized theropods are preserved on the surface of 5 isolated blocks. These footprints are nearly identical to those reported from coeval tracks from the Apulian Platform in southern Italy suggesting a possible connection of these landmasses during the early Cretaceous. A third and younger Cenomanian site located only a few km east of the Chenini locality contains the most diverse and best-preserved footprints assemblage. The track-bearing surface records more than 90 footprints diagnostic to ichnogenera. The most abundant are mid-sized (less than 20 cm) theropod footprints. In addition, the footprints of at least one crocodylan and unusually small (no more than 2 centimeters long) birds have been observed. Such well-preserved tracks represent the first occurrence of birds in the Cretaceous fossil record of Tunisia. These new Tunisian footprint sites provide a unique and useful census of terrestrial associations along the southern margin of the peri-Mediterranean area during the late Juras- sic and mid-Cretaceous time.

Technical Session X (Friday, November 4, 11:00 am)

A NEW THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC APPROACH FOR DIETARY RECONSTRUCTION IN EXTINCT PLATYRRHINE PRIMATES FROM PATAGONIA, COLOMBIA, AND THE CARIBBEAN COOKE, Siobhan, Duke University, Durham, NC, USA Substantial samples of extinct platyrrhine primate are known from three major temporal and geographic regions: the Early Miocene sites of Patagonia, the Middle Miocene site, La Venta, in Colombia, and the Holocene sites in the Greater Antilles. This study explores the paleobiology of these primate communities through the analysis of functional dental mor- phology with an aim toward dietary reconstruction.

A new approach using three-dimensional geometric morphometrics is employed to explore the relationship between molar shape variation and diet in a sample of laser-scan generated models of lower second molars. Nine extant and sixteen extinct platyrrhine genera are exam- ined. Principal component analysis of twenty-three x, y, z coordinate landmarks describing the occlusal table and tooth sidewalks showed that dental relief was the main contributing factor to variation along the first axis. Discriminant function analysis (DFA) of PC 1 scores and centroid size accurately classified extant platyrrhines according to dietary preference 87.4% of the time; however, without centroid size, the successful classification rate was somewhat lower.

Within this framework, most of the fossil platyrrhines were predicted to have had a pre- dominantly frugivorous diet, but several taxa were classified as having a frugivorous/ insectivorous diet including the Miocene Neovenataea fields, Patastu magdaleae, and Lavernitana annectens, all from La Venta. Alouattinus, including the Laventana Stritonia taenioconis and the Cuban Paralouattus varonii, showed variable classification as either fru- givores or folivi/forugrives. Xenothrix mcgregori, from Jamaica, was classified either as a frugivo Probe or frugivo/omnivore. Dietary profiles across different extinct platyrrhine com- munities differed with the Patagonian and Caribbean forms showing less dental and dietary variation than the Late Miocene plato Mathematic community showed. The Patagonian sites have been heavily sampled for more than one hundred years, so sampling is thought not to be a factor, but the Caribbean primates remain relatively little known, thus rendering firm conclusions about the nature of this faunal community difficult.

Poster Session III (Thursday, November 3)

A SKULL OF MOROPUS (PERISSODACTYLA, CHALICOTHERIIDAE, SCHIZOTHERINAE) WITH AN ASSOCIATED LEFT MAXILLA FROM THE EARLY HEMINGFORDIAN OF NORTHWEST NEBRASKA, USA COOMBS, Margery, University of Massachusetts, Amherst, MA, USA; ROUNDS, Carolyn, University of Massachusetts, Amherst, MA, USA Complete skull remains of chalicotheres are relatively rare. In North America, Moropus elatus (late Arikareean) and Tyleocephalonyx skinneri (late Hemingfordian) are known from good skull material, and Moropus hollandi (late Arikareean) by a single skull. Generally speaking, early Hemingfordian chalicotheres have occurred as sporadic, fragmentary fossils that make it difficult to reconstruct whole animals or analyze relationships. More recently Bruce Bailey collected a large, unusually complete chalicotheria skull, now in the collections of the University of Nebraska State Museum, from Runningwater deposits in Cherry County, northern Nebraska. Dental morphology and the absence of a skull dome preclude reference to Tyleocephalonyx. The upper cheek teeth resemble those of M. elatus and M. hollandi, but differ in several ways. Upper molars, especially M2 and M3, are notably elongated, with an unusually long circular ridge extending posteriorly from the lingual side of the protocone. The upper canines (Mx, y, z) are very prominent. A particularly important aspect of this skull is the preservation in place of the delicate right premaxilla. Only one other premaxilla of Moropus has ever been described, that specimen being an isolated, less complete premaxilla attribut- able to M. elatus. The premaxilla of the Runningwater skull resembles that of M. elatus in general shape and in lacking the upper incisors and canine. It differs in being much shorter in proportion to the size of the rest of the skull, suggesting that the anterior snout of this animal projected less than its counterpart in M. elatus. M. elatus has well developed lower incisors and lacks a canine; the anterior lower jaw of this animal remains unknown. This skull may
Mammals evolved a stunning degree of phenotypic diversity in bone architecture in response to their occupation of extreme habitats (e.g., aquatic, aerial). To achieve powered flight, bats altered the architecture of their long bones by reducing mineral concentrations and altering cross-sectional geometries. Unfortunately, the bat transitional fossils that could illuminate how this important evolutionary transition occurred have not been found. To understand how this transition happened we need to look beyond the fossil record. This study aimed to quantify the differences in adult bone architecture of the short-tailed bat (Carollia) relative to terrestrial rodents (Mus, Peromyscus). By integrating microstructural analyses via nanoindentation tests with whole bone bending tests, as well as visualization of cross-sectional areas, this study offers the first thorough documentation of architectural differences in limb bones of aerial and terrestrial mammals. Nanoindentation tests revealed that the metacarpals of bats are 40% as stiff and 36% as hard as that of Mus. Whole bone bending tests revealed that the humerus of the bat and mouse are roughly equivalent in stiffness, however the bat radius was much more compliant, suggesting a decreased mineral content. Micro-CT scans showed that the humeral, femoral, and tibial cross-sectional geometries are equivalent in both Carollia and Peromyscus; however, distal bones of the bat displayed 8-40% larger medullary cavities compared to rodents. To determine how endochondral ossification differs between Carollia and Mus diaphyseal dimensions were measured. Results indicate that Carollia delays appositional ossification relative to Mus, but begins diaphyseal longitudinal growth earlier. At late fetal stages, Carollia rapidly elongates the diaphysis, a finding consistent with reports that most endochondral ossification occurs postnatally in bat forelimb bones. These findings further our understanding of the microstructural properties of chiropteran bone biology, and support the assertion that during its evolutionary history Carollia has altered its bone development and adult architecture relative to rodents.

The present study provides a high resolution magnetostratigraphic reference for the poorly known continental Early Eocene Epoch of North Africa, thereby allowing more precise faunal comparisons and correlations with other sections that could lead to a better understanding of the early Tertiary evolutionary history of mammals in Africa.

The phylogenetic relationships and evolutionary history of Lepidosirenian lungfishes has been extensively studied. However, many aspects of their evolution remain poorly understood. The present study provides a high resolution magnetostratigraphic reference for the poorly known continental Early Eocene Epoch of North Africa, thereby allowing more precise faunal comparisons and correlations with other sections that could lead to a better understanding of the early Tertiary evolutionary history of mammals in Africa.

The phylogenetic relationships and evolutionary history of Lepidosirenian lungfishes has been extensively studied. However, many aspects of their evolution remain poorly understood. The present study provides a high resolution magnetostratigraphic reference for the poorly known continental Early Eocene Epoch of North Africa, thereby allowing more precise faunal comparisons and correlations with other sections that could lead to a better understanding of the early Tertiary evolutionary history of mammals in Africa.
problematic fossils. Because Cenozoic lpidosoririd fossil material is known from only jaw and tooth plate elements, this study provides an expanded suite of morphological characters that allows for the apomorphic identification of both extant material and disarticulated fossil specimens in this morphologically complex group.

Poster Session III (Friday, November 4)  FINITE ELEMENT ANALYSIS OF CANONICAL DUROPHAGOUS TEETH CROFTS, Stephanie, University of Washington, Seattle, Seattle, WA, USA

Due to their highly mineralized nature, teeth are common in the fossil record, and the gross morphology of teeth is often used to infer the diet of organisms. Durophagous organisms have modified jaws and teeth that allow them to eat hard prey, and can be found in a number of lineages, both extinct and extant. One proposed explanation for the molariform tooth shapes associated with this lifestyle is that they are an adaptation that allows teeth to more effectively crush the hard shells of prey items. An alternative explanation for durophagous tooth morphology is that it allows for increased resistance to tooth breakage. In this study, we test the second of these hypotheses, and explore the effects of forces on teeth using finite element analysis (FEA). FEA is an engineering technique used to analyze the effects of forces on complex shapes. The program takes a complex shape subjected to a force, subdivides the shape into smaller simpler elements, and determines the effects of the force on the elements. Finally, the program re-integrates the elements, showing the effects of the force over the entire shape. We constructed three series of tooth models that graded from one morphological extreme to another. These morphologies varied the degree of convexity/concavity of the occlusal surface, as well as the radius and height of a centrally located conical stress concentrator. The tooth models were subjected to a variety of loading regimes, simulating different prey morphologies. We used maximum principal stress as an indicator of where on the tooth failure was most likely to occur, and which tooth forms are most likely to fail. We found that shallowly domed and cupped teeth are probably most effective at resisting breakage, and that there are functional limits to the shape of a central force concentrator. Our results demonstrated that effective tooth shape depends, in part, upon the size and shape of the prey item.

Poster Session III (Friday, November 4)  EGGSHELL THICKNESS VARIATION IN CHINESE EGGS CROGHAN, Jasmine, Montana State University, Bozeman, MT, USA; BARTA, Daniel, Montana State University, Bozeman, MT, USA; BRUNDRIDGE, Krista, Montana State University, Bozeman, MT, USA; DRONT, Jordan, Montana State University, Bozeman, MT, USA

Observation of approximately 200 dinosaur eggs from the Cretaceous Tiantai basin, Zhejiang Province, China, reveals substantial eggshell thickness variation within the presumed Spheroolithus sp. eggs. Examination and analysis of eggs in hand sample combined with radial thin sections of two eggshells with differing variation allowed investigation of two potential sources of variation in eggshell thickness across an egg: original egg morphology or postmortem taphonomic processes. Eggshell thickness changes laterally from 2.0 mm to 0.6 mm and back to 2.0 mm across one side of an egg, with upper and lower values of 2.6 mm and 0.3 mm, respectively, and a standard deviation of up to .51 mm in the data set; observation of thin sections indicate a likely .3 mm overestimate for thickness measurements taken in hand sample. The thinnest areas likely represent the top or bottom of the egg and result from local dissolution during early diagenesis, with some global dissolution taking place shortly thereafter. The consistency of this variation among different localities within the Tiantai basin remains unclear. Because eggshell thickness is commonly used to assign fossil eggs to an oospecies, distinguishing biologic from taphonomic attributes is important for assessing the diversity of oostegia in the Tiantai basin. The recognition of eggshell thickness variation as the result of a taphonomic process provides a non-empirical reference for explanation of sources of variation in the fossil record of eggs.

Technical Session X (Friday, November 4, 11:30 am)  STABLE ISOTOPES EXPLAIN ANACHRONISTIC PLANT DEFENSES IN MADAGASCAR CROWLEY, Brooke, University of Cincinnati, Cincinnati, OH, USA; GODFREY, Laurie, University of Massachusetts, Amherst, Amherst, MA, USA

The southern quadrant of Madagascar is home to a unique and diverse floral community dominated by spiny endemic plants, including the Didiereoideae, an endemic subfamily of the family Didieraceae. Spines are believed to have evolved in response to pressure from herbivores, but very few vertebrate species consume these plants today. Thus, spines can be viewed as anachronistic. The vertebrate community of Madagascar experienced a dramatic decline over the past 2000 years. Pygmy hippopotamuses, elephant birds, giant tortoises, and at least 17 species of large-bodied lemurs all vanished. Because elephant birds, tortoises, and hippopotamuses would not have been able to climb, the spines on tall trees cannot be viewed as defenses against such animals. Large extinct lemur species, on the other hand, are excellent candidates. To probe this further, we analyzed stable carbon and nitrogen isotope values of leaves collected from a broad spectrum of plant species and bone collagen from eight extinct lemur species.

The Didieraceae rely on Crassulacean Acid Metabolism (CAM) to fix carbon dioxide. As such, these plants cannot be viewed as defenses against such animals. Large extinct lemur species, on the other hand, are excellent candidates. To probe this further, we analyzed stable carbon and nitrogen isotope values of leaves collected from a broad spectrum of plant species and bone collagen from eight extinct lemur species. Our results suggest that Hadropithicus stenognathus is the only extinct lemur that exhibits carbon and nitrogen isotope values compatible with regular CAM consumption. Hadropithicus’ tooth wear patterns as well as its dental, cranial and postcranial adaptations provide additional evidence that this extinct lemur may have consumed foliage from the Didiereoideae. Moreover, its geographic distribution matches that of the Didiereoideae in the south and west. Stable isotope analysis provides a mechanism for identifying past species interactions. Apparent evolutionary anachronisms can be explained when the ecological roles of extinct species are taken into account.

Poster Session I (Wednesday, November 2)  VALIDATION OF THE FINITE ELEMENT METHOD ON AN AVIAN SKULL AND IMPLICATIONS FOR DINOVAURIAN MODELING CUFF, Andrew, University of Bristol, Bristol, United Kingdom; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom

Finite element analysis (FEA) can deduce stress and strain in biological structures during function. It provides an insight into the mechanical performance of the musculoskeletal system, and can be used to test the functional significance of morphological features. FEA has been used in paleontology for over 10 years, but questions remain about how well modeling results replicate reality. For fossil taxa we must rely on validation studies in closely related living taxa to inform which parameters influence the results of our fossil FE-models. A recent study on the ostrich (Struthio camelus) mandible demonstrated congruence between experimental and computationally derived strain. Here we extend this work to determine the validity of FE-models of the ostrich cranium. Muscle loads were applied via an artificial tendon to the M. pseudotemoralis superficialis muscle site of a defleshed ostrich skull held in a custom built testing rig. Strains on the skull were recorded ex vivo using 13 rectangular rosette strain gauges. Computed tomography (CT) scans of the same specimen were segmented in Avizo 6.3 to separate cortical bone, cancellous bone, suture and rhomboid. The surface generated was transferred into Hypermesh 10.0 to produce a series of models with increasingly fine mesh size for convergence testing. Using the appropriate sized mesh (where change between mesh size models is <5% strain), the model was loaded with the exact conditions as the ex vivo skull, and strains at equivalent sites compared. Results show that, whilst not perfect, the FE-method produce results similar to those recorded by ex vivo gauges, although the FE-model is consistently stiffer than the ex vivo skull. The rhomboid reduced overall strain, but as seen in prior studies, the sutures have very little effect. These results provide increased confidence in data obtained from future FE-studies of fossil avians, and derived non-avian maniraptorans with rhomboid and/or reduced teeth.

Poster Session II (Thursday, November 3)  PRELIMINARY DESCRIPTION OF A SMALL SKULL SPECIMEN OF ENALLIARTOS (CARNIVORA, PINNIPEDIMORPHA) FROM THE MIocene OF WESTERN Oregon CULLEN, Thomas, Carleton University, Ottawa, ON, Canada; RYBCZYNski, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada; SCHRÖDER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada

Enalliarctos is a genus that includes at least five species of early pinniped relatives, known from the Oligocene and Miocene of the west coast of North America. This genus, considered to represent the early phases of marine evolution in pinnipeds, is highly diverse, and may be a metaxaxon. In order to better understand the diversity and evolution of this group some specimens are being reexamined. This study reports on a skull specimen from the early to middle Miocene of western Oregon. This specimen was originally referred to Enalliarctos emlongi, based on similarities of the dentition and morphology of the zygoma. Enalliarctos emlongi is known from only three specimens: A large, well preserved holotype skull specimen, a partial skull and snout, and a smaller slightly crushed skull. This smaller skull is the subject of the current study and its ultimate size was considered to be a juvenile. Although the skull is slightly crushed dorsoventrally, the palate, portions of the basicranium, and the rostrum are well preserved. Results of this study reveal that the specimen is most likely to be an adult. The interfrontal, maxilla, basioccipital-prephenoid, and maxilla-premaxilla sutures are all fully closed. Previous research in modern otariids, as well as studies of other mammals, has shown that these are among the last cranial sutures to close in ontogeny. Ongoing work will determine whether this small adult specimen represents a species different from E. emlongi. Alternatively this may be a female E. emlongi, an interpretation consistent with the appearance of the relatively low sagittal crest, and the more mediolaterally compressed canines. If the specimen is female, it would suggest that E. emlongi may have been highly sexually dimorphic, implying that strong sexual dimorphism, seen in modern pinnipeds, particularly otariids (sea lions), may have arisen early in the evolution of pinnipeds.
as well as to document general trends in the vertebral anatomy of ceratopians. In particular, we focused on the anatomy of the zygapophyses, structures important for constraining vertebral movement. Measurements and photographs of a Leptoceratops vertebral column (CMN [Canadian Museum of Nature, Ottawa, Ontario] 8889) were taken, the angles between the left and right zygapophyses were measured in Imagemag, and the data were graphed to visualize trends. The angle between the zygapophyses in the cranial dorsal vertebrae is around 90 degrees, but zygapophyseal angle increases caudally, measuring up to 130 degrees between the prezygapophyses in cranial view. The angle of the zygapophyses is also greater in the cranial cervical vertebrae, around 110 degrees between the prezygapophyses. Assuming that a greater angle allowed greater transverse movement, the results show that L. gracilis displayed a high amount of horizontal movement at both the front end of the neck and the caudal region of its trunk. This may suggest lateral undulation in the posterior part of the body during locomotion. More restricted horizontal movement in the cranial dorsal vertebrae could be related to the attachment of the scapula in this region. Similar patterns are seen in large, definitively quadrupedal ceratopsids such as Triceratops. This suggests that Triceratops and Leptoceratops had similar spinal flexibility and mobility, possibly consistent with predominantly quadrupedal rather than bipedal locomotion in Leptoceratops gracilis.

Poster Session III (Friday, November 4)
CAPACITY OF THE PTEROSAUR, ANHANGUERA SANTANAE, TO LAUNCH FROM WATER
CUNNINGHAM, James, Cunningham Engineering Assoc., Collierville, TN, USA; HABIB, Michael, Chatham University, Pittsburgh, PA, USA
Here we present the results of a quantitative and comparative morphological analysis of the large pterosaur, Anhanguera santanae, regarding the capacity for water launch. Many of the large pterodactyloid pterosaurs come from marine sediments or inland freshwater deposits. It is likely that some species took food from the water, and as a result, it is plausible that some large pterosaurs were forced into the water through feeding behaviors or stochastic events. Unless a water launch was possible for large pterosaurs, such events would be lethal, unless a shoreline was immediately available.

We estimated the capacity for water launch by applying variable soft tissue reconstructions and then iteratively solving quasi-steady fluid equations for the maximum potential drag output against the water during limb extension with a slightly-opened wing. Our results indicate that Anhanguera could launch from calm water, without the assistance of wind or waves, using a form of quadrupedal takeoff. The initial escape phase from surface suction could be accomplished with a net remaining acceleration of approximately 15-20 m/s², and an acceleration of up to 40 m/s² on the subsequent propulsive bounds. These were high, but large, accelerations would have the side effect of promoting rapid circulation generation on the wing at the end of the launch cycle. Anhanguera seems to have been adapted for a water launch using a series of repeated propulsions, which would have occurred as a series of “hops” across the water surface.

We cannot confirm that Anhanguera actually utilized a water launch in life. However, our model produces testable hypotheses of expected morphological patterns in marine versus terrestrial pterosaurs. Anhanguera, along with many other marine pterosaurs, present a suite of characteristics that would be expected in water-launching pterosaurs. Quadrupedal water launch behavior would allow for pterodactyloids to expand their habitat range, using the scapular-notarial joint, warped deltoplectoral crest, exceptionally broad MCIV-PHIV wing finger joint, limb length disparity, and expanded space for posterior brachial musculature observed in Anhanguera.

Poster Session III (Friday, November 4)
A VERY COMPLETE DORCATHERIUM PIGOTTI (TRAGULIDAE, MAMMALIA) SKELETON FROM RUSINGA ISLAND, KENYA: IMPLICATIONS FOR FUNCTIONAL MORPHOLOGY
CURRAN, Sabrina, University of California, Santa Barbara, Santa Barbara, CA, USA
Tragulidae is the most primitive taxon in the suborder Ruminantia. Though there are three extant genera comprising up to ten species and dozens of fossil taxa, they remain enigmatic in terms of their taxonomy, functional morphology, and behavior. All extant species occur in Eurasia and Africa; however, the interrelationships at the base of Ichthyopterygia remain unresolved as well as to document general trends in the vertebral anatomy of ceratopians. In particular, we focused on the anatomy of the zygapophyses, structures important for constraining vertebral movement. Measurements and photographs of a Leptoceratops vertebral column (CMN [Canadian Museum of Nature, Ottawa, Ontario] 8889) were taken, the angles between the left and right zygapophyses were measured in Imagemag, and the data were graphed to visualize trends. The angle between the zygapophyses in the cranial dorsal vertebrae is around 90 degrees, but zygapophyseal angle increases caudally, measuring up to 130 degrees between the prezygapophyses in cranial view. The angle of the zygapophyses is also greater in the cranial cervical vertebrae, around 110 degrees between the prezygapophyses. Assuming that a greater angle allowed greater transverse movement, the results show that L. gracilis displayed a high amount of horizontal movement at both the front end of the neck and the caudal region of its trunk. This may suggest lateral undulation in the posterior part of the body during locomotion. More restricted horizontal movement in the cranial dorsal vertebrae could be related to the attachment of the scapula in this region. Similar patterns are seen in large, definitively quadrupedal ceratopsids such as Triceratops. This suggests that Triceratops and Leptoceratops had similar spinal flexibility and mobility, possibly consistent with predominantly quadrupedal rather than bipedal locomotion in Leptoceratops gracilis.

Poster Session III (Friday, November 4)
DYNAMIC ANALYSIS OF THE SPECIALISED JAW MOVEMENTS IN SPHENODON AND RELATED CHARACTERS ACQUISITION IN FOSSIL RHYNCHOCEPHALIA (DIAPSIDA: LEPIDOSAURIA)
CURTIS, Neil, University of Hull, Hull, United Kingdom; JONES, Marc, University College London, London, United Kingdom; O’HIGGINS, Paul, University of York, York, United Kingdom; FAGAN, Michael, University of Hull, Hull, United Kingdom; EVANS, Susan, University College London, London, United Kingdom
Sphenodon, the New Zealand tuatara (Rhynchocephalia), has a specialized feeding system in which the lower jaw closes between two upper tooth rows before sliding forward to tear food apart like a steak-knife. This shearing action is unique amongst living amniotes but some related osteological characters are known in Mesozoic rhynchocephalians. The details of this jaw movement were analysed using Multibody Dynamics Analysis, where a 3-Dimensional model of Sphenodon was constructed from Computed Tomography scans and used to simulate a typical feeding sequence. This model included accurate joint contact surfaces and a detailed representation of the jaw muscles. Results show that the shearing mechanism is more complex than previously appreciated. Anterior shearing of the lower jaws is accompanied by long axis rotation that alters how the lower and upper dentition interact. At first shearing occurs between the anterolingual flanges of the dentary teeth and posterolingual flanges of the maxillary teeth, but towards the end of the shearing phase it occurs between the anterolingual flanges of the dentary teeth and the posterolingual flanges of the palatine teeth. Hence, precise point loading occurs that cannot be appreciated by manipulation of dried skeletal specimens. The hinge-like symphyisis is integral to this proorol feeding system permitting the long axis rotation and necessary changes of the intermandibular angle. A survey of the fossil taxa shows that many of the anatomical features required for the Sphenodon mode of feeding, such as the elongate articular and hinge-like symphyisis, were acquired early in rhynchocephalian evolution (e.g. the Early Jurassic Cynosphenodon). The Upper Jurassic-Late Cretaceous eileodontines appear to have elaborated on the Sphenodon type jaw movement by transversely expanding their dentary and palatine teeth and closing the suborbital fenestra to create a single upper occlusal surface. This contradicts previous suggestions that the specialized jaw arrangement found in Sphenodon restricted continuing evolutionary development.

Poster Session I (Wednesday, November 2)
RE-EXAMINATION OF THE CRANIAL MORPHOLOGY OF UTATUSSaurus Hataii FROM THE OSAWA FORMATION (LOWER TRIASSIC) OF MIYAGI, JAPAN
CUTHBERTSON, Robin, University of Calgary, Calgary, AB, Canada; RUSSELL, Anthony, University of Calgary, Calgary, AB, Canada; ANDERSON, Jason, University of Calgary, Calgary, AB, Canada
Limited and poorly preserved material of chronologically early members of Ichthyopterygia has hindered interpretation of the early evolutionary patterns of the group. Relative to other Early (E.) Triassic ichthyopterygians, Utatussaurus hataii is well known, but details of its cranial morphology remain sparse, making comparison to other basal forms problematic. The specimen that best preserves the skull, UHR 30691, has been referred to U. hataii based on a similar geologic occurrence and the following shared features: subteethodont tooth implantation; distomessially compressed tooth crowns; hemurs longer than wide and bearing equally sized ulnar and radial facets. We re-studied the skull of UHR 30691 to improve its comparative utility and confirmed the following notable points: premaxilla slender; external nares with its dorsal margin formed by the nasal; frontal, parietal, and postfrontal bearing the posterior portion of the left postorbital and parietals, or the atlantal floor of the body of water. Therefore, it is possible that the morphology of Hyemoschus is in fact not primitive, but rather more specialized than previously considered, and thus not the best model for early trigluids.
THE OPISTHOTONIC DEATH POSE AS A FUNCTION OF MUSCLE TONE AND AQUEOUS IMMERSION

CUTLER, Alicia, BYU Dept of Geological Sciences, Provo, UT, USA; BRITT, Brooks, BYU Dept of Geological Sciences, Provo, UT, USA; SCHIETZ, Rodney, BYU Museum of Paleontology, Provo, UT, USA; COTTON, Joshua, BYU Dept of Geological Sciences, Provo, UT, USA

In the classic death pose of theropod dinosaurs (avian and non-avian) and other animals the head and neck are hyper-extended resulting in a strongly arched neck with the skull roof resting above the sacrum and the tail arching cranially over the head and neck. In less extreme cases the neck and tail range from vertical to the classic case just described. A number of mechanisms have been proposed for this pose, including desiccation, asphyxiation, and poisoning. Most specimens preserved in this pose were deposited in aqueous (fluvial or lacustrine) environments. We hypothesized that the swelling of the more massive epaxial musculature of theropods by the intake of water during prolonged submersion would swell elongate muscle cells equatorially, shortening them along the long axis. Our tests of this model utilized complete, fresh or frozen, plucked chickens completely immersed in cool water (n=7) for periods up to a month. Within seconds of immersion the heads and necks were pulled back into a range of death poses, including the extreme case with the head directly above the pelvis or with the head floating lateral to the back or pelvis. Over time hypoxertension increased only slightly but tended to pull the head and neck into the sagittal plane. A control desiccation study was conducted by placing a fresh chicken on sand (n=7) in a fume hood with the neck out-stretched parallel to the back. No movement occurred over a period of three months.

Our experiments suggest that although the roads to the opisthontic death pose are many, im-

tervention is the water is the simplest explanation.

Poster Session I (Saturday, November 5)

SYSTEMATIC RELATIONSHIPS OF MIOCENE SPECIES OF MONOSAULAX (RODENTIA: CASTORIDAE) FROM THE GREAT BASIN OF NORTH AMERICA

CZAPLEWSKI, Nicholas, Univ of Oklahoma, Norman, OK, USA; SMITH, Kent, Oklahoma State Univ, Tulsa, OK, USA

The Miocene Climatic Optimum (17-15 Ma) was a time of dramatic change in both global climate and species evolution. During this geologic time span, in the Great Basin of North America, several local faunas were preserved. Four of the local faunas (e.g., Barstow, L.F; Massacre Lake I.F; Stewart Valley L.F; and Eastgate L.F) revealed Monosaulax taxa of which three species (M. paunus, M. curtus, and M. tedii) are known. At Eastgate, an endemic species of Monosaulax is represented by a large sample (>54 specimens) of maxillae, mandibles, and upper and lower cheekteeth. These specimens represent a range of life stages from juvenile to adult, and are sufficient to confirm a new species of Monosaulax. Quantitative analyses of upper and lower cheekteeth of Monosaulax includes coefficient of variation, principal components analysis, correspondence analysis, and cluster analysis. These univariate and multivariate methods support the identification of a new species of Monosaulax from Eastgate. Numerous qualitative characters of the maxillae, mandibles, and upper and lower cheekteeth taken from the Eastgate specimens and the literature were evaluated as well. Species A from Eastgate most closely resembles M. tedii but differs from it in being smaller in size, lacking a sigmoid pattern on the occlusal surface formed by the mesossofassitid in the absence of the paraossofassitid and metaossofassitid, and in having a long mesostrid spanning greater than 50% of the total crown height of the cheekteeth.

Technical Session XI (Friday, November 4, 3:30 pm)

EARLY EVOLUTION OF TITANOSAURIFORM SAUROPOD DINOSAURS: TAXONOMIC REVISION, PHYLOGENY, AND PALEOBIOGEOGRAPHY

D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA

Titanosauriforms was a long-lived, diverse, and geographically widespread clade of mega-

herbivores that included both the largest and smallest sauropods. I present a taxonomic revision of all Early Cretaceous North American sauropods, which results in augmented hypodigm, synonymization or invalidation of some previously distinct genera, and recogni-

tion of a new genus and species. Based on these taxonomic revisions, first-hand observations of relevant taxa, and development of novel characters, I present a genus-level cladistic analy-

sis focusing on basal titanosauriforms. Three main clades are recovered: Brachiosauridae, composed of Late Jurassic and Early Cretaceous mostly Laurasian taxa (e.g., Brachiosaurus, Somosaurus), a clade composed of several Early Cretaceous East Asian taxa (e.g., Euhelopus, Phuwiangosaurus, Tassagnosaurus), and a paraphyletic, globally distributed set of taxa leading to Titanosauria (e.g., Logusaurus, Tastavinsaurus). Several putative brachiosau-

rids are recovered as non-sauropods, members of the East Asian clade, or close relatives of Titanosaurus. The Early Cretaceous of North America contained both brachiosaurids and more derived titanosauriforms, all of which disappeared before or at the time of the incursion of the Western Interior Seaway. The ca. 30 million-year-long Late Cretaceous ‘sauropod hia-

tus’ in North America was the result of extinction and reinvasion of sauropods from another landmass. East Asia appears to have hosted an endemic clade of sauropods during the Early Cretaceous, though the effects of missing data in fragmentary taxa decrease support for this hypothesis. This study yields novel hypotheses of relationship and character evolution that help to form the basis for future examination of the origins of Titanosaurus.

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In the Lower Cretaceous of Mongolia, only fragmentary remains of Trionychinae indet. are known (Dzun Shakhai). In the Cenoman-Santonian (Baiyun Formation), trionychid osteoderms are represented by three genera: *Amyda*, *Kouriogenys*, and *Peramus*. From the Yixian Formation (Liu et al., 1995) in Liaoning Province, China, the most complete skeleton of a small trionychid is known (Kouriogenys major sp. nov.). The known sample of the important pre-tribosphenic mammal Peramus tenuisculus, housed in the Natural History Museum (London, UK), was imaged using micro-computed tomography (CT). Substantial morphological diversity was discovered, prompting establishment (and resurrection) of additional taxa from within the original hypodigm of Peramus tenuisculus: Peramus dubius comb. nov., Kourionergus minor gen. nov., and Peramusoides tenuiscus gen. et sp. nov. The Peramus are revised; this group is restricted to taxa with clear evidence of a fully-functional upper molar embrasure for the dominant lower molar talonid cusp (hyperconid), either through development of wear facet 4 or differentiation of a distinct hypocoel. The Peramus are the most likely sister-taxa to the Trionychidae (including living members and placental species) and represent a distinct molar morphology, transitional between primitive lineages characterized by dominant orlal shear (e.g. dryolestoids) and those with modern, multi-functional tribospheny. A very large masseteric foramen is identified in peramurans, but this feature appears to be autapomorphic and of uncertain function.

**Poster Session II (Thursday, November 3)**

**A NEW WAY TO ESTIMATE THE DIRECTIONAL SENSITIVITY OF THE SEMICIRCULAR CANALS SYSTEM**

DAVID, Romain, MNHN/Collège de France, Paris, France; ALLAIN, Ronan, MNHN, Paris, France; BERTHOZ, Alain, Collège de France, Paris, France; JANVIER, Philippe, MNHN/CNRS, Paris, France

The vertebral vestibular system is involved in balance, gaze control, movement coordination and navigation. The inner ear houses the peripheral receptors of this system, the semi-circular ducts system and the otolithic endorgans. The six semi-circular ducts detect head rotations. The functioning of each duct depends on its sensitivity and its maximal response plane. The detection of a head rotation in space thus depends on the structure of a particular octahedron, composed of six semi-circular ducts vectors. We named this set of vectors the ‘semi-circular canals system functional structure’. The ducts are contained inside labyrinths, which can be retrieved in fossil specimens using microtomography technologies and 3D-reconstruction. We developed a new method that allows us to (1) extract the semi-circular canals system functional structure from the bony labyrinth; (2) determine the sensitivity of the system for pitch, roll and yaw rotations; and (3) estimate the error of these inferences from key morphological parameters. The power of this method was ensured from a data set composed of bony and membranous labyrinths from five phylogenetically distant, extant tetrapods. We applied this new methodology to a data set composed of forty archosaurian specimens. This data set contains nineteen extant species (birds and crocodiles), as well as twenty-one extinct species (phytosaurs, SUCHS and Dinosaurs). The key steps of this method will be explained and its applicability among vertebrates’ labyrinths will be discussed.

The directional sensitivity and the estimated range of angular head velocity retrieved through this method will be presented for two fossil specimens, a crotaroton and a dinosaur.

**Preparators’ Session (Thursday, November 3, 11:45 am)**

**VIRTUAL AND REAL: USING 3-D SCANNING, MODELING, AND PRINTING IN RECONSTRUCTING A JUVENILE APATOSAURUS SKELETON**

DAVIES, Kyle, Sam Noble Oklahoma Museum of Natural History, Norman, OK, USA; STARLY, Binil, University of Oklahoma, Center for Shape Engineering and Advanced Manufacturing, Norman, OK, USA

Using Apatosaurus bones from the Morrison Formation of the Oklahoma panhandle collected between 1933-1941, the Oklahoma Museum of Natural History determined to build a full skeletal mount of the smallest individual represented, an animal only around 84 centimeters (33 inches) high at the hip and 4 meters (13 feet) long. In the 1990s a 28 meter (92 feet) long display mount was created from bones representing a huge adult individual from the same quarry. A minimum of four juveniles, shown by duplicate right tibiae all within 10% of each other in size, contributed to bones in the smallest size grouping. Early on 3-D imaging and printing was chosen to produce mirror images of selected bones and models versus hand sculpting. Use of 3-D computer modeling expanded to where nearly 57% of the bone reconstructions by count (skull and jaws counting as only three pieces) were generated on the computer. Besides mirror images, methods included shrinking scans of bones from larger individuals to fit, blending between models or real bones to fill gaps in a series, and using formulas to generate other series by distortion of models. Some crushing, distortion, and damage was removed or repaired on scans of real bones. All regularly reconstructed bones or sculpted clay models were also 3-D scanned and a virtual skeleton made. Care was taken to retain juvenile characters that could be identified in the real bones and add the best guesses for missing bones. The virtual skeleton allowed evaluation of reconstruction choices and correction of those choices, if needed, as work progressed. The virtual skeleton remains as a resource to evaluate possible changes to the reconstruction in the future.

**Poster Session III (Friday, November 4)**

**COMPLETE CENSUS OF PUBLISHED FOSSIL DINOSAUR INTEGRUMENT QUANTIFIES TAPHONOMIC BIAS TOWARDS PREVALENCE OF HADROSAUROID SKIN**

DAVIS, Matt, Yale University, New Haven, CT, USA

Most examples of fossil dinosaur skin come from hadrosaurids but this taphonomic bias has never been quantitatively measured or fully explained. After a lengthy literature review of all published dinosaur skin and reanalysis of recent lithographic occurrence data, I can confirm quantitatively that hadrosaurid dinosaurs do fossilize skin at a much higher rate than any other clade of dinosaurs. These specimens dominated the literature so completely that it was not until the mid-1990’s that the total number of published non-hadrosaurid skin samples surpassed the number of published hadrosaurid skin samples. Despite these taphonomic biases, the amount and quality of hadrosaurid fossil skin begs us not to hastily rule out a true biological effect like specialized behavior or integument morphology.
A pentacodontid mammal is described from the early Paleocene of Hainin, a Belgian locality that yielded the earliest Cenozoic mammal fauna of Europe (MP1-5 reference-level). This taxon, represented by a new genus and species is the oldest and smallest European member of the order Pantolesta. It is also the first pentacodontid of Europe, a group that was previously only known from Western North America. The very small new taxon compares relatively well to Bisalouneus from the North American Tiffanian and Aphronurus from the North American Torrejonian. Lower molars differ from Bisalouneus in their smaller size, the more developed precingulid on m1-3, the more lingual position on the hypoconulid on m3, and the shorter m3 talonid. The Belgian species shares with other pentacodontids a decreasing size of the molars from m1 to m3 and a relatively low molar crown with rounded outlines. Both characters differentiate the family from the closely related pantolestids whose molars are increasingly larger from m1 to m3 and have sharper crowns. Derived pentacodontids such as Pentacodon feature a great size difference between the first, second and third molars, whereas the more primitive Bisalouneus displays almost similarly sized molars. The new pentacodontid that we present here has similarly sized molars, but the m3 talonid is slightly shorter than in Bisalouneus though not as short as in Pentacodon. The presence of a pentacodontid in the European Paleocene offers improving evidence for a faunal interchange between Europe and North America before the Upper Paleocene.

Posters Session II (Thursday, November 3)

SIGNIFICANT NEW MESOZOIC LOCALITIES FOUND DURING A PALEONTOLOGICAL RESOURCE INVENTORY OF BLM WILDLANDS IN WASHINGTON COUNTY, UTAH

DEBILLEUX, Don, Utah Geological Survey, Salt Lake City, UT, USA; HUNT, Gary, Utah Geological Survey, Salt Lake City, UT, USA; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; FERRIS-ROWLEY, Dawna, Bureau of Land Management, St. George, UT, USA; MILNER, Andrew, St. George Dinosaur Discovery Site, St. George, UT, USA

In 2009, the Omnibus Public Lands Bill was signed into law. In addition to the Paleontological Resource Preservation Act, it included the Washington County Wilderness Bill which designated 129,300 acres of public land administered by the Bureau of Land Management (BLM) as wilderness. As part of the planning process, the BLM funded the Utah Geological Survey (UGS) to conduct a paleontological inventory of these wilderness areas. This provides us with an opportunity for input into critical land-use and management decisions and is the first time that paleontological resources have been included in an initial natural resource inventory for a new public wilderness area.

As a starting point, we created potential fossil yield classification (PFYC) maps for the wilderness areas using data from UGS 1:24,000 and 1:100,000-scale geological maps of the region. These maps were used to prioritize paleontological data collection in the field. Important fossil-bearing strata in these areas include the Chindle, Moenave, and Kayenta Formations and, to a lesser degree, the Navajo Sandstone and Carmel Formation. Based on these geologic units and their proximity to developed areas, the BLM selected the Cottonwood Canyon, Red Mountain, and Canaan Mountain Wilderness Areas for field inventory.

Fieldwork began in the fall of 2010 at Red Mountain and Cottonwood Canyon. Numerous tracksites with tracks attributed to Grallator, Eubrontes, and Brasilichnium were discovered in the Navajo Sandstone along with several tracksites in the Kayenta Formation. In the spring of 2011, we focused our work on Canaan Mountain and made numerous significant discoveries. A spectacular dinosaur tracksite was discovered in the Whitmore Point Member of the Moenave Formation. A number of vertebrate bone-bearing localities were found in the Petrified Forest Member of the Chinde Formation including a boned bone, a possible crocodylo-morph skull, and a partial pterosaur skull.

Symposium 1 (Wednesday, November 2, 11:00 am)

THE ORIGIN OF WINGS

DECECCCHI, Alexander, McGill University, Montreal, QB, Canada; LARSSON, Hans, McGill University, Montreal, QB, Canada

The evolutionary transformation of arms into wings marks one of the most extreme modifications of the tetrapod limb. Flight, in both an aerial and aquatic context, has evolved multiple times within amniotes. Here we discuss necessary morphological adaptations to create a viable wing. The three known cases of aerial flight in vertebrates (birds, bats and pterosaurs) have marked convergences in morphology, physiology and genome size. However, the question arises as to which of these changes are necessary and sufficient for flight and which are later refinements. Although flight dynamics are not identical across the three groups, the physical constraints of flight are. Teropoda present the best transitional series of morphologies that encompass the entire transition to powered flight. We examined the quantitative and qualitative trends in morphology inferred necessary for flight throughout the three major avian phylogenetic history. The early transition period to powered flight is presumed to have passed through a rapid transition between Simpsonian adaptive zones where dramatic morphological changes occurred. We identify phylogenetic zones where rapid rates of morpho-

logical change are coupled with the origin of distinct allometric relationships and, in turn, the evolution of a novel pattern of inter- and intra-limb length covariance. Aves has a significantly different allometric relationships than non-avian theropods, with longer forelimbs and shorter hindlimb lengths at a given body size. The relationship between forelimb and hindlimb lengths, however, is derived from a large extent avian (subset (~640 specimens), to yield minimal wing skeleton length values to compare to non-avian theropods and basal birds. As all basal birds, including Archaeopteryx, meet this minimal threshold, as do a few small bodied paravians. This integrated approach suggests flight was present minimal at the base of Aves, and possibly even Paraves. By associating these nodes to the origin of powered flight, despite debate on the ecological circumstances of its origin, we can begin to isolate the modifications that are necessary and sufficient to evolve an arm into a wing.
distributed both in western and eastern Europe; and the purported, still unnamed new species from the Late Miocene of Mytilini (Samos, Greece) should be compared with it.

Poster Session I (Wednesday, November 2)

NEW TAXONOMIC, PALEOBIOGEOGRAPHIC, AND BIOSTRATIGRAPHIC RECORDS OF FOSSILS FROM THE HELL CREEK AND TULLOCK FORMATIONS OF GARFIELD COUNTY, MONTANA

DEMAR, JR., David, University of Washington, Seattle, WA, USA

A recent investigation of the caudate (salamander) fossil assemblages of the latest Cretaceous and earliest Paleocene (Lancian and Puercan North American Land Mammal “Ages” [NAMLA], respectively) of Garfield County, northeastern Montana, resulted in the discovery of new caudate species and paleobiogeographic and/or temporal range extensions of known salamander taxa. Identifications of new Lancian salamanders are based on isolated atlantes and trunk vertebrae from the lower two-thirds of the Hell Creek Formation. Of particular interest is the presence of a single trunk vertebra similar in form to the Late Paleocene (Tiffanian NAMLA) *Sectatrix krausei* (Proteidae) of Saskatchewan, Canada. If the phylogenetic relationships are correct, this specimen would push the known fossil record of protoids back into the latest Cretaceous. In addition to the identifications of new salamander taxa are specimens previously undescribed from a known fossil site, *Habrosaurus prodilatus*. The original description of *H. prodilatus* from the Campanian (Judithian NAMLA) Dinosaur Park Formation of Alberta, Canada, was based on isolated premaxillae, dentaries, and an atlas-centrum. Here I describe a partial right maxilla (UBWM 59340) and a near complete left vomer (UCMP 556520) of *H. prodilatus* from the Hell Creek Formation and compare it to those of its congener, *H. dilatus*. Furthermore, trunk vertebrae of the fossil amphibian, *Proamphibia crenaeae*, were discovered from three localities of the Tullock Formation. These specimens represent the first evidence of unequivocal Paleocene-aged *P. crenaeae* outside of the temporally-mixed (latest Cretaceous—earliest Paleocene) fossil assemblages of the Bug Creek AMNH of McCone County, Montana. As the fossil record of latest Cretaceous and Early Paleocene liass amphibians improves, a better understanding of their diversity and biostratigraphic ranges will ultimately aid in the interpretation of their evolution, extinction, and recovery, specifically during the Cretaceous-Paleogene mass extinction.

Poster Session I (Wednesday, November 2)

DIETARY RECONSTRUCTION OF MIocene APes (PRIMATES: Hominidae) FROM CATALONIA (NE SPAIN) BASED ON DENTAL MICROWEAR

DEMIQUIEL, Daniel, Institut Catala de Paleontologia, Barcelona, Spain; ALBA, David, Institut Catala de Paleontologia, Barcelona, Spain; MOYÁ-SOLA, Salvador, Institut Catala de Paleontologia, Barcelona, Spain

Diet is one of the most important parameters for understanding primate evolution from an adaptive viewpoint, with significant implications for dental morphology. Together with gross wear, the latter can provide many insights into the diet of extinct organisms. Dental microwear analyses, however, have the potential to reveal more subtle differences in dietary regimes and feeding behaviors (including seasonal changes) among a great variety of fossil species. Here we report microscopic wear patterns for five Middle to Late Miocene hominoid taxa from Catalonia (NE Spain), and explore their significance from a paleodietary perspective.

Poster Session II (Thursday, November 3)

MAMMALIAN ZOOGEOGRAPHY OF THE HIPPARIAN FAUNA IN THE LATE MIOCENE OF CHINA

DENG, Tao, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

Late Miocene fossil localities containing Hipparion faunas are numerous in China, especially in the red clay deposits of northernmost China. In eastern China, they are comparatively infrequent and preserved in fluvial sandstones or lacustrine marlites. The distribution of Neogene mammals indicates that the faunas of eastern and western China were obviously differentiated during the early and middle Miocene, while evidence for this differentiation is scarce for the late Miocene. Differences between eastern and western China before the late Miocene are easily recognized because they have extremely different ecosystems, i.e., dense forests and open grasslands, respectively. Since the late Miocene, on the other hand, the dense eastern forests have become sparse woodlands that have more similarities to the open grasslands in the west, and thus the two are not easily distinguished. However, the taphonomic and sedimentary features of the late Miocene indicate the existence of a boundary between the eastern and western regions of North China, and zoogeographical subregions can be recognized. The south sector of this boundary is situated between Xian’an and Xinzhou in Henan, the middle sector is between Baode and Yushu in Shanxi, and the north extension is determined to situate between Siziwang and Sonid in Inner Mongolia. During the late Miocene, the east region of this boundary was humid forest grassland, persisting since the early Miocene, while the west region was a dry open steppe that had changed dramatically since the middle Miocene, being strongly affected by the Tibetan Plateau uplift. This boundary shows that the present Chinese zoogeographical distribution had been established since the Miocene. Based on faunal components, *Chilotherium* flourished in the western ecosystem of this zoogeographical division during the late Miocene, and it became extremely dominant in the community. The second largest group was various grassland byenias. They composed a particular endemic fauna in China. In the faunas to the east of this boundary, *Chilotherium* was very rare, while *Hipparion* was dominant.

Poster Session III (Friday, November 4)

MAMMALIAN Niche CONSERVATION THROUGH DEEP TIME

DESANTIS, Larisa, Vanderbilt University, Nashville, TN, USA; BEAVINS TRACY, Rachel, Vanderbilt University, Nashville, TN, USA; KOONTZ, Cassandra, Vanderbilt University, Nashville, TN, USA; ROSEBERRY, John, Vanderbilt University, Nashville, TN, USA; VELASCO, Matthew, Vanderbilt University, Nashville, TN, USA

Climate change is currently altering the distribution of species, causing plants and animals to move north or to higher elevations with current warming trends. Bioclimatic models predict the distribution of species based on extant realized niches and often assume that ecological niches are maintained over long time scales. Recent work has demonstrated that niche conservatism operates above the species level during the Quaternary. Here, we build upon this work by evaluating if niches are conserved at the family level through deep time, from the Eocene to the Pleistocene. We analyzed the occurrence of all mammalian families (with >3 occurrences in the Paleobiology Database) in the continental USA, calculating range area, range area rank, and range polygon centroids during each respective epoch. Range areas generally increase from the Eocene to the Miocene, decrease from the Miocene to the Pliocene, and increase from the Pliocene to Pleistocene, while range area ranks are largely conserved. Furthermore, centroids demonstrate a southeastern shift from the Eocene through the Pleistocene. These changes may correspond to major environmental events and/or climate changes such as the Miocene grassland expansion and cooling since the mid-Miocene climatic optimum. High statistical concordance between rank orders across time demonstrates that niches are conserved at the family level and further supports the idea that niche conservatism at higher taxonomic levels is controlled by life history traits. Furthermore, families containing megafauna and/or terminal Pleistocene extinction victims did not incur significantly greater declines in range area rank changes then families containing only smaller taxa and/or only survivors, from the Pliocene to Pleistocene. Similarly, the time depth of a family does not affect range area rank changes. These results demonstrate the resilience of families to climate and/or environmental change in deep time, the absence of terminal Pleistocene “extinction prone” families, and the subsequent importance of conserving biodiversity at higher taxonomic levels to allow for greater flexibility to maintain existing niches.

E&O Poster Session

VERTEBRATE PALEONTOLOGY AS THE CORNERSTONE OF A FIRST-YEAR COLLEGE SEMINA R

DEWAR, Eric, Suffolk University, Boston, MA, USA; MACELI, Ashley, Suffolk University, Boston, MA, USA; PIETRANTONIO, Heather, Suffolk University, Boston, MA, USA

Many colleges and universities require incoming students to complete a first-year seminar to introduce them to the rigor of college-level work. At Suffolk University, the seminars are reading- and writing-intensive courses centered around topics chosen by faculty. Last year a new freshman seminar entitled “Vertebrate Fossils and Evolution” was developed with vertebrate paleontology as its organizing theme. Of the 20 students who chose this seminar, only six were biology majors—the rest came from across the curriculum. Given a wide range of life history traits. Furthermore, families containing megafauna and/or terminal Pleistocene extinction victims did not incur significantly greater declines in range area rank changes then families containing only smaller taxa and/or only survivors, from the Pliocene to Pleistocene. Similarly, the time depth of a family does not affect range area rank changes. These results demonstrate the resilience of families to climate and/or environmental change in deep time, the absence of terminal Pleistocene “extinction prone” families, and the subsequent importance of conserving biodiversity at higher taxonomic levels to allow for greater flexibility to maintain existing niches.

E&O Poster Session
phylogenies. Letting them measure fossil trackways to reconstruct locomotion was better than reading about it. Getting off campus as a group helped to bond them to each other socially and as collaborators. Formal lab reports were less important than demonstrating clear thinking in writing. This problems-based approach was effective to model scientific thinking for non-scientists and entering science majors alike.

Technical Session XII (Friday, November 4, 1:45 pm)
FROM EXTANT TO EXTINCT: EMPIRICAL STUDIES OF TRANSITIONAL FORMS AND ALLOMETRIC CORRELATES DELIMIT BOUNDARIES OF FUNCTIONAL CAPACITY
DIAL, Kenneth, Univ Montana, Missoula, MT, USA
Applying scientific rigor to hypotheses that ascribe functional capacity to historical forms is perpetually challenging. Only straightforward empirical evaluations of extant form-function patterns can limit the imaginative speculation regarding the functional capacity of fossil forms. Comparative functional anatomy is experiencing a revolution due to emerging technologies (e.g., dynamic internal and external 3-D imaging, micro- and macro-biomechanical recording equipment, computer modeling based on experimentally-derived data). These techniques allow us to clarify extant form-function relationships relevant to historical forms. Our work on the ontogeny and allometric correlates of avian locomotor performance may thus elucidate aspects of historical functional capacity.

Living birds commonly engage forelimbs and hindlimbs simultaneously to negotiate terrestrial obstacles and vertical substrates, even if they posses only an incipient flight apparatus. Such wing assisted incline running (WAIR) and controlled flapping descent in pre-flight developing birds are observable examples of locomotor function with clear incremental adaptive stages based on juvenile forms. Here I present an expansive and comparative study to document the adaptive benefits of incipient aerodynamic structures, skeletons, muscles, and nervous systems. I review behavioral and experimental data to include: 1. ontogeny of maximum locomotor performance, 2. fluid visualization using particle image velocimetry, 3. propeller experiments on prepared wings to directly measure aerodynamic forces, 4. 3-D skeletal kinematics, 5. fluid flow visualization using XROS and power output, 6. ground reaction forces of hindlimbs during inclined flapping running, 7. the negative allometry of maximum performance in adult birds and developing brush turkeys, and 8. the phylogenetic ubiquity and (probable) plesiomorphic status of WAIR. Comparative phylogenetic and experimental studies of extant forms that integrate behavioral, ontogenetic, and allometric measures are likely to delimit functional boundaries incorporated in hypotheses addressing the evolution of historical forms.

Poster Session II (Thursday, November 3)
NEW DATA ON THE LATE CRETACEOUS CARDABIODONTID SHARK BASED ON AN ASSOCIATED SPECIMEN FROM KANSAS, USA
DICKERSON, Ashley, DePaul University, Chicago, IL, USA; SHIMADA, Kenshu, DePaul University, Chicago, IL, USA; REILLY, Brian, Children’s Memorial Hospital, Chicago, IL, USA; RIGSBY, Cynthia, Children’s Memorial Hospital, Chicago, IL, USA
Cardabiodontids are large extinct lamniform sharks that lived during the Late Cretaceous, but much of their biology remains poorly understood. Here, we describe a specimen Cardabiodon Siverson from Kansas, USA that represents the first associated cardabiodontid material from North America. The specimen, FHSM VP-425 housed in the Sternberg Museum of Natural History in Hays, Kansas, consists of a set of teeth, pieces of calcified cartilage, and placoid scales. The combination of direct observation and radiographic (computed tomography) examination reveals that the specimen contains at least 53 teeth, including functional and replacement teeth. The teeth vary in size and morphology, suggesting that the dentition of the shark showed heterodony. The total number of represented tooth rows in FHSM VP-425 is small and thus accurate dental reconstruction is difficult. However, the tooth set includes relatively large teeth with a crown tip that is highly curved distally, likely representing the ‘upper intermediate teeth’ that concomitantly support the previously proposed “Regalis” groups, as defined in the literature, were not recovered. The results show that the occlusal surface of the lower p3 extends beyond the reentrants present on its labial surface. In particular, the shape of the mesial surface varies from rounded to pointed, and may be a factor driving the observed clustering. Morphological variation in occlusal shape of the lower p3 may provide new insight for investigating the origin and evolution of dental characters in this group over time.

Poster Session IV (Saturday, November 4)
EVALUATION OF PLOICE Fossil RIBB PHYLOGENY (GENUS: HYPOLAGUS) USING EIGENSHAPE ANALYSIS
DIONNE, Danielle, Carleton University, Ottawa, ON, Canada; MIDDLETON, W., Carleton University, Ottawa, Canada; RYBCZYNSKI, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada; SCHRÖDER-ADAMS, Claudia, Earth Sciences Department Carleton University, Ottawa, ON, Canada
Hypolagus is the most diverse and widespread of the fossil rabbit genera making up the subfamily Archaeolaginae (Leporidae, Lagomorpha), ranging from the Middle-Miocene to the Late-Pliocene. Traditionally, the taxonomy of Hypolagus has been based primarily on tooth size as well as qualitative characteristics such as linear and angular measurements of reentrants on the occlusal surface of the lower third premolar (p3). A challenge with using these features to identify new specimens is that morphological variation overlaps between species. Also, this approach ignores the overall shape of the tooth which may be phylogenetically significant. Here we use eigenshape analysis of the lower p3 to determine whether the shape of the occlusal surface agrees with the proposed pattern of phylogenetic intra-relationships for North American Hypolagus. A cluster analysis using Ward’s method was performed on eigenvalues resulting from eigenshape analysis of the North American specimens. Preliminary results recovered two groups with Penelopagius mexicanus as the out-group. Hypolagus regalis, H. arizonensis, and H. ringensdorfi form a group separate from a second group containing H. vetus, H. furlangi, H. gidleyi, H. edemis, H. redfordi, H. fos tintalis, H. limnetus, H. oreogenensis, H. parvicipicatus, and H. voorhi. The second group contains most of the species of the traditionally recognized “Vetus” group. This group was characterized by a triangular shaped lower p3 with a point on the posterior mesial portion of the tooth and a shallow, posteriorly deflected, posteroexternal reentrant. The “Regalis” and the “Oreogenensis” groups, as defined in the literature, were not recovered. The results show that morphological variation in occlusal shape of the lower p3 extends beyond the reentrants present on its labial surface. In particular, the shape of the mesial surface varies from rounded to pointed, and may be a factor driving the observed clustering. Eigenshape analysis of the occlusal surface of the lower p3 may provide new insight for investigating the origin and evolution of dental characters in this group over time.
A. recki where this gradual increase in δ13C composition through time suggests an increase in the amount of dietary C4 grass versus C3 browse. This isotopic data set matches well with the floral record from Bed I and provides further evidence that hominins and other fauna at Olduvai were subject to fluctuating environmental conditions during the earliest Pleistocene.

Poster Session III (Friday, November 4)  
THE ISOTOPIC ECOLOGY OF MIDDLE MIocene HERBIVORES FROM THE MADRID BASIN (SPAIN)  
DOMINGO, Laura, Earth and Planetary Sciences Department, University of California, Santa Cruz, CA, USA; KOCH, Paul, Earth and Planetary Sciences Department, University of California, Santa Cruz, CA, USA; GRIMES, Stephen, School of Geography, Earth and Environmental Sciences, University of Plymouth, Plymouth, United Kingdom; MORALES, Jorge, Departamento De Paleobiologia, Museo Nacional De Ciencias Naturales-CSIC, Madrid, Spain; LOPEZ-MARTINEZ, Nieves, Departamento De Paleontologia, Universidad Complutense De Madrid, Madrid, Spain

The Middle Miocene was a period of profound worldwide palaeoclimatic change. The Miocene Climatic Optimum (MCO; ~17 to 14 Ma), characterized by warm conditions, was followed by a sudden drop in temperatures and an increase in aridity. This Middle Miocene Cooling (MMC; 14-13.8 Ma) event was related to the reestablishment of the Eastern Antarctic ice cap. These global climate episodes have been mainly studied in the marine record, but terrestrial studies have proved to add valuable information. The Madrid Basin (Spain) has provided a sequence of mammalian fossil sites that spans the Middle Miocene. Analysis of the δ13C and δ18O values of mammalian tooth enamel have been performed on different herbivore genera from 16 fossil sites ranging in age from ~15.9 Ma to ~13.2 Ma (Middle and Upper Aragonian, MN5 and MN6, local zones Db to G). The δ13C results show differences in the ecological niches occupied by the taxa with the equid Anchitherium, the rhino Hispanotherium nutrix and the bovid Tehytragrus languai inhabiting more open environments, whereas the rhinos Alocercus simorone and Hoploaceratherium tetractylatum, the gomphothere Gomphotherium angustidens, the cervid Heteroprox moralesi and the paleomerycid Tricercomeryx pachecii were inhabiting slightly more closed habitats. A δ13C trend spanning the local zones suggests a slight increase in δ13C values in local zone Dd (~14.8-14.1 Ma). The most notable feature of the δ18O results is a decrease in the local zone E (~14.1-13.7 Ma), which is linked to a drop in the δ18O value of local water (and possibly air temperature) coinciding with the timing of the MMC event. In spite of this palaeoclimatic change, no turnover on mammalian faunal assemblage has been detected in local zone E. Thus, the MMC event has been recorded for the first time by using stable isotope analyses on mammal tooth enamel from a terrestrial sequence highlighting the importance of exploring terrestrial records to build a more complete global picture of past climatic events.

Poster Session II (Thursday, November 3)  
DIET OF THREE MIocene HYPERCARNIVORES FROM THE MADRID BASIN (SPAIN) BASED ON CARBON-ISOTOPE COMPOSITION OF TOOTH ENAMEL  
DOMINGO, M. Soledad, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA; DOMINGO, Laura, Earth and Planetary Sciences Department, University of California, Santa Cruz, CA, USA; BADGLEY, Catherine, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA; MORALES, Jorge, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

Stable-isotope analyses are rarely performed on extinct carnivores due to the scarcity of their remains in fossil sites and their high value in systematics studies. Thus, ancient predator-prey systems remain understudied at least from the perspective of isotope geochemistry and this fact is more evident the deeper we go in time. Abundant and diverse mammalian remains of Vallesian age (Late Miocene, ca 9 Ma) occur in the fossil sites of Cerro de los Batallones (Madrid Basin, Spain). We conducted C and O stable-isotope analyses in fossil enamel from mammalian herbivores (Rhinocerotidae, Equidae, Giraffidae, Gomphotheriidae, Suidae) and also from the sabre-toothed cats Promegantereon angustidens, Hispanotherium nutrix and Magericyon anceps. Preliminary results of the δ13C values are presented here and potential predator-prey relationships are inferred. Herbivore tooth enamel displays δ13C values indicative of a diet based on C3 plants from open woodland; there are no statistically significant differences among the δ13C values of the herbivores. The two sabre-toothed cats are indistinguishable in terms of their δ13C values whereas both show statistically significant differences from Magericyon andespi. δ13C values of the carnivore enamel were adjusted by +1.3‰ to account for trophic-level isotopic fractionation and compared to herbivore values. ANOVA of δ13C values shows no significant differences so the three carnivores could have potentially preyed or fed upon any of the herbivores.

Poster Session I (Wednesday, November 2)  
FOOD SELECTION IN JURASSIC SALAMANDERS FROM INNER MONGOLIA, CHINA  
DONG, Liping, IVPP, Chinese Academy of Sciences, Beijing, China; HUANG, Diying, Nanjing Institute of Geology and Palaeontology, Nanjing, China; WANG, Yuan, IVPP, Chinese Academy of Sciences, Beijing, China

Conchostracans and corixids have been reported as the food of extant salamanders, all of which constitute an ecologically important part of lacustrine environments. The stomach contents of the Jurassic conchostracans and corixids were found in the guts of Jeholoroton paradoxus and Chamerpeton tianyiensissi discovered at the Jurassic Daohugou locality, Ningcheng County, Inner Mongolia, China. This discovery provides real evidence supporting hypotheses about the ecology of vertebrate and invertebrate assemblages dating back to the Jurassic. It also provides fossil evidence that these Jurassic salamanders exercised prey selection; Jeholoroton preying only on juveniles of the conchostracan Euesseractia huangpingensis, and Chamerpeton only on the corixid Yonolariasia chtensissi. This supports inferences about dietary differences and thus niche partitioning in Jurassic salamanders based on structural differences in the jaw and hyoid elements.

E&O Poster Session  
A LIVING LABORATORY APPROACH TO TEACHING STUDENTS ABOUT THE SCIENTIFIC METHOD AND EVOLUTION: CRAFTING A CURRICULUM THAT ALLOWS STUDENTS TO GENERATE THEIR OWN EVIDENCE AND FORMULATE THEIR OWN CONCLUSIONS ABOUT EVOLUTIONARY PROCESSES  
DREWWIJK, Patricia, Bay Path College, Longmeadow, MA, USA; SEMPREBON, Gina, Bay Path College, Longmeadow, MA, USA

A non-traditional approach to teaching students at the baccalaureate level about fundamental concepts that form the foundation of evolutionary biology was undertaken as part of an elective course that services both biology majors and non-science majors. This approach was conceived as part of an outreach program to middle school students with girls who are interested in science, and to teach science and the scientific method. The approach was so successful that it was incorporated into a college setting. The traditional teaching paradigm of using lectures and/or laboratory exercises was not employed but rather a discovery-based and team-taught approach where faculty served as facilitators and mentors in guiding students in the development, administration, and interpretation of a series of semester-long research projects designed by students in teams. Each project was intended to investigate topics inclusive of the course outline. Weekly sessions with faculty were used for discussion of assigned readings for the topic of the week and for designing an investigation for that topic that would then be carried on independently by students throughout the semester. Projects involved active laboratory investigations that were intended to generate raw data that then was analyzed and from which conclusions were drawn. Even non-science students were expected to subject their data to statistical hypothesis testing – including employing multivariate statistical techniques using statistical software. Students were required to produce and defend scientific posters and present them in scientific journal manuscripts on a project of their choice. This methodology for teaching students about evolution proved to be a very powerful tool for enabling students to see in real time processes such as mutation and selection for certain traits and provided a living laboratory for actively exploring these concepts. Student responses were overwhelmingly positive.
to this approach and show a true investment by these students in the power of the scientific method as a process for the systematic study of the natural world through observation and experimentation.

Technical Session IX (Friday, November 4, 8:00 am)

AN EXCEPTIONAL NEW ICTHYOSAUR FROM THE UPPER JURASSIC AGARDHJELLET FORMATION (VOLGINAL), SVALBARD, NORWAY DRUCKENMILLER, Patrick, University of Alaska Museum, Fairbanks, AK, USA; HURUM, Jørn, Natural History Museum, University of Oslo, Oslo, Norway; KNUTSEN, Espen, Natural History Museum, University of Oslo, Oslo, Norway; NAKREM, Hans Arne, Natural History Museum, University of Oslo, Oslo, Norway

Ophthalmosaurid ichthysaurs (Ichthyosauria: Ophthalmosauridae) were one of the dominant clades of secondarily aquatic marine vertebrates during late Mesozoic. Although geologically long-lived (Middle Jurassic to early Late Cretaceous) and cosmopolitan in their distribution, the overall diversity and relationships of the clade remain very poorly understood. Fieldwork conducted between 2004 and 2010 in the arctic archipelago of Svalbard, Norway, has resulted in the discovery of several new specimens of Late Jurassic ichthyosaurs. In 2009, an exceptionally complete and nearly articulated skeleton of an ophthalmosaurid ichthyosaur was recovered in the Sassenfjorden area, on the island of Spitsbergen. The specimen was recovered from the Slottsmøyra Member of the Agardhjellet Formation, a 75-meter-thick unit of dark grey to black silty mudstone deposited in low oxygen, shallow marine settings on the Barents shelf. Molluscan and foraminiferal biostratigraphy indicates a Volgian age for the unit, close to the Jurassic-Cretaceous boundary.

The well preserved specimen measures 4.5 meters in length and includes the entire skull, much of the axial column, the pectoral and pelvic girdles and a well preserved fore- and hindlimb. The Svalbard specimen represents one of the most complete and articulated ophthalmosaurid skeletons discovered to date and is significant in several respects. First, a comparative analysis of the skull and forelimb to other ophthalmosaurids indicates the specimen represents a new taxon that most closely resembles Undosaurus, a poorly known Russian genus. Secondly, it provides important new anatomical data for ongoing studies of ophthalmosaurid phylogeny, which is poorly resolved. Additionally, the well articulated pelvic girdle and hindlimb provide unequivocal new data regarding the orientation of the ophthalmosaurid femur. Finally, the specimen represents an important new data point to our rapidly growing knowledge of ichthyosaurian diversity and evolution at high paleolatitudes preserved in the Slottsmøyra Lagerstätte.

Symposium 3 (Thursday, November 3, 10:30 am)

DIRECT EVIDENCE OF CROCODYLIFORM PREDATION ON SMALL DINOSAURS FROM THE KAIAPORWITS FORMATION OF UTAH DRUMMELIER, Stephanie, The University of Iowa, Iowa City, IA, USA; BOYD, Clint, The University of Texas at Austin, Austin, TX, USA

Crocodyliforms are important taphonomic agents, capable of both accumulating and modifying vertebrate remains. Previous discussions of Mesozoic crocodyliform predation in terrestrial and riverine ecosystems have often focused on the largest members of the clade, and especially on their interactions with equally large dinosaurian prey. However, recent evidence suggests that the impact of smaller crocodyliforms on their environments should not be discounted. Here we present direct evidence of predation by a small crocodyliform on juvenile specimens of a basal ornithopod dinosaur from the Upper Cretaceous (Campanian) Kaiaparwits Formation of southern Utah. Bite marks were identified on a left scapula and a right femur referred to this taxon. Two pits are present on the proximal portion of the scapula, one of which displays a pronounced punctum. The femur exhibits two pits and a punctum with a partial tooth crown embedded in the latter. Computed tomography (CT) scans of the puncture reveal impact damage to the surrounding bone and that the distal tip of the tooth was missing prior to the biting event. Between the morphology of the embedded tooth (ovoid in cross-section) and the presence of the bisected pit (diagnostic of crocodyliforms) these bite marks are confidently identified as crocodyliform in origin. While crocodyliforms continuously shed teeth throughout their lives, often during the act of feeding, this is the first incidence of a tooth from a member of this clade being found embedded directly into prey bone. These bite marks provide insight into the trophic interactions of the ecosystem preserved in the Kaiaparwits Formation. The high diversity of crocodyliforms within this formation would have led to accentuated niche partitioning and intense competition for resources. Additionally, the presence of abundant dinosaurian eggshell fragments from a variety of taxa indicates close proximity to a nesting ground that would have provided regular influxes of small prey items into the ecosystem. This dynamic provided the ideal condition for the deposition and preservation of evidence of crocodyliform predation on young dinosaurs.

Technical Session XIV (Saturday, November 5, 8:45 am)

THEROPODS IN MORPHOSPACE: A GEOMETRIC MORPHOMETRIC APPROACH TO VARIATION AND DIVERSITY IN THEROPOD CRANIOMORPHIC MORPHOLOGY DU, Trina, McGill University, Montreal, QB, Canada; LARSSON, Hans, McGill University, Montreal, QB, Canada

Theropods present an excellent opportunity to study morphological variation over long timescales. Originating as small, morphologically conservative forms in the Late Triassic, by the end of the Mesozoic, theropods had diversified into a wide range of sizes, shapes, and ecological niches. The extent and pattern of morphospace occupation provides insights into factors that contributed to different morphologies, as well as trends and timing of diversification events. We examine the tempo and mode of theropod cranial evolution using discrete and continuous data, comparing the evolutionary rates of discrete characters to those within geometric morphometric space. The discrete character data was compiled from recent phylogenetic analyses, and the continuous data was produced by a principle component analysis on 2D Procrustes shape variables collected from the skulls of over 60 non-avian and early Aves taxa. Changes in morphological diversity through time were evaluated using multiple measures of disparity and compared to simulated data using Brownian motion models in discrete, continuous, and Procrustes character spaces. Allometric scaling plays a limited role in explaining interspecies variation, while skull morphology is significantly related to both adaptive and digenetic features within these and other fossil eggs and aid in determining the nature and timing behind the fossilization of eggs in the Tiantai Basin.

Poster Session II (Thursday, November 3)

LANDSCAPE NEOTAPHONY AND EAST AFRICAN CARNIVORE GUILD STRUCTURE: MODELING HOMININ SCAVENGING OPPORTUNITIES BEHRENSMEYER, Anna, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; BEHRENSMEYER, Anna, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; BLUMENSCHINE, Robert, Rutgers University, New Brunswick, NJ, USA; FAITH, John, The George Washington University, Washington, DC, USA

Landcape-scale bone assemblage structure and the amount of carcass resources available for hominins consumption are determined in part by population densities of carnivores relative to those of prey and carnivore guild structure. Because of hyeind bone-cracking adaptations, their population density compared to that of other carnivores such as meat-slicing large felids has a significant impact on what animal resources remain on the landscape after the initial predation event. Based on observations in Serengeti National Park/Ngorongoro Conservation Area (Tanzania) ecosystem, it is argued that among different habitats, those with large numbers of hyenas, particularly spotted hyenas (Crocuta crocuta), will present fewer scavenging opportunities for hominins. Neotaphonomic surveys in Amboseli National Park (Kenya) ecosystem document the effects of changing spotted hyena densities over time on bone survival and carcass fragmentation. In this study, we compare data on carcass fragmentation following bone destruction from Serengeti/Ngorongoro and data from Amboseli and new data from Shompole Conservation Area in southern Kenya. We test the generality of the relationship between spotted hyena density and carcass fragmentation across different habitats and through time. In environments with the highest spotted hyena density, we find the lowest skeletal element evenness (an index of carcass completeness), depressed axial skeletal element frequencies, and increased deletion of long bone epiphyses. Based on our observations in modern ecosystems, it is clear that past hominin scavenging opportunities must be considered in the context of dynamic ecosystems in which the abundance of bone-cracking carnivores can change over time and across habitat boundaries. Past scavenging opportunities would be expected to increase in times and places where bone-cracking members of the carnivore guild were relatively rare, suggesting that the abundance and paleolandscape distribution patterns of associated stone artifacts and hominin-modified vertebrate remains could reflect varying Plio-Pleistocene carnivore guild structures.
data show similar patterns of occupation in the Triassic and Jurassic, but significantly different patterns in the Cretaceous. Real data occupies a region of morphospace outside of that predicted by Brownian motion, corresponding to skulls with antero-posteriorly compressed antorbital regions, such as those of oviraptorids. Contrastingly, simulated data predict the expected by Brownian motion, corresponding to skulls with antero-posteriorly compressed antorbital regions, such as those of oviraptorids. Contrastingly, simulated data predict the

Extinct saurupods and mammals have fast bone growth as evidenced in both groups by fibroameloblast bone. This convergent trait is hypothesized to be related to the biomechanics of the bone. Because bone crystallography can provide insights into biomechanics, we examined principal crystallographic orientation and apatite crystal size in an ontogenetic series of long bone cortices of the sauropod Apatosaurus sp. These samples were compared with recent and subfossil mammal bones, with the use of X-Ray diffraction and transmission electron microscopy (TEM).

Crystallographic texture investigations describe the degree of preferential orientation of apatite crystals during different growth stages of the sauropod. Similar to recent animals, our TEM results for Apatosaurus revealed distinctly different crystallographic orientations between primary and secondary bone as well as intermediate structures in secondary osteonal bone. Our X-Ray diffraction results indicate that an initial 001 crystallographic fibre texture aligned to the direction of the bone axis is maintained during all stages of ontogeny, even with progressive bone remodeling. This type of texture seems to be the most efficient pattern for resisting high compressive loads. The texture index in Apatosaurus was higher than in recent animals with the exception of the elephant, which had an equivalent index. Our result suggests that texture strength correlates with the weight of the animal.

Crystal sizes were determined using both techniques as well. Apatite crystals in fossil bone are larger than in recent and subfossil mammal bone, which is usually interpreted as a diagenetic effect. Although crystal size does not necessarily increase through sauropod ontogeny, a young Apatosaurus sample has a much wider crystal size distribution compared to the femora of an adult individual from the same locality. This suggests a relationship between crystal size distribution and ontogenetic age rather than a diagenetic effect. Apatite crystals in woven primary bone are smaller and have a higher aspect ratio (ratio between longer and shorter crystal dimension) than crystals in mature lamellar bone.

Posterb Session IV (Saturday, November 5)

FAIRMERE LANDFILL: A DIVERSE MIDDLE IRVINGTONIAN BIOTA IN CALIFORNIA’S CENTRAL SAN JOAQUIN VALLEY

DUNSTON, Matthew, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; CANCHOLA, Joe, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; ASAMI, Rebeca, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; NG, My, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; CANDOLA, Joe, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA

While there are several dozen Irvingtonian localities in North America, few sites fall within the 0.78 Ma to 0.55 Ma range, the age of Fairmarine Landfill. Located along State Route 99 ten miles north of Madera, California on the Chowchilla River alluvial fan, Fairmarine Landfill has produced thousands of specimens since the discovery of fossils there in 1993. The site preserves a middle Irvingtonian biota consisting of 57 taxa (27 mammals, 5 birds, 3 reptiles, 2 amphibians, 1 fish, 1 bivalve, 1 gastropod, 1 plant macrofossil, 16 diatoms). For example, 122 mammal taxa have been identified, including 5 of Ectenomys, 3 of Dipodomys, 2 of Hesperomyidae, and 1 of Perotomys. The site has yielded several important finds, including a nearly complete skeleton of a large marsupial, a partial skeleton of a large rodent, and a partial skeleton of a large mammal identified as a member of the family Phalangeridae.

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GIANI COECLANCANTH MEGALOCOELACANTHUS DOBIEI FROM THE UPPER CRETACEOUS OF NORTH AMERICA AND ITS BEARINGS ON THE PHYLOGENY OF MESOZOIC COECLANCANTH

DUTEL, Hugo, Muséum national d'Histoire naturelle, Paris, France; MAISEY, John, American Museum of Natural History, New York, NY, USA; SCHWIMMER, David, Columbus State University, Colombus, GA, USA; JANVIER, Philippe, Muséum national d'Histoire naturelle, Paris, France

Megalocoelacanthus dobiei, a giant fossil coelacanth from the Late Cretaceous strata of North America, is re-described based on new complete and outstandingly preserved material. M. dobiei has been previously described on the basis of composite material that consisted of isolated elements. Consequently, many aspects of its anatomy remained unknown. Previous studies have suggested that M. dobiei is closer to the extant Latimeria and Macropoma than to M. macropoma, both from the Cretaceous. However, this assumption was only based on the morphometric analysis of the overall similarity of few anatomical features, but not on a phylogenetic character analysis. The new material allows the detailed description of the skull of M. dobiei and a new phylogenetic analysis of Mesozoic coelancaths. Although strongly flattened, the skull and jaws are preserved in three dimensions and show many derived features that are shared with Latimeriidae such as Latimeria, Macropoma and the Jurassic genus Libys. Notably, the parietonasal shield is narrow and flanked by very large, continuous vacuities forming the supraorbital sensory line canal. Such an unusual morphology is also known in Libys. Other features of M. dobiei such as its large size and the absence of teeth are shared with Mawsonia and Axelrodiichthys. Previsous phylogenetic analysis suggested a group relationship between these two taxa within Mawsoniidae. This close affinity between toothless, meter-sized Mesozoic coelancaths raised the question whether these features could have evolved once, or independently in several lineages. Our cladistic analysis supports the sister-group relationship of dobiei and Libys. This topology strongly suggests that toothless, large-sized coelancaths evolved in both the Latimeriidae and Mawsoniidae during the Mesozoic.

A DROWNED MESOZOIC BIRD BREEDING COLONY

DYKE, Gareth, University College Dublin, Dublin, Ireland; VREMIR, Matyas, Transylvania Museum Society, Cluj Napoca, Romania; KAISER, Guy, Royal British Columbia Museum, Victoria, BC, Canada; NAISH, Darren, University of Portsmouth, Portsmouth, United Kingdom

Despite a rapidly improving fossil record, the reproductive biology of Mesozoic birds remains poorly known: only a handful of undisputed, isolated Cretaceous eggs (some containing embryonic remains) are known. We report fossil evidence for a breeding colony of Mesozoic birds, preserved at the Upper Cretaceous (Maastrichtian) Oarda de Jos (Od) site in the Sebes area of Transylvania, Romania. This assemblage, preserved as a single, massive, lens-like accumulation deposited by floodwater and collected from the basal fluvio-paludal portion of the Sebeș section, includes the bones of adult enantiornithine birds, neonate skeletons-like accumulation deposited by floodwater and collected from the basal fluvio-paludal and a new phylogenetic analysis of Mesozoic coelancaths. Although strongly flattened, the skull and jaws are preserved in three dimensions and show many derived features that are shared with Latimeriidae such as Latimeria, Macropoma and the Jurassic genus Libys. Notably, the parietonasal shield is narrow and flanked by very large, continuous vacuities forming the supraorbital sensory line canal. Such an unusual morphology is also known in Libys. Other features of M. dobiei such as its large size and the absence of teeth are shared with Mawsonia and Axelrodiichthys. Previsous phylogenetic analysis suggested a group relationship between these two taxa within Mawsoniidae. This close affinity between toothless, meter-sized Mesozoic coelancaths raised the question whether these features could have evolved once, or independently in several lineages. Our cladistic analysis supports the sister-group relationship of dobiei and Libys. This topology strongly suggests that toothless, large-sized coelancaths evolved in both the Latimeriidae and Mawsoniidae during the Mesozoic.

INFERENCES OF THE PALEOECOLOGY OF THE BASAL PLEURODIRE NOTOEMYS ZAPATOCENSI S BASED ON COMPUTED TOMOGRAPHY IMAGERY

EARLY, Catherine, North Carolina State University, Raleigh, NC, USA; CADINGA, Edwin, North Carolina State University, Raleigh, NC, USA; KSEE, K., Denver Museum of Natural History, Denver, CO, USA; CADINGA, Philip, North Carolina State University, Raleigh, NC, USA

In 2006, a new specimen of the primitive platychelyid pleurodirid turtle Notoemy zapatocensis was found in a limestone layer of the Rosablanca Formation of Colombia, which has been dated to the Late Valanginian (Early Cretaceous). This specimen is the first and only one of this species to preserve a fully articulated carapace and plastron. In order to examine the skeletal elements embedded in matrix infilling the shell, CT images were obtained. Scans reveal that much of the vertebral column, the pelvic girdle, and the axillar and inguinal buttesres are preserved in the shell. Details of these elements offer insight on this basal pleurodirid turtle’s likely paleoecology. The morphology and orientation of the pelvis indicate that Notoemy zapatocensis inhabited an aquatic environment. However, the geologic context for all known specimens suggests that these turtles inhabited near-shore environments, in contrast to the freshwater habitats occupied by all extant pleurodirids. The vertebræ and the attachment sites for the ribs can provide information on the shape of the costovertebral tunnel, formed by the ribs, carapace, and vertebræ, and how this has changed over time by comparing our specimen with the extant pleurodirid Chelus fimbriatus (Matamata). The costovertebral tunnel is greatly enlarged as in Chelus fimbriatus, indicating a large longisimus dorsii muscle, which is involved in the quick striking feeding motion in prey captures in Chelus fimbriatus. Based on morphology and ecological context, we infer a similar ambush predator ecology for Notoemy zapatocensis.

RESOURCES PARTITIONING IN LATE MIOCENE CENTRAL EUROPEAN MAMMALS: ISO TOPE EVIDENCE FROM THE RUDABÁNYA FAUNA

EASTHAM, Laura, University of Toronto, Toronto, ON, Canada; FERANEZ, Robert, New York State Museum, Albany, NY, USA; BEGUN, David, University of Toronto, Toronto, ON, Canada; LASZLO, Kordos, Geological Institute of Hungary, Budapest, Hungary

The Vallesian Crisis (9.7 Ma), a Late Miocene mammalian turnover event recorded throughout Europe, marks the extinction of many closed forest adapted faunal forms that were characteristic of the Middle Miocene. In western and central Europe this turnover event is associated with increasing seasonality, as well as a shift in vegetation from subtropical evergreen to deciduous forest. Examining how fauna coexist within these changing forest ecosystems is critical to understanding Late Miocene mammalian evolution and dispersal patterns. The rich Late Miocene mammalian assemblage of Rudabánya in north-central Hungary provides a unique opportunity to examine resource use and partitioning during this time in Europe. To evaluate resource use and partitioning among the Rudabánya fauna, we examine the stable carbon and oxygen isotope values in enamel from ten genera of medium to large-bodied herbivores. Sampled taxa include Hippotherium intravus, Motroscoragus sp., Tetralophodon longirostris, Acracercus incisivum, Chalicotherium cf. goldfussi, Dorcatherium nani, Luctenicta apies, Micromeryx florensen- sius, Parachlenaechthus kreuzeri, and Protopamotherium palaeochoerus. Isotopic values of the sampled fauna (n=65) conform with foraging in a forest to woodland environment, with restricted areas of closed canopy. The range of carbon isotope values indicates a diet of predominantly, if not entirely, C3 resources. Significant differences in oxygen and carbon isotope values occur among taxa, indicating resource partitioning. For example, the tragulid D. nani shows the most negative carbon values, suggesting feeding in a closed canopy. In contrast, the suid M. florensen- sius shows the least negative carbon values, suggesting a preference for more open settings, possibly forest clearings. The relatively more negative oxygen isotope values of T. longirostris and A. incisivum may indicate feeding on fruits. The carbon values of A. incisivum, suggest similar habitat preferences to extant browsing rinoce rosos. These results provide insight into the paleoecology of the Rudabánya fauna during a highly dynamic period in the evolution of terrestrial mammals in Europe.
MAMMALIAN DIVERSITY IN THE EARLY EOCENE HIGH ARCTIC

EBERLE, Jaclyn, University of Colorado at Boulder, Boulder, CO, USA; DAWSON, Mary, Carnegie Museum of Natural History, Pittsburgh, PA, USA

As a result of over three decades of paleontological fieldwork in Canada's High Arctic, at least 23 mammalian genera in some 17 families and 11 orders, ranging from plagiomimic primates to creodonts and carnivorans to tapirid perissodactyls, are documented from early Eocene (late Wasatchian; ~52-53 Ma) fossil vertebrate assemblages in the Eureka Sound Group on Ellesmere Island, Nunavut. Eocene mammalian fossils are considerably less abundant in the Arctic than at North American mid-latitude localities; specifically, a total of approximately 200 mammalian specimens diagnosed to genus level are known from central Ellesmere Island, and approximately one-third of these specimens were recovered from a single locality – Locality 85 near Bay Fiord on central Ellesmere Island (~79°N). However, rarefaction techniques can be used to compare diversity in samples of different size. With these data, we have calculated diversity curves for Eocene localities in the Arctic. Our results indicate that mammalian generic richness in the Early Eocene Arctic Locality 85 is within the range of expected richness for comparably aged, mid-latitude North American localities. Specifically, Locality 85 appears to support more diversity than expected diversity in the Green River Basin, though less diverse than the Wind River Basin fauna (especially from University of Colorado Museum Locality 80062, known for its productivity and unusually high species richness). While mammalian diversity seems numerically comparable at mid- and high-latitude localities, there are notable differences in faunal composition. At the Early Eocene mid-latitude localities, Hypopodus is the most abundant taxon and actinodactyls occur in modest diversity, whereas neither taxon is known from Arctic Locality 85, where plagiomimic primates are the most abundant faunal element. An implication of our study is that a relatively flat latitudinal diversity gradient for North American mammals existed during the Early Eocene, which correlates with a reduced latitudinal temperature gradient for this time interval noted by prior paleoclimate studies. This is in stark contrast to today's steep latitudinal diversity gradient in North American mammals.

SYNCHROTRON RAPID SCANNING X-RAY FLUORESCENCE OF SOFT-TISSUE PRESERVED IN FOSSILS

EDWARDS, Nicholas, University of Manchester, Manchester, United Kingdom; BARDEON, Holly, University of Manchester, Manchester, United Kingdom; MANNING, Phillip, University of Manchester, Manchester, United Kingdom; BERGMANN, Uwe, SLAC National Accelerator Laboratory, Linac Coherent Light Source, Menlo Park, CA, USA; WOGEILUS, Roy, University of Manchester, Manchester, United Kingdom

Geochemical and biological analytical techniques have been employed by others in the identification and quantification of soft-tissues from the fossil record. However, almost all of these techniques require destructive sampling and are unable to provide high resolution, large scale, spatially resolved chemical information from fossil material. Synchrotron rapid scanning x-ray fluorescence (SRS-XRF) developed at the Stanford Synchrotron Radiation Lightsource (SSRL, CA, USA), non-destructively provides highly sensitive, in-situ and large scale 2D elemental maps with rapid scanning times (~30 sec/cm²). SRS-XRF reveals the distribution of elements present in a sample at concentrations below the detection limits of many conventional geochemical techniques. Furthermore, we have uniquely combined x-ray absorption near edge spectroscopy (XANES) with SRS-XRF to produce maps showing the distribution of only organic material or specific species within fossil material. Our recent multi-technique study of fossilised reptile skin (Green River Formation, USA, ~50 Ma), employing SRS-XRF, Fourier Transform Infrared (FTIR) spectroscopy and Pyrolysis-Gas Chromatography/ Mass Spectrometry, strongly suggests that remnants of the living organism’s original chemistry (protein-derived compounds) are preserved. FTIR maps of the fossil skin reveal that amide functional groups are discretely correlated with preserved scales, and this pattern is directly comparable to that observed in extant reptile skin. Py-GCMS demonstrates that the chemical inventory of the skin is markedly different from the surrounding matrix. Trace metal composition and distribution revealed by SRS-XRF within the fossil skin is also comparable to extant skin. These results are duplicated in another preserved reptile skin specimen from the Green River Formation. From these results, a new taphonomic model has been proposed to explain the survival of these compounds, involving ternary complexation between organic molecules, trace metals and silicate surfaces.
undoubtedly held many more. Most of the tracks are referable to therapsids and occur as
noteworthy in several ways. Although therapsid tracks have been reported from other
sites in deposits of this Early Jurassic erg in the western US, this slab is especially
engaging for the following reasons:

1. The slab is composed of a nearly integregous bed of the Early Jurassic desert deposits of the
western US have been referred to the genus *Brachycnichum*.

2. The orientation of the loose slab can be determined from wind ripples oriented parallel to dip
across the lee surface. A number of tracks can be identified. Most tracks are directed up slope,
as evidenced by a crescentic push-up of sand at the back end of the impression. However, at
least two tracks are progressing downslope. These downslope trails show greater deformation
of surrounding sediment than upslope tracks. Collapse features define the upslope side of the
tracks. A flat-topped crescent occurs on the downslope side. Downslope impressions are
deeper at the front end of the impressions, and a few downslope tracks show toe impressions.
A few tracks traverse the slope as indicated by the orientation of toe impressions.

3. Track size ranges from a width of 32mm to 7mm. The latter among the smallest therapsid/
mammaloid tracks reported from the Jurassic. Other therapsid track sites from Early Jurasic
erg deposits consist of few trails and a limited number of tracks, most reports indicating
tracks of similar size. It has been suggested that different size tracks represent different
species or different body lengths. If true, then it would appear that the species were segregated
and did not occupy the same locales. Track variation on the Utah University slab shows that
either different therapsid species, or adults and juveniles of the same species occurred
together, or both of these factors are true.

**Technical Session VI (Thursday, November 3, 3:30 pm)

**PHYLOGENETIC PATTERNS OF PTEROSAUR WING SKELETON ALLOMETRY**

*Engelmann, George, University of Nebraska - Omaha, Omaha, NE, USA; Chure, Daniel, Dinosaur National Monument, Jensen, UT, USA*

A single slab of Nugget Sandstone on exhibit at the University of Utah preserves a remark-
able record of therapsid tracks. The Early Jurassic Nugget Sandstone was deposited in a vast
erg that covered much of the western US. Although therapsid tracks have been reported from
other sites in deposits of this Early Jurassic erg in the western US, this slab is especially
noteworthy in several ways. Nearly 400 tracks are preserved on the 1.8m x 1.2m slab and the original, complete surface
unoubtedly held many more. Most of the tracks are referable to therapsids and occur as

**Poster Session IV (Saturday, November 5)

**THE SYSTEMATIC UTILITY OF THE ILIO-SACRAL BLOCKS OF THE EUROPEAN STEGOSAUR DACENTRURUS ARMATUS**

*Escaño, Fernando, Unved, Madrid, Spain; Ortega, Francisco, Uved, Madrid, Spain; Sanz, José Yum, Madrid, Spain; Malafaia, Elisabete, Mnh, Lisbon, Portugal*

*Dacentrurus armatus* was the first stegosaur named, and until recently was considered one of
the most widespread European dinosaurs. Currently, *Dacentrurus armatus* is restricted to the
most widespread European dinosaurs. Currently, *Dacentrurus armatus* is restricted to the
type material (BMNH 46013) from the Kimmeridgian of England, whereas the rest of
these specimens described in France, Portugal and Spain (and previously ascribed to this spe-
cies) are considered only at generic level. Unfortunately, the incompleteness of the numerous
partial skeletons reported date difficult to define a solid character combination to diagnose
this taxon. One of the most common skeletal remains preserved for this stegosaurus are the
pelvic bones, highlighting ilio-sacral blocks. Here we discuss the taxonomic relevance of the
ilio-sacral blocks of this dinosaur based on a reevaluation of Portuguese specimens.

The study of this material indicates that the pelvic girdle of *Dacentrurus armatus* is unique
among stegosaurs showing, at least, two exclusive autapomorphies on the ilio-sacral region.
The ilio-sacral blocks of *Dacentrurus armatus* show a smooth curvature between the anterior
margin of the sacral plate and the medial margin of the iliac anterior process and, when preserve,
a cranially short and broad anterior process of the ilium. Thus, these two features and the
transverse breadth of the supraacetabular region provide a butterfly-shape to the ilio-sacral
block of *Dacentrurus*, are diagnostics for this taxon. Slight differences observed in the ilio-
sacral blocks from the European *Dacentrurus* specimens are explained as the result of tapho-
onomical distortion or individual variation, including sexual dimorphism.

**Preparers’ Session (Thursday, November 3, 8:00 am)**

**NEW APPLICATIONS FOR MEDIUM AND SMALL SCALE 3D PHOTOGRAMMETRY IN VERTEBRATE PALEONTOLOGY**

*Esker, Donald, The Mammoth Site of Hot Springs, South Dakota, Hot Springs, SD, USA*

Photogrammetry is the science of taking measurements from photographs. In the past
this was done strictly on the largest scales for the purpose of producing topographic maps. The
process required precisely calibrated equipment and took time-consuming, painstaking man-
ual labor; thus photogrammetry on the scale of a single paleontological site was impractical.
Fortunately, recent advances in computer processing power and new software has brought
photogrammetry into the digital age and made it a practical tool for bonebed cartography.
Simply by loading multiple images into the appropriate program, would-be photogrammetri-
cians can produce a precise and accurate three dimensional representation of nearly any
surface, at nearly any scale. The significance of these advances was not lost on paleontologists.
Digital photogrammetry has been used for years to document and monitor large ichnosites
with great success. The technology need not be limited to the study of trackways; with
appropriate vantage points, entire paleontological sites can be mapped. On the other end of
the scale, it is possible to combine macrophotography with photogrammetry to produce accurate
three-dimensional computer models of even the tiniest specimens.

At The Mammoth Site of Hot Springs South Dakota, progress is being made on both fronts.
Much of the western half of the sinkhole has been mapped with digital photogrammetry,
with results that compare well to the site’s state-of-the-art geographic information system
map. Researchers who are unable to travel to South Dakota can now study the bonebed
almost as if they were there in person. Macrophotography has proven invaluable for
studying the microfaunal material from the site. Most of this material has consisted of inver-
tebrate shells, scattered fish bones, and minuscule rodent teeth. By producing digital models
of these specimens, it is possible to examine them closely without risk of damage. With
the advent of rapid-prototyping, it is even possible to ‘print out’ a greatly enlarged copy of
the specimen under consideration. Photogrammetry promises to revolutionize paleontological
cartography at every scale.

**Technical Session XV (Saturday, November 5, 11:45 am)**

**THE INHIBITORY CASCADE IN MARSUPIALS**

*Evans, Alistair, Monash University, Melbourne, Australia; Proctor, Karlena, Monash
University, Melbourne, Australia*

The inhibitory cascade is a developmental and macroevolutionary model for the evolution
of relative molar sizes in mammals. It predicts that the relative sizes of molars follow a simple
formula, such that the middle molar in a series of three will always be 1/3 of the total row
area. In a morphospace of relative tooth sizes, plotted as m2/m1 vs m3/m1, the centre of the

**November 2011—PROGRAM AND ABSTRACTS**
morphospace at (1, 1) represents equal-sized teeth, and the inhibitory cascade is a diagonal line passing through the centre at y = 2x - 1. We present the first comprehensive test of the model in the second-largest radiation of extant mammals, the marsupials. Marsupials have four molars rather than the general maximum of three in eutherians, in which the model was developed. We investigated whether the presence of a fourth molar causes the molar proportions to substantially deviate from the pattern predicted by the inhibitory cascade in more than 50 modern and 10 fossil marsupial species. To do this we considered the molars 1-3 as the first series of three teeth and molars 2-4 as the second series.

We found more deviation from the predicted inhibitory cascade pattern in some species than found in most placental mammals. In a few species, such as the koala Phascolarctos cinereus, all four teeth are approximately the same size and so both series fall in the centre of the morphospace. In other species, such as the red kangaroo Macropus rufus, both series fell close to the inhibitory cascade line, but the first series was positioned further towards the top right-hand quadrant of the morphospace than the second series. Several species showed a pattern of the one series on the inhibitory cascade line and the other series below it (including the moun-
tain pygmy possum Burramys parvus), and in others, both series sat at an approximately equal distance below the line (such as Antechinus). The South American didelphids appeared more conservative in their deviation from the inhibitory cascade. Molar ratios for fossil species examined largely followed their closest extant relatives.

The inhibitory cascade line appears to form an upper bound in the morphospace in marsupi-
als, but some deviation below the line for one or both series is common. We conclude that the inhibitory cascade is therefore a major controlling factor in tooth size patterning but not the only developmental factor.

Symposium 3 (Thursday, November 3, 11:30 am)
NEW PERSPECTIVES ON THE EVOLUTION AND HISTORICAL BIOGEOGRAPHY OF CAMPANIAN HADROSAURIDS (ORNITHISCHIA) OF LARAMIDIA
EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; GATES, Terry, Field Museum of Natural History, Chicago, IL, USA
Hadrosaurs were a widespread and diverse group of ornithischian dinosaurs in Late Creta-
ceous ecosystems of Asia and North America. By any taphonomic mode, hadrosaurs domi-
nate Campanian dinosaur assemblages of western North America (Laramidia). Hadrosaurs therefore provide a taxonomically diverse, densely sampled dataset for evaluating hypoth-
eses of dinosaur evolution and biogeography in the Cretaceous. Considerable new efforts to
refine the biogeographic and geographic ranges of hadrosaurs in the Western Interior Basin (WIB) of North America have resulted in a high-resolution biogeographic framework that is summarized here. The biogeographic ranges of lambeosaurines are well documented in the northern WIB. New data on the biogeography of hadrosaurines in the Campanian of Alberta reveals no overlap between Prosauropodus and Gryposaurus within the Dinosaur Park Formation. Extensive overlap of G. notabilis and G. incurvimanus within a narrow stratigraphic range at the base of the Dinosaur Park Fm argues against their recognition as separate taxa. New high-resolution biogeographic data from the southern WIB reveals that with the possible exception of Gryposaurus notabilis, northern and southern regions of the WIB do not share any hadrosaurid species in common during the late Campanian, suggesting that dispersal between the two areas was limited during this time.

A new species-level phylogeny of hadrosaurine hadrosaurs provides a framework for assessing historical biogeography within this clade, as well as permits comparison and inte-
gration with the data for lambeosaurines. A cladistic historical biogeographic analysis (PACT) performed on hadrosaurine and lambeosaurine clades, with Pachycephalosau-
ridae used to resolve biogeographic ambiguities. The time-calibrated General Area Clado-
gram reveals at least one general dispersal event from North America to Asia in the late Campanian, possibly initiated by dropping sea-level at this time. The analysis also reveals interchange between northern and southern biotic provinces within the WIB occurred in the middle Campanian.

Technical Session IX (Friday, November 4, 10:45 am)
THE EARLY CRETACEOUS LIZARD YABEINOSAURUS: INSIGHTS FROM NEW SPECIMENS
EVANS, Susan, University College London, London, United Kingdom; WANG, Yuan, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China
The lizard Yabeinosauros tenuis was one of the first tetrapsods to be described from the Early Cretaceous Jehol Biota of north-eastern China, but it was misinterpreted for decades because both the lost holotype and a subsequent neotype were poorly preserved juveniles. However, the recovery and identification of more mature specimens from the Yixian and overlying Jiuf-
fotang formations (125-120 million years ago) has now shown that the adult Yabeinosauros was a large (~300 mm SVL) robust lizard that probably reached full size over several sea-
sons. New skeletal data, including scattered osteoderms, has allowed more comprehensive phylogenetic analysis, placing Yabeinosauros and its sister taxon, the roughly contemporane-
ous Japanese (Teziori Group) Sakurasaurus, on the scelerosaurian stem. It has also provided
a basis for a roundtable discussion. A recent comprehensive study has placed it within Adapisorculidae, but near the base of the eutherian tree. On the ecological side, it has been described as having an arboreal or scanorial lifestyle, based on similarities in ankle morphology with eutherians. We present a 3-D geometric morphometric (GM) study of the astragali to rigorously test hypotheses of Deccanolestes's phyletic affinities. We focus on the astragali because it bears several key characters that relate to foot mobility and is often used to characterize the locomotory ecology of extinct mammals. We further included relevant Paleocene and Eocene taxa, from extinct eutherians, such as Pliasidaeformes (Promochotheres and Deccanolestes), an early condylarthran. In addition, we constructed a neighbor-joining tree based on Euclidean distance

Poster Session I (Wednesday, November 2)
A 3-D MORPHOMETRIC ANALYSIS OF THE LOCOMOTORY ECOLOGY OF DECCANOLESTES, A EUTHERIAN MAMMAL FROM THE LATE CRETACEOUS OF INDIA
FABRE, Anne-Claire, University College London, London, United Kingdom; CORNETTE, Raphaël, Muséum National d'Histoire Naturelle, Paris, France; PRASAD, Guntupalli, University of Delhi, Delhi, India; BOYER, Doug, Brooklyn College, City University of New York, Brooklyn, NY, USA; GOWAMI, Anjali, University College London, London, United Kingdom
Known only from isolated dental, mandibular, and postcranial elements, the relationships and ecology of Deccanolestes, a eutherian mammal from the Late Cretaceous of India, have been a topic of considerable interest and debate. A recent comprehensive study has placed it within Adapisorculidae, but near the base of the eutherian tree. On the ecological side, it has been described as having an arboreal or scanorial lifestyle, based on similarities in ankle morphology with eutherians. We present a 3-D geometric morphometric (GM) study of the astragali to rigorously test hypotheses of Deccanolestes's phyletic affinities. We focus on the astragali because it bears several key characters that relate to foot mobility and is often used to characterize the locomotory ecology of extinct mammals. We further included relevant Paleocene and Eocene taxa, from extinct eutherians, such as Pliasidaeformes (Promochotheres and Deccanolestes), an early condylarthran. In addition, we constructed a neighbor-joining tree based on Euclidean distance
shape variables to identify similarities among taxa. Results show Deccanolestes to cluster most closely with plesiadapiforms, which, together with Protungulatum, form a separate cluster from all extant mammals and extinct Euprimates. The astragali represented by this cluster are more robust, with a relatively short neck. The astragalus morphology of Deccanolestes seems to have no analogue among living species, but this morphology ap-
ppears prevalent among Paleocene eutherian mammals. Consistent with previous studies, the morphological proximity of Deccanolestes to plesiadapiforms supports its reconstruction as an arboreal mammal.
Dietary adaptations in eocene archaeanocete whales revealed by microwear and macrowear analysis and stomach contents

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Eocene archaeanocetes gave rise to all modern whales. The cetacean transition from life on land to life in water is well-documented in the fossil record. It has been hypothesized that an early shift to piscivory initially caused cetaceans to abandon land. To assess archaeanocet diet and its evolution through time, we analyzed microwear of pachydont, protocetid, and basosaurid archaeanocetes, representing the full terrestrial-to-marine transition throughout the Eocene. We quantified wear features on shearing facets of upper and lower cheek teeth using low-magnification stereoscopic microwear analysis. Our modern comparative sample included terrestrial carnivores, felid, and hyaenid carnivores, (semi-)aquatic mustelid, phocid, otariid, and odobenid carnivores, marine delphinid and phocoenid odontocetes. Archaeanocetes have more scratches and fewer pits than terrestrial and aquatic predators, but overlap with odontocetes and pinnipeds. Large pit numbers are higher than in the modern sample, suggesting the presence of more hard objects in the archaeanocete diet. Microwear microwear most closely resembles that of delphinids and otariids. These results suggest that their diet consisted of fish and cephalopods, and likely included crustaceans. An exception is the earliest cetacean in this study, Pakicetus inachus, which has previously been assumed to have foraged in freshwater. Microwear of P. inachus resembles that of the modern walrus, which is a bottom feeder relying mostly on invertebrates. Stomach contents of Dorudon ater consist of fish, but stomach contents of Basilosaurus isis include remains of juvenile Dorudon besides pycnodonts and sharks. Macroscopic tooth wear shows more evidence of crushing in B. isis than in any other archaeanocete, and microwear shows heavy gouging, supporting the hypothesis that B. isis fed on organisms with a heavy skeleton or shell, like large mammals or large reptiles. We conclude that piscivory developed early in cetaceans, possibly via a stage of bottom-feeding in Pakicetus. Piscivory was maintained during whale evolution, occasionally supplemented with crustaceans. Some later forms included mammal meat in their diet (Basilosaurus, Orea).

Technical Session XI (Friday, November 4, 1-4:55 pm)

Evolutionary trends in sauropod body plan expressed in fossil tracks and trackways

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Fossilised tracks are widely cited as providing evidence of behaviour, biomechanics and ecology of vertebrates, thus complementing and supplementing the osteological record. However, trackways are often overlooked in macroevolutionary studies. The loading of the foot is a direct result of the limb motion relative to the centre of mass of the animal, and variations in limb motion or centre of mass may be expressed in the 3D morphology of any resultant track. For example, variations in centre of mass of quadrupedal animals will result in differential loading between manus and pes, which when combined with the relative surface areas of fore- and hind-feet, may produce drastically different under-foot pressures. If a substrate exhibits an elastic-plastic behaviour, a specific load will be required to exceed the elastic response of the substrate and cause it to plastically deform and produce tracks. We interpret this as being the result of sauropods evolving to be more ‘front heavy’ through-out the course of their evolution. Additionally, the substrate types in which manus- or pes-dominated tracks from the Eocene. We show that predicted underfoot pressures of different sauropod dinosaurs preferentially restrict to non-cohesive substrates (e.g. sandstones). This may be the result of niche parti-tioning among sauropod taxa, associated with the Cretaceous diversification of the anatomically and environmentally specialised titanosaurs.

New data on two large dinosaur tracksites from the middle Jurassic of eastern Turkmenistan, central Asia

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A collaboration between the University of Bologna, Italy, and the National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection of Turkmenistan allowed to visit one of the largest dinosaur tracksite ever reported in Central Asia. This unique site is located in the Koidaing National Park, Lebap Province, north-eastern Turkmenistan and has been assessed an Oxfordian-Kimmeridgian age. Known as the ‘ Hodjapil-ata’ tracksite, it has been the object of two preliminary studies by K. Amanarzakov in the 80’s and later by a team led by Martin Lockley in the 90’s. Accurate GPS mapping as well as a comparison with previous studies provide the most detailed database available for this extraordinary site. The track-bearing surface, resulted from an ancient landslide, is exposed discontinuously over an area of 28.500 sq.m. Four continuous trackways exceed 95 meters in length, and two reach approximately 220 meters. We conclude that 22 trackways and a total of 7966 prints are preserved, and confirm the existence of the two ichnogenera Megalosauripus and Therapspondylus. To support these conclusions, several footprints and tracks have been measured and acquired by using high-resolution photogrammetry and secondarily examined with 3D software. In addition, a second and previously unreported site named “Ak gaya” (meaning “white stone”) located a few km to the east has been studied. Overall the exposed sections of the track-bearing surface extend over 24.000 sq.m., and a total of 40 trackways and 730 footprints have been mapped and measured. Moreover, isolated footprints have been observed in a second layer which is largely covered by slumped detrital and several outcrops were not examined due to weather conditions. Rock samples were taken from both sites in order to refer the track-bearing layers to a specific depositional facies. These sites represent the sole evidence of dinosaurs in Turkmenistan and they are among the richest in the world.

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CROCODYLOFORM AQUATIC LOCOMOTION AND AXIAL FLEXIBILITY: COMPARATIVE VERTEBRAL ANATOMY OF MESOEUCROCODILIANS

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As semi-aquatic predators, modern crocodilians display a wide range of locomotor patterns, including semi-erect high walk, sprawling low walk, and undulatory swimming. Although the functional morphology of terrestrial locomotion in crocodilians is well documented, the current understanding of aquatic locomotion remains incomplete due to observation that thrust is accomplished by using vertebral column undulations. In other undulatory swimmers, locomotor behavior is constrained by axial flexibility, which is mediated by the skeletal, muscular, and integumentary systems. For instance, regional variation in vertebral anatomy of marine undulatory swimmers underlies their relative flexibility. In crocodilians, axial mobility is also constrained by skin elasticity and osteodermal configuration. The present study seeks to characterize axial skeleton morphology in representative extant and extinct crocodiliforms, including those occupying terrestrial, semi-aquatic, and fully marine habitats. We evaluate the hypothesis that, like other swimming tetrapods, crocodilians possess specialized axial skeletal morphology related to a semi-aquatic lifestyle. The tail of crocodilians is stiffest proximally, increasing in flexibility distally. The vertebral anatomy is predicted to reflect this trend and to correlate with locomotor style.

We quantified vertebral metrics (e.g., centrum length, centrum height, neural spine height) in seven extant species, including representatives of the major crocodilian clades (e.g., Caiman crocodilus, Alligator mississippiensis, Gavialis gangeticus), and several mesoeucrocodilians (e.g., Pliosuchus, Simosuchus). Methods for comparing serial structures were applied to analyze the vertebral metrics. Preliminary data show that semi-aquatic and terrestrial crocodilian crocodiliforms differ in that terrestrial taxa have dorsal centra that are approximately as wide as they are tall, whereas semi-aquatic crocodiliforms have dorsal centra that are wider than they are tall. This supports the hypothesis that swimming crocodiliforms have different vertebral anatomy than their terrestrial relatives, providing new insight into the biomechanics and ecomorphology of Crocodylia.

Romer Prize/Technical Session 5 (Thursday, November 3, 11:45 am)

EVIDENCE FOR NICHE CONSERVATISM IN PLEISTOCENE MAMMALS FROM EUROPE

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Niche conservatism suggests that species maintain their ecological characteristics over time, which has implications for speciation and creation of biodiversity. While the concept of niche conservatism has, in general, been supported by data, many studies on the topic do not directly examine aspects of a niche over the time span that a particular species existed. Instead, these studies use proxy data to infer niche characteristics, such as a species’ geographic range. The aim for this study was to investigate the concept of niche conservatism using data that directly examined aspects of niches over time. The study focused on iden-
tifying diet and habitat use in mammals, and specifically tested the hypothesis that species maintain their ecology and ecological relationships over spatial and temporal scales during the Pleistocene of Europe.

To determine the ecology of ancient species, stable carbon and oxygen isotopic values from the tooth enamel of large mammals were examined. The analysis of δ13C and δ18O values obtained from the teeth of fossil mammals has proven extremely useful for ascertaining the paleoecology of ancient species. Numerous additional samples were obtained and compared to previously published data from sites in Central and Western Europe. Results show that C3 plants dominated the Pleistocene landscape of Europe as they do today. Horses (Equus sp.), red deer (Cervus elaphus), and bovids (i.e., Bos primigenius and Bison sp.) commonly displayed the most positive δ13C values and maintained a regular ecological relationship when present together at a locality. Consistently, the most negative δ13C values were displayed by individuals in the cave bear lineage (i.e., Ursus spelaeus, Ursus deningeri), and suggest herbivory. For oxygen, canids (Canis sp.) generally displayed the most positive δ18O values, which may relate to obtaining water from a different source than the other analyzed taxa. Overall, the data show limited isotopic differences over time and between localities implying that species maintained their ecology. These data support the tested hypothesis as well as the concept of niche conservatism in Pleistocene European mammals.

Poster Session II (Friday, November 4)

A NEW MARINE TETRAPOD ASSEMBLAGE FROM THE EOCENE OF WESTERN SAHARA

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Late Eocene basalsaurid archaecoetes whales in Africa have been reported from Egypt, Libya, Tunisia, and Senegal. Recently, they have also been reported from the Sambat Formation, which outcrops in coastal Western Sahara. On the basis of its shark fauna, at least part of the formation has been roughly assigned to the late Eocene, approximately 37 to 34 million years before present. Fieldwork in March 2011 yielded numerous marine tetrapod fossils, in addition to a single Lambeothorax tooth, a single basilosaurid tooth, and abundant selachian remains that have already been described. Tetrapod remains include several specimens of both large and small archaecoetes whales (tentatively identified as Basilosaurus sp. and Dorudon sp., as well as an additional even smaller basilosaurid), marine crocodiles and rare turtles. On the basis of preliminary results from ongoing analyses, the marine tetrapod as-
semblance appears to be similar to that from late Eocene beds of the Fayum, Egypt. Although we are awaiting detailed biostratigraphic results from analysis of marine dinoflagellates, the Samlal Formation’s tetrapod fauna supports its referral to the late Eocene as indicated by the selachian fauna. The excellent quality of preservation and abundance of the vertebrate material from this region make these poorly understood fossil beds extremely promising, and have the potential to yield new insights into the paleobiogeography and diversity of late Eocene archaeocetes.

Poster Session II (Thursday, November 3)

A FOURTH SPECIES OF APATEODUS (TELEOSTEI: AULOPIFORMES) AND ITS IMPLICATIONS TO THE DIVERSITY OF APATEODUS

FIELITZ, Christopher, Emory & Henry College, Emory, VA, USA; SHIMADA, Kenneth, DePaul University, Chicago, IL, USA; FRIEDMAN, Matt, University of Oxford, Oxford, United Kingdom

Apateodus is a Late Cretaceous aulopiform fish genus of the suborder Ichthyopterygii previously known by only three species, the North American A. buesseni and the European A. glyphodus and A. striatus. Here, we describe a second North American species of Apateodus based on a partial skeleton (AMNH FF 11560) from the Smoky Hill Chalk Member of the Niobrara Formation of western Kansas, which is housed in the American Museum of Natural History, New York. We place AMNH FF 11560 within the based on the diagnostic presence of a diastema between the first and second palatine teeth that is filled by teeth from the dentary when occluded. This unique feature is not found in any other fossil aulopiform taxa. It is a new species based on the large hyomandibula and metapterygoid. It shares several features of the mandible with A. buesseni that differ from conditions in A. striatus. These include a more slender mandible, thinner dentary teeth, the angular only making up about 20% of the mandible, and a more prominent retroarticular process. Like A. buesseni, this new species was slender fish. Whereas A. buesseni is known from Kansas, A. glyphodus and A. striatus are from the UK and Belgium, isolated bones and teeth of Apateodus have been reported from localities worldwide including Germany, southwestern Russia, India, western Canada, western USA, and Bolivia. Additionally, there is an isolated mandible, also from the Smoky Hill Chalk, that is likely to be another species of Apateodus. The recognition of the fourth species of Apateodus is significant because it provides a reasonable assertion that the genus, which geologically ranged from the Albian to Maastrichtian, was likely much more speciose than what is known today.

Poster Session II (Thursday, November 3)

A NEW SPECIMEN OF ARARIPESUCHUS (MESOEUCROCODYLIA) WITH SOFT TISSUE PRESERVATION FROM THE LOWER CRETACEOUS ROMUALDO FORMATION (ARARIBE BASIN), BRAZIL

FIGUEIREDO, Rodrigo, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil

The Araribe Basin is famous worldwide for its two fossiliferousstätten: the Lower Cretaceous (Aptian-Albian) Crato and Romualdo Formations of the Santana Group. Of those, the Romualdo Formation has shown several vertebrates with soft tissue preservation, particularly observed in fishes but also very rarely in dinosaurs and pterosaurs. Here we report a new specimen of the crocodyliform Araripesuchus sp. that shows soft tissue in several portions of the skeleton. The specimen (MN 7061-V) is almost complete, including skull, lower jaw, partial fore and hind limbs, and most of the vertebral column, which is covered by two rows of osteoderms. The morphology of the rostrum is alike to that of other Araripesuchus species allowing the assignment of this material to that genus. The orbit size and its proportions in MN 7061-V are similar to A. gomesii, but rather smaller than in A. patagonicus, A. buitreraensis, and A. tsangatsangana. MN 7061-V has long and slender limbs, which are also reported in A. gomesii, A. patagonicus and A. tsangatsangana. This is consistent with the current idea of araripesuchids as cursorial animals. The main feature of this specimen is the preservation of large portions of soft tissue close to the abdominal region and along the axial skeleton. It is preserved as a white substance and is most likely phosphatised, similarly to what has been observed in other reptiles from this deposit. Preliminary studies under UV light shows that most of the soft tissue is composed of muscle fibers, but in some parts the epidermis is also visible. A large mass of white substance is observed anterior to the pelvic region, but no stomach contents could be identified yet. To our knowledge, MN 7061-V shows the best soft tissue preservation in an extinct member of the Crocodyliformes.

Poster Session III (Friday, November 4)

MAMMALIAN FAUNAL DYNAMICS IN NORTH AMERICA OVER DEEP TIME

FIGUEIRIDO, Borja, Brown University, Providence, RI, USA; JANIS, Christine, Brown University, Providence, RI, USA; PÉREZ-CLAROS, Juan, University of Málaga, Málaga, Spain; PALMOVIST, Paul, University of Málaga, Málaga, Spain

We show here that the North American fossil record of large Cenozoic mammals can be summarized by six evolutionary faunas, each characterized by the predominance of a cluster of associated taxa (subfamilies) over sequential time intervals. These faunal groupings were determined by a Q-mode factor analysis of taxonomic presence/absence data. The data were binned into 26 subequal time intervals, and we selected those factors with eigenvectors greater than one, which were subsequently extracted and rotated by the interactive procedure of VARIMAX. Also, these factors were statistically coherent. This resulted in six significant factors, signifying six sequential episodes of faunal associations over the past 65 million years.

This methodology shows that 85% of the complexity of the Cenozoic North American mammalian fossil record can be summarized in six successional evolutionary faunas each composed by a specific association of taxa. Following their temporal distributions we recognize these faunas as follows: (i) Paleocene fauna; (ii) early-middle Eocene fauna; (iii) middle-late Eocene fauna; (iv) the “Oligocene fauna”; (v) Miocene fauna; and (vi) Plio-Pleistocene fauna of the modern fauna. These evolutionary faunas fit well with previously proposed “Chronofaunas” based on qualitative assessments.

We also show, in a more qualitative fashion, that the rise and fall of each fauna is associated with changes in the paleotemperature curve, allowing us to infer climatic influences on changing faunal dynamics over Cenozoic mammalian evolution.

Technical Session XVI (Saturday, November 5, 9:30 am)

RE-DESCRIPTION OF THE SKELETAL ANATOMY OF CHONDRENCHYLES PROBLEMatica AND ANCESTRAL CONDITIONS IN THE HOLOCEPHALI

FINARELLI, John, University of Chicago, Chicago, IL, USA; COATES, Michael, University of Chicago, Chicago, IL, USA

Recent sequencing of the elephant shark genome has increased interest in holoccephalans as model systems in early gnathostome evolutionary biology. As such, fossil holoccephalans have the potential to provide important tests to hypotheses derived from extant taxa. For example, a recent study of the dentition of the Mississippian (Viséan) holoccephalan, Chondrichelys problematica, overturned hypotheses of toothplate formation in holoccephalans and provided critical understanding of the evolution of the developmental mechanisms in early gnathostome teeth. Here we re-describe the skeletal anatomy of Chondrichelys, taking advantage of three new and exceptionally-preserved specimens.

Modern holoccephalans display a suite of distinctive morphologies. While Chondrichelys does possess key features of holoccephalans (e.g., toothplates, a holostylic palatoquadrate), the new specimens preserve features not observed in extant holoccephalans (e.g., claw-like denticles lining the rims of the pectoral fins). Chondrichelys also lacks the polypondyous axial skeleton and sub-otic gill basket characteristic of extant holoccephalans.

Chondrichelys’ skull has a jaw articulation posterior to the orbit, prominent occipital areas, foramina for the superficial optic nerve on the dorsal surface, and widely separated orbits without an interorbital septum. Additionally, there is no ethmoid canal and the orbits are not displaced dorsal to the neurocranium. Therefore, in overall form, the skull of Chondrichelys appears more similar to elasmobranchs than holoccephalans. However, the large orbits, short postorbital region, and high-walled rostrum imply an adductor mandibularis muscle inserting on the rostrum, as in extant holoccephalans. Thus, the new specimens demonstrate that the unique holoccephalan masticatory apparatus and the position of the gill arches under the skull are not causally linked as has been hypothesized. Chondrichelys demonstrates that modern holoccephalans are highly aponomorphic and represent a relatively recent radiation. Extant morphological diversity in this clade cannot be assumed as primitive for chondrichthysans, or more generally, gnathostomes.

Symposium 3 (Thursday, November 3, 8:00 am)

CRETAEOUS DINOSAURS OF ALASKA: IMPLICATIONS FOR BIogeOGRAPHY IN ANCIENT BERINGIA

FIORILLO, Anthony, Museum of Nature and Science, Dallas, TX, USA; TYKOSKI, Ronald, Museum of Nature and Science, Dallas, TX, USA

The latest Cretaceous continental rocks of Alaska contain the richest record of sub-polar and polar dinosaurs found anywhere in the world. The vertebrate record, known primarily from northern and south-central Alaska and to a lesser extent from other correlative sections around the state, comprises both body and trace fossils. The dinosarurian record includes small and large theropods, ankylosaurs, hypsilophodontids, hadrosaurids, pachycephalosaurids and ceratopsids. In addition to these taxa, fossil fishes and mammals are also represented. Radiometric dating (69 Ma – 70 Ma) and biostratigraphy suggest this fauna is Early Campanian in age. The combined fauna shows that ancient Alaska contained significant vertebrate biodiversity during the Cretaceous. Rather than being oddities within present geography, plate tectonic reconstructions of the microplates containing these fossiliferous sections show that Late Cretaceous fossil vertebrates from Alaska were animals that actually lived in the high latitudes. The accretion of terranes in the region between Asia and North America created a land bridge, sometimes referred to as Beringia, by approximately 100 Ma, thus connecting the two continents and generating the pathway for faunal exchange between previously disconnected landmasses. Though many taxa likely used this land bridge, the known record of Alaska shows that neoceratopsians were among the first to cross Beringia. Additionally, the fossil bird footprint record suggests that Cretaceous birds from Asia and North America may have used Cretaceous Beringia in a manner similar to modern migratory birds in Alaska. Though aspects of the fauna show adaptation to life in an environment that experienced extreme seasonality, adaptation does not warrant the establishment of a new faunal province at this time.
NEW OPHITALMOSAURIDS FROM EUROPE AND RUSSIA BROADEN THE BIODIVERSITY OF FOSSIL VERTEBRATE ICHTHYOSAURS

FISCHER, Valentine, RBINS, Brussels, Belgium

Ophthalmosaurus is a successful clade of ichthyosaurs that rapidly diversified during the Middle Jurassic. By Late Jurassic, Ophthalmosauridae were diverse, widespread, and formed an important component of the marine trophic webs. By contrast, the record of Berriasian-Aptian ichthyosaurs is extremely poor, and all ichthyosaurs from that interval have been referred to a single genus, Platypterygius, until recently. This apparent diversity drop led numerous authors to recognize a severe ichthyosaur extinction at the end of the Jurassic that left ichthyosaurs as a small group on the decline. New specimens from poorly sampled time periods (late Valanginian, late Hauterivian and late Barremian) in Europe and Russia contradict this latest Jurassic extinction hypothesis and show that new and highly derived as well as typically ‘Late Jurassic’ ichthyosaurs roamed the Eurasian archipelago during the Early Cretaceous. Moreover, these new forms occupied ecological niches markedly different from that of Platypterygius, significantly broadening the disparity and ecological diversity of Cretaceous ichthyosaurs.

Romer Prize/Technical Session 5 (Thursday, November 3, 10:30 am)

SNOWMASS: PROBOSCIDEAN PALEOBIOLOGY BEFORE THE BEGINNING OF THE END

FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA; ROUTTREY, Adam, University of Michigan, Ann Arbor, MI, USA

The Snowmass site in west-central Colorado preserves a diverse, high-elevation Pleistocene biota spanning an interval from about 150,000 yrBP to > 45,000 yrBP. Snowmass proboscids include at least four mammoths and more than eight mastodons. The best-preserved mammoth, a partly articulated young-adult female, was found near the top of the sequence of lacustrine deposits. Her dental traits are typical for Mammutus columbi, with none of the “M. primigenius-like” traits that occur in late Pleistocene mammoth populations in the Great Lakes region, often referred to M. jeffersonii. The mosaic intermediary seen in this nominal species may reflect hybridization between M. columbi and M. primigenius, but we see no morphologic evidence of such interaction in this earlier Rocky Mountain population.

Snowmass Mammut americanum occur mostly in the lowest levels at the site and include multiple adult males, one adult female, and at least two juveniles represented by a dp2, a dp3, and a deciduous mandibular tub (the latter two could derive from one individual). The permanent upper tusks of Snowmass mastodonts have a strongly “fluted” dentin-cementum interface, with regularly spaced grooves that spiral about the tusk axis. Both the amplitude of fluting and the degree of twist are attentuations of features normal for later Pleistocene mastodonts of the Great Lakes region. Both the dp2 and the di2 (and possibly the dp3) have accentuated incremental features in the cornual dentin that we identify as neonatal lines, and in each case, they are in positions consistent with recently documented neonatal lines in comparable teeth in mammoths. These observations suggest that Snowmass mastodonts had a dental formation and eruption schedule that at least started off in a manner similar to that of mammoths. Proboscidean life history data from Snowmass (especially on growth rates and seasons of death) will establish a baseline from a time well before the end-Pleistocene extinction, against which we look for life history changes associated with the extinction may be better interpreted.

Preparators’ Session (Thursday, November 3, 12:00 pm)

A TUTORIAL ON TIME-LAPSE PHOTOGRAPHY FOR ONLINE DISSEMINATION OF PALEONTOLOGICAL SCIENCE: FOSSIL PREPARATION, SKELETAL MOUNTING, AND FLEX MOLD MODEL RESTORATION AS EXAMPLES

FITZGERALD, Erin, University of Chicago, Chicago, IL, USA; SERENO, Paul, University of Chicago, Chicago, IL, USA; KEILLOR, Tyler, University of Chicago, Chicago, IL, USA

The use of photography to create time-lapse movies has the potential to vividly capture the most effective time-lapse movies. The time has come to bring graphic animation, and sound. We also discuss strategies during preparation, modeling and seasons of death) will establish a baseline from a time well before the end-Pleistocene extinction, against which we look for life history changes associated with the extinction may be better interpreted.

Technical Session XIX (Saturday, November 5, 2:00 pm)

A NEW LATE oligocene ARCHIAcIQUADONITID FROM NEW ZEALAND

FORDYCE, Robert, Dept Geology, University of Otago, Dunedin, New Zealand

Species of Squalodontidae (Cetacea: Odontoceti) are reported widely from the Late Oligocene to Middle Miocene, but most are fragmentary and enigmatic. A new, long-jawed archaic species from New Zealand is revealing for morphology and relationships, and adds to the diversity and disparity of Oligocene squalodontids. The specimen is OU22457, Geology Museum, University of Otago: an adult skull of condylobasal length 74.5 cm, and part skeleton; Milburn Limestone, Waitakian stage, Late Oligocene. The skull has robust jaws, procumbent incisors, and close-spaced emergent cheekteeth (11 post-canines) with strongly denticulated crowns carrying prominent, anastomosing and nodular/papillate ornament; posterior maxillary teeth have a three lingual root. Teeth are worn, both on apices and denticles (possibly from a durophagous diet) and on labial and lingual faces (from occlusion). The long symphyseal is unfused; the panbone and mandibular fossa are large. The facial fossa for nasofacial (echolocation) muscles does not expand far over the temporal fossa, and there is an intertemporal constriction. The supraoccipital is primitively subrectangular. The forelimb shows features attributed to Platanistoidea: vestigial coracoid, prominent acromion, reduced supraspinous fossa. Some teeth and periosteic features appear intermediate between Squalodontidae and Prosqualodon (supposed Prosqualodontidae), blurring putative family distinctions. The new skull is topotypic with, and phenetically close to, prominently ornamented teeth attributed to “Squalodon andrewsi”, but whether conspecific is uncertain. In conventional taxonomy, OU22457 represents a new genus. The record of squalodontids, which is mostly patchy and poorly-documented beyond the North Atlantic, shows that the clade was established by the start of the Late Oligocene, and was widespread by the start of the Miocene. Its extinction later in the Miocene is still perplexing.

Posters Session IV (Saturday, November 5)

ECOLOGICAL SEGREGATION OF THE LATE JURASSIC ORNITHISCAN DINOSAURS STEGOSAURUS AND CAMPTOSAURUS (MORRISON FORMATION, NORTH AMERICA): WAS IT PRONOUNCED OR SUBTLE?

FOSTER, John, Museum of Western Colorado, Grand Junction, CO, USA

The Upper Jurassic Morrison Formation of western North America has yielded a number of species of the ornithischian dinosaurs Stegosaurus and Camptosaurus, and many of these specimens come from channel sandstone deposits. Six new specimens from western Morrison of both Stegosaurus and Camptosaurus were described in this volume, with the most effective time-lapse movies. The time has come to bring fellow scholars and the public common sequential activities in paleontological laboratory work via effective cost-efficient media productions.
marasaurus and Diplodocus), but statistical analysis of this pattern by either localities or individuals indicates little significance to the trend. However, Campitosaurus appears more strongly associated with channel sandstone deposits relative to other dinosaurs than does Stegosaurus. These results suggest that any ecological segregation of these genera was moderate, but that, if present, it was more pronounced in Campitosaurus.

Poster Session IV (Saturday, November 5)

NEW LAGOMORPH MATERIAL FROM THE EOCENE-OLIGOCENE BOUNDARY OF WYOMING AND IMPLICATIONS FOR THE PHYLOGENY OF CHADROLAGUS AND LITOLAGUS

FOSTOWICZ-FRELIK, Luca, American Museum of Natural History, Division of Paleontology, New York, NY, USA; MENG, Jin, American Museum of Natural History; Division of Paleontology, New York, NY, USA;

Stem lagomorphs from late Early Eocene to Late Miocene are a diverse group with over 20 genera. Among North American lineages, Chadrolagus and Litolagus were proposed as sister taxa on the basis of some dental characters, including full hypsodonty and acceleration in the development of the occlusal enamel pattern. Recent reexamination of the lagomorph material from the classic Eocene-Oligocene fossiliferous sites in Wyoming (Flagstaff Rim, Douglas, and Lusk vicinities) revealed new excellently preserved cranial material of Litolagus mollerosi and remains of a new species of, so far monotypic, Chadrolagus. The skull of Litolagus is characterized by a larger basioccipital angle and significantly shortened palate; the portions are enlarged due to the elevated frontal and the lowered zygodontic arch. A phylogenetic analysis based on 40 cranio-dental characters of 12 lagomorph taxa indicates that Litolagus is not an immediate descendant of Chadrolagus, but is more closely related to Archaeolagus and Lepus. In terms of morphology, Litolagus is the most advanced Oligocene lagomorph known, which may be directly related to extant Leporidae. The new species of Chadrolagus is significantly larger than C. emyri and has a more pronounced body. Finally, the results of our analysis suggest a paraphyly of Palaeolagus as currently understood.

Poster Session IV (Saturday, November 5)

REASSESSING CERATOPSID DIVERSITY USING UNIFIED FRAMES OF REFERENCE

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A “diversity first” approach to dinosaur taxonomy interprets morphological variation as diagnostic of unique taxa, leading to an explosion of species. Description of differing morphologies is useful and important for our understanding of evolution; however, disparity is not always indicative of diversity. An alternative to “diversity first” is “Unified Frames of Reference” (UFR): a method that analyzes morphology in context with ontogeny, stratigraphy, phylogeny, geography and taphonomy. Using UFR, work on Triceratops (Ceratopsidae) shows that 18 historically described taxa instead represent ontogenetically variable morphologies within chronospecies of a single unbranching lineage. Similar cases have been presented for Lambeosaurinae (Hadrosauridae) and Centrosaurinae (Ceratopidae).

Here we show that several newly described ceratopsids are more parsimoniosely interpreted as ontogenetic morphs of existing taxa, with important implications for paleobiological interpretation. Predictable ontogenetic changes in cranial morphology (including more pointed frontalis epipterygoids; short broad squamosals; unresorbed postorbital horns) suggest that Microraptor and Kosmoceratops represent immature individuals of stratigraphically equivalent taxa Chasmosaurus sp. and C. irvinensis (respectively). Titanoceratops presents the opposite case, exhibiting characters expected of a mature Pentaceratops (extensive coronal sinus; anteriorly directed postorbital horn cores; broad, blunt epIsoquamosals). Other recently described ceratopsids are problematic in that they are based on incomplete material, but it is likely that at least some pertain to already recognized species. A subtle north-south biogeographic signal in ceratopsids is supported, but extreme faunal endemism dissolves through application of UFR. This revision also suggests that cladogenesis in Ceratopsidae is limited to the Middle Campanian (80.6-76.4 Ma), after which there is currently no evidence of further branching. Why this short period should correspond to an unusual burst of cladogenesis is unknown, but it helps focus the search for potential geographic or other barriers that drive speciation.

Symposium I (Wednesday, November 2, 10:15 am)

Hox Gene Expression and Anatomical Differences in Archosauria

FOWLER, Donald, Redpath Museum and Department of Biology, McGill University, Montreal, QB, Canada; DE BAKKER, Merijn, Department of Integrative Zoology, Institute of Biology, Leiden University, Leiden, The Netherlands; RICHARDSON, Michael, Department of Integrative Zoology, Institute of Biology, Leiden University, Leiden, Netherlands

Developmental and genetic studies hold promise to establish a mechanistic basis of anatomical differences. The Hox gene clusters have provided rich results to study these developmental differences that result in different anatomies. Changes in axial Hox gene expression are at least partly responsible for the loss of forelimbs in snakes. The function of the posterior HoxD cluster genes in the limb from mutational mice experiments provides the basis for hypotheses on their effect on adult limb proportions. HoxD11 is hypothesized to increase zeugopodial and autopodial length with increased expression, reducing this expression should reduce these lengths proportional to the stylopod. Here, the expression patterns of HoxD11 were analyzed using in situ hybridization of six archosaurs, from Nile crocodiles to zebra finches. The expression data was compared to the limb proportions in adult specimens of the species and other archosaurs. The resulting comparisons do not show any clear correlations between expression data and limb proportions, providing little indication in the way the developmental systems of other birds or ancestral theropods have changed to produce their different anatomy. This highlights the difficulty in making these hypothesis statements. The hopeful correlations between genes and anatomy must find the intervening systems acting in a way that facilitates such reasoning. Lengths and proportions, unlike other phenotypic characters, typically confound these types of studies with many genes partially responsible for their adult phenotype. But beyond finding the responsible genes, is organizing them into a mechanism that can create real anatomy. Models using regulatory state networks have provided some data that indicate further hypotheses of the nuances through which Hox genes influence limb anatomy. With these, the promise of developmental studies on understanding anatomy can start to be fulfilled.

Poster Session IV (Saturday, November 5)

COMPARING CLIMATE CHANGE AND MAMMALIAN TAXONOMIC RICHNESS IN THE NEOGENE OF THE GREAT PLAINS, USA

FOX, David, University of Minnesota, Minneapolis, MN, USA; MARCOT, Jonathan, University of Illinois, Urbana, IL, USA

Climate is hypothesized to be a major driver of biotic evolution. Previous studies generally show a weak relationship between past global temperature (from benthic foramin 018O) and mammalian richness, possibly because foramin do not faithfully reflect local continental climate. We examine the relationship between climate and richness in the Great Plains using a large data set of pedogenic carbonates and mammalian tooth enamel from Neogene localities in Nebraska and Texas as climate proxies and sampling-standardized estimates of mammalian taxonomic richness from the same regions. We use published and unpublished isotopic data that include 184 pedogenic carbonates from measured sections, 181 teeth of large-bodied ungulates, and 196 teeth of grises from 64 distinct localities. Isotopic and fossil occurrence data were aggregated into 1.5 My bins from 0-15 Ma to provide a common timescale and to allow for sampling standardization; not all bins in each region have isotopic or richness data. Based on modern climatic and mammalian richness gradients, we predict a positive correlation between 018O values and richness. Paleosol and ungulate 018O values preserve reasonable latitudinal gradients through time, although slopes vary. Paleosol 018O in Nebraska is highest in the Early Miocene and lower in the Late Miocene, and ungulate values are highest in the Middle Miocene and lower in the Plio-Pleistocene, which is broadly consistent with Neogene cooling; values for grises have no obvious temporal trend. Isotopic records in Texas are relatively invariant through time. Sample-standardized richness in Nebraska was consistently higher than in Texas, likely due to fewer localities in Texas. In Nebraska, 018O of ungulates and grises have positive correlations with generic, but not species, richness; surprisingly, both generic and species richness have negative correlations with paleosol 018O values. Richness in Nebraska is invariant in relation to all isotopic records. Our results are consistent with minimal climate change in Texas and climatic sensitivity of richness if tooth enameled 018O is the more reliable record of local climate at localities in Nebraska.

Poster Session IV (Saturday, November 5)

DENTAL AND CRANIAL STRUCTURE OF LAINORYCTES (MAMMALIA: EUTHERIA: PALAEOARCHYTIDAE)

FOX, Richard, University of Alberta, Edmonton, AB, Canada; SCOTT, Craig, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada

Lainoryctes was described based on a maxilla with P3-4, M1-3, from the late Paleocene Paskapoo Fm., near Red Deer, Alberta, Canada. The upper molars are small and wide, paracone and metacone are conuate, and the main cusps and crests are tall and sharp, characters of early Tertiary Palaeanctydidae. Lainoryctes is now represented by skull, lower jaws, and near-complete upper and lower adult dentitions, including features not known before in palaeanctydids. The dental formula is 3/3, 1/1, 3/3, 3/3. The premolariform C1 is two-rooted, P2 is one-rooted, the three-rooted P3 can have a small lingual lobe (or not), P4 is submolariform, with an incipient metacone; i1 is small, i2 the largest lower incisor, i3 is tiny, c1 and i1 are one-rooted, p2 is two-rooted, p3 two-rooted, p4 is submolariform; the molars have high trigonids and narrow, skewed talonids. The Lainoryctes rostrum is short and high, the infraorbital canal long, and the lacrimal is covered externally by the maxilla; the frontal overlaps the maxilla; the lacrimal, maxilla, and palatine meet in the orbit. The zygomatic arch is incomplete, the jugal absent. Posterolaterally, the squamosals form a lamboïd plate, convergent on that in Aptonemus. The middle ear is partly shielded by the entotympanic and by the petrosal rostral process; the entotympanic recess is greatly expanded. The internal carotid artery divides into stapedial and promontorial branches, not enclosed in bony tubes; a groove on the petrosal for the promontorial branch is individually variable in occurrence. The dentary is slender, the coronoid process tall, the condyle transversely widened, and the angular process hooked. Lainoryctes most closely resembles Palaeoeryctes, Eoryctes, and Ottorcytes in shared, derived features. It shows no special resemblance to Pararcyctids, sometimes included in Palaeanctydidae, nor to “Cimololestidae”, often purported to be ancestral to palaeoeryctids. Instead, our preliminary analysis suggests that contrary to traditional opinion, these three lineages convergently evolved a faunivorous protozalambdodont dentition.
**STASIS IN LATE QUATERNARY BIRDS FROM THE LA BREA TAR PITS DURING THE LAST GLACIAL-INTERGLACIAL CYCLE**

FRAGOMENI, Ashley, Natural History Museum of Los Angeles County, Los Angeles, CA, USA; PROTHERO, Donald, Occidental College, Los Angeles, CA, USA

The emphasis on gradual evolution in response to climatic change, as typified by the studies on Galapagos finches, suggests that birds should respond with changes in body size and shape to significant changes in climate. We examined the most commonly fossilized birds at Rancho La Brea to see if there were measurable changes during the last glacial-interglacial cycle. Measurements of the tarsometatarsi of the common birds, such as the bald eagle (Haliaeetus leucocephalus), the extinct California turkey (Meleagris californica) and the caracara (Caracara plancus prelutosus) showed complete stasis for the last 35,000 years, with no statistically significant size or robustness changes even during the peak glacial interval at 20,000 years ago, when the climate at Rancho La Brea was dominated by closed-cone forest and snowy winters. Even though birds such as the bald eagle and caracara show a strong Bergmann’s rule effect, with larger body sizes in colder climates, the bald eagles and caracaras at Rancho La Brea did not change in size during the coldest period of the glacial maximum. These results, along with previously documented examples of La Brea condors and golden eagles, suggest that birds are not as sensitive to long-term changes in climate as is traditionally thought.

**MODEL SELECTION AND THE PHYLOGENETIC COMPARATIVE METHOD: RUMINANT GRAZERS DO NOT HAVE LARGER MASSETER MUSCLES**

FRASER, Danielle, Carleton University, Ottawa, ON, Canada

Non-phylogenetically controlled analyses have shown that the masseter muscle is largest in ruminant grazers due to their requirement for powerful lateral translation of the mandible during mastication. To illustrate the effects of evolutionary model choice on the phylogenetic comparison of traits, I used ruminant cranial morphology as a test case. I tested the hypotheses that masseter mass is correlated with percent dietary grass and that linear measurements of the masseteric attachment sites (length of the superficial masseteric scar, width of the masseteric insertion area, height of the jaw gelenoid) could be used to predict muscle mass using phylogenetic generalized least squares regression. Four different evolutionary models were applied including Brownian motion, Grafen’s scaling of branch lengths, Blomberg’s model of variable evolutionary rates, and the Ornstein–Uhlenbeck model of stabilizing selection. Standard selection techniques (Akaike Information Criterion) were used to evaluate model fit. The Brownian motion model was best-fitting (LRT = 5.39) to the cranial metrics. Only the length of the superficial masseteric scar (origination site of the masseter) showed correlated evolution with masseter mass, suggesting that the other two cranial metrics cannot be used to estimate masseter size in ruminants. Blomberg’s model, which did not show correlated evolution of masseter mass and percent dietary grass, was best-fitted. Grafen’s model provided the poorest fit in all cases. Type I error rates and thus the biological interpretation of the data also varied among models. These results suggest that the ruminant activity of chewing cud has relaxed selection for larger chewing muscles in grazers. Alternatively, a positive relationship between body mass and percent dietary grass suggests that body mass is a more important determinant of digestive efficiency than chewing muscle size. Further, these results highlight the importance of phylogeny in comparative analyses and of using model selection techniques in testing evolutionary hypotheses.

**DEVELOPMENT AND EVOLUTION OF THE URODELE LIMB — INTEGRATING MORPHOLOGY, GENES, AND THE FOSSIL RECORD**

FREDERICKSON, Joseph, University of Wisconsin-Milwaukee, Milwaukee, WI, USA

The pattern of skeletogenesis in the development of the tetrapod limb follows a highly conservative overall developmental program. However, there is great diversity in forms and functions of the adult structure. It is characterized by a general proximo-distal progression in the establishment of skeletal elements and a postaxial polarity in digit development. Salamanders are the only exception to this pattern among extant tetrapods and display an early establishment of distal autopodal structures, specifically the basale commune (an amalgamation of distal carpal/tarsal 1+2) and digits I and II, and a distinct preaxial polarity in digit development. All salamanders share this fundamental pattern of limb skeletal development, but the data at hand also indicate a high degree of variation within salamander limb development with respect to overall timing as well as specific patterns of skeletogenesis. Our new data on the skeletogenesis of the limb skeleton in the basal salamander Cryptobranchus and the highly derived, direct developing plethodontid Bolitoglossa highlight the diversity within salamander limb skeletogenesis within the common framework of preaxial polarity and affirm that the variation is correlated with life history pathways. Moreover, new data on gene expression patterns in salamander limb development show that Bmp4 has a late preaxial expression domain during autopodal development not present in amniotes. Bmp4 is thought to play a central role in autopodal differentiation and digit identity and may play a role in the establishment of preaxial polarity. Importantly, key features previously believed to be highly derived in salamander limb development have been identified in Paleozoic amphibians: preaxial polarity of digit development in branchiosaurs and a basale commune in the derived amphibian Gerobatrachus, both nested within a clade frequently suggested to include modern amphibians. The deep time perspective highlights the antiquity of this distinct pathway in tetrapod limb development, but its evolutionary history and phylogenetic significance remains elusive, until more fossil data becomes available and the developmental basis of preaxial polarity is fully understood.
are casselette, the centra of these and at least some of the sacral vertebrae are composed of cancellous bone. Pneumaticity is also extensive in the dorsal ribs, sacral ribs, and in the ilia and entire absent from the forelimbs, shoulder girdle elements, hindlimbs, pubes, and ischia. Within the ilia, pneumatic chambers are greater in size than in the vertebrae, irregular in form, and absent from the anteromedial edge of the preacetabular lobe, the pubic peduncle, and the acetabulum.

Technical Session VIII (Thursday, November 3, 4:00 pm)
ELBOW ADDUCTOR MOMENT ARM AS AN INDICATOR OF SPRAWLING POSTURE OF THE FORELIMB IN QUADRUPEDAL TETRAPODS
FUJWARA, Shin-ichi, Structure and Motion Laboratory, The Royal Veterinary College, Herts, United Kingdom; HUTCHISON, John, Structure and Motion Laboratory, The Royal Veterinary College, Herts, United Kingdom

Determining forelimb posture (sprawling/sagittal/creeping) in terrestrial horizontal locomotion has been a major issue in skeletal reconstructions of extinct quadrupedal tetrapods (e.g., ceratopsid dinosaurs, desmostylian mammals). Humeral orientations have mainly been estimated based on shoulder morphologies, although both the orientation/position of the pectoral girdle and range of shoulder motion are difficult to determine reliably because of postmortem decay of soft tissues and because reconstruction methods have seldom been validated in various extant species. Here, I report a new forelimb posture indicator, which is applicable to a majority of extant tetrapods. First, the degree of elbow joint adduction/aduction movement was determined in several lizards specimens. This step revealed that the carpal flexors also function as elbow ‘adductors’, which may play a major role during the stance phase in sprawling postures. This function is different from sagittal and creeping (against surface friction: e.g., sloths) limb postures, which respectively depend more on elbow extendors and flexors for propulsion. Measurements of elbow muscle moment arms in 288 extant tetrapod skeletons (Amura, Synapsida, and Reptilia: 32 orders, 116 families, and 243 genera) revealed that sprawling, sagittal, and creeping tetrapods respectively emphasize elbow adductor, extensor, and flexor over muscle functions over others. Furthermore, scannorial taxa possess relatively larger flexor moment arms than in non-scanorial taxa. Thus, forelimb postures of extinct tetrapods can be reconstructed based on quantitative index, and both Triceratops (ceratopsids) and desmostylian mammals were categorized as sagittal non-scanorialists based on this indicator. The totality of prevailing evidence supports the hypothesis that these large tetrapods did not typically use forelimb postures that would be classified as sprawling.

Poster Session III (Friday, November 4)
NEW FOSSIL REMAINS OF LANTANOTHERIUM (ERNACEIDAE, MAMMALIA) FROM THE VALLESIAN (LATE MIOCENE) OF VILADECAVALLS (NE SPAIN)
FFURIÓ, Marc, Institut Català de Paleontologia, Barcelona, Spain; ALBA, David, Institut Català de Paleontologia, Barcelona, Spain; CARMONA, Raül, FOSSILIA Serveis Paleontològics i Geològics, Sant Celoni, Spain; RIFÀ, Eudald, FOSSILIA Serveis Paleontològics i Geològics, Sant Celoni, Spain

Lantanotherium has been reported in several Miocene localities from Europe, Asia, North America and Africa, although the only record in the latter continent has been recently challenged. Uncertainties remain regarding the phylogenic position of this taxon: it has been considered the earliest representative of the Erinaceidae (recent moles and shrews), currently distributed in Southeast Asia, by some previous authors, while others (e.g., Piscataway, NJ, USA; FIELD, Paul, Rutgers University, Piscataway, NJ, USA; OLSSON, Richard, Rutgers University, Piscataway, NJ, USA) have reported its homology has long been controversial. Using Synchrotron Radiation X-ray Tomography, the derivative structures of the trabeculae have been clearly identified in galeaspid, a 435 - 370 million year old ‘ostracoderm’ group from China and Vietnam. Like that chondrichthyan, the orbitosphenoid lamina of galeaspid forms the posterolateral wall of the nasal capsule; the supraorbital crest is developed and penetrates by a row of supraorbital foramina; the suborbital shelf floors the orbital cavity ventrally. More strikingly, the orbitosphenoidal lamina extends rostrally as a small ethmoid process just rostral to the hypophyseal opening. Compared with that of chondrichthyans, the ethmoid process is not developed enough to form the internasal wall, which separates the paired nasal sacs in galeaspondids. This indicates that the gnathostome-like trabecular cranii were likely present in the jawless galeaspid, and partly in osteostrates. The presence of trabecular cranii in stem-gnathostomes provides further evidence that the assembly of gnathostome characters accrued piecemeal before the origin of jaws rather than as buds of innovation.

Technical Session XIII (Friday, November 4, 2-30 pm)
QUANTIFYING CHEWING EFFICIENCY OF RUMINANT DENTAL PATTERNS—AN APPROACH USING THREE-DIMENSIONAL METROLOGY SYSTEMS
GAILER, Juan Pablo, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; KAISER, Thomas M., Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany

Understanding the complex masticatory system of ruminants has led research to focus on the mechanical interactions between occlusal tooth morphology and biomechanical food properties. Occlusal morphological traits have successfully been linked to feeding categories (e.g., browser, mixed feeders and grazers). However, the underlying mechanisms behind these morpho-ecological interrelations are still poorly coupled to functional biophysical interpretations. Former works studied one tooth position only, the second upper molar (M2); we extend our investigation to the third and fourth premolars (P3, P4) as well as to all molars (M1, M2, M3) and test for dietary adaptations of the post-canine tooth row as a functional unit within the masticatory system.

Three-dimensional (3D) models of upper cheek teeth of eleven extant bovid species (Bovini, Cetartiodactyla) are generated using a tomographic digitization system. We then implement high-precision 3D engineering techniques to quantify 3D linear, surface and volumetric parameters of the enamel and dentin components of the occlusal topography.

The relative complexity of the inner enamel structures (el) on each tooth position reveals a consistent pattern for all grazer species from the P3 to the M3. This pattern is characterized by an abrupt increase in el from premolar to molars, contrasted to homogeneity between premolars and between molars. With the exception of a difference detected between P3 and P4, the figurative species displays a pattern similar to the grazers. We interpret this functional differentiation between premolars and molars to be induced by greater masticatory loads towards the back of the tooth row related to tough and hard diets. There is however no consistent pattern along the tooth row for the leaf browsers. The pattern recognition along the tooth row for grazers and frugivores therefore indicates that the abrasiveness and hardness of grass and fruits are the primary selective pressures driving to an optimized functional unity of the post-canine dentition.

A program of continuous core drilling in the Cretaceous-Paleogene (K/P) marine sequence in the Atlantic Coastal Plain of New Jersey has produced iridium excursions at the K/P bounday at six well sites. Several of these cores were drilled at or near historically important vertebrate fossil localities that yielded important specimens of Late Cretaceous and Early Paleogene vertebrate fossils for Cope, Marsh and others. At McColl Farm, old mines in the New Egypt and Hornerstown Formations produced a number of type specimens for O.C. Marsh, including mosasaur, crocodile, and bird material. An iridium anomaly of 0.5 ppb was detected in the core from this site in the Hornerstown Formation at the level of the fossil concentration in the base of the formation. Below this the Late Maastrichtian New Egypt Formation yielded the types of the mosasaurs Halisaurus platyspondylus and Mosasaurus princeps (= M. hoffmanni). At the Inversand Pit, a source of fossils for modern collectors and close to historically important sites, a modest iridium anomaly was directly associated with the basal Hornerstown fossil concentration that continues to produce numerous specimens of vertebrate fossils. The Ir excursion at Inversand is 279 ppb, an order of magnitude over background levels above and below this horizon. The Ir anomaly shows a Pt/Ir ratio of 1.35, suggesting an extraterrestrial source. Directly below this level is the New Egypt Formation, the ‘chocolate marl’ of Cope and Marsh, which has yielded dinosaur specimens such as the Dryptosaurus (Cope) and “Hadosaurus minor” Marsh. This formation also produces mosasaur material, including M. maximus, Prognathodon rapax, and H. platyspon- dylos. The assembly in the basal Hornerstown Formation includes chondrichthyans, osteichthyans, chelonians, crocodylians, mosasaurs, and birds. Direct association of the Ir excursion with this bed suggests that it represents mass mortality in the aftermath of environmental
disturbances associated with large asteroid impact. Dinoflagellate biostratigraphy constrains the Ir anomalies at these several sites to the K/P boundary. Taphonomic evidence suggests that this is not a reworked lag deposit, but rather contains many multi-element specimens in associated or partially articulated condition. Mass mortality and diversity suppression in the oceans after the K/P event was caused by the release of toxic substances due to the massive extinction of benthic organisms. Taphonomic evidence points to the simultaneous presence of large, elongate, benthic organisms with preserved forms of clams, brachiopods, and crinoids, suggesting a catastrophic event. However, crocodylians did radiate into marine environments during this interval to become apical marine predators after mosasaurs went extinct, and more modern lamnomd sharks bagon to appear in this section in Danian time.

Poster Session I (Wednesday, November 2)

A NEW SKELETON OF THE LATE CRETACEOUS BONY FISH, MICROPYCNODON KANSASENSIS, FROM THE NIOBRAARA CHALK OF KANSAS, USA
GALLUZZI, Carmela, DePaul University, Chicago, IL, USA; SHIMADA, Kenshu, DePaul University, Chicago, IL, USA

Micropycnodon kansensis is a poorly known pycnodont fish that lived in the Late Cretaceous Western Interior Seaway of North America. Here, we report a second partial skeleton of the species that occurred in the Smoky Hill Chalk Member of the Niobrara Chalk in Cower County, Kansas. The new specimen, KUVP 127042 housed in the University of Kansas Museum of Natural History, Lawrence, is well preserved and consists of the anterior three-fifths of the fish, including a nearly complete skull with incisiform teeth and a set of tooth plates suited for durophagy. The specimen is significant because it reveals that the entire head and the anterior rim of the body are covered with numerous small (up to 3 mm high), posteriorly-directed hook-like, pointed dermal denticles that likely served as protection against predation. Although the posterior end of the body is missing, the preserved portion indicates that the fish is deep-bodied and nearly circular in lateral view, measuring approximately 24 cm in estimated standard length (SL) and 23 cm in estimated maximum body depth excluding the fins. The estimated total length (TL) of the fish is approximately 30 cm. The anterolateral length of the lower tooth plate is 7% of the SL. Another partial skeleton of the species, KUVP 7030, is a slightly larger individual with an estimated SL of 31 cm, but the ratio of each lower tooth plate length to the SL is similar to KUVP 127042. The fossil record of M. kansensis includes isolated tooth plates that are slightly larger than the tooth plates in KUVP 7030, but the species likely did not generally exceed 35 cm SL. The body shape and size range of M. kansensis suggest that the fish was likely fed on small, inactive shelled invertebrates, such as cirripeds and bivalves that were no larger than a few centimeters.

E&D Poster Session

ALLIGATORS NEAR AND FAR: USING THE MAPS IN MEDICINE: INSIDE ALLIGATORS HIGH SCHOOL WORKSHOP AND 3D ALLIGATOR WEBSITE AS EDUCATIONAL TOOLS IN ANATOMY AND EVOLUTION
GANT, Cortaiqa, University of Missouri, Columbia, MO, USA; SKILJAN, Rebecca, University of Missouri, Columbia, MO, USA; TSAI, Henry, University of Missouri, Columbia, MO, USA; FOLK, William, University of Missouri, Columbia, MO, USA; HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA

We present two related educational modules developed at the University of Missouri that use alligator biology to broaden participation of local schools and the general public in anatomical and evolutionary sciences. Alligators are familiar, easily obtainable, large-bodied, charismatic reptiles that not only have evolved unique adaptations to their environment but also provide numerous comparative insights into mammalian, dinosaur, and reptile anatomy in general, making them excellent model animals for vertebrate evolution education and outreach. First, the Holliday Lab collaborated with the Howard Hughes Maps in Medicine program at Mizzou to coordinate a day-long “Inside Alligators” workshop for students and their teachers from four Missouri high schools. First attending a public scientific seminar introducing educational topics in the field of alligator evolution and anatomy, students participated in 4 workshops covering state-outlined curricular topics in biology with focuses on animal relationships, mathematics, comparative anatomy, and scientific inquiry. Workshops staffed by undergraduate, graduate and veterinary medicine students included: tooth morphology and diet; sense organs and skull anatomy; measuring and estimating skull length; and gross anatomy. Second, the Holliday Lab paired with the Witmer Lab to co-launch the “3D Alligator”, two online modules directed at the broader internet audience with general and scientific Alligator content using a mix of 3D pdfs, movies, and Javascript-embedded interactive models to explore head anatomy. The Holliday Lab 3D Alligator presents individual elements of an adult skull with dedicated pages including labeled images, brief descriptions of major features, and embedded Wirefusion models of each element. Additional modules including mandibular symphysis anatomy; limb articular cartilage models, and 3D jaw muscle models will be uploaded to the 3D Alligator site in the near future. These ongoing collaborations with universities, local schools and the public are critical to fostering increased awareness of biological principles and the basics of scientific inquiry.

Poster Session I (Wednesday, November 2)

SKELETOCRONOLOGY OF THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS): THE UTILITY OF VARIOUS ELEMENTS FOR DETERMINING GROWTH PATTERNS AND LONGEVITY
GARCIA, Bonnie, Florida State University, Tallahassee, FL, USA

Neontological studies of reptilian skeletocronology are important as the results can be used with confidence to make inferences about growth and longevity in extinct relatives. While most skeletocronology studies have focused on lines of arrested growth in major long bones, especially the femur, the utility of other elements for determining age and age at death is for the most part unexplored. Modern archosaurs such as crocodylians, and in particular the American alligator (Alligator mississippiensis), allow for not only an interesting modern system but a proxy to the past given their close evolutionary ties to fossil archosaurs such as crocodiles and dinosaurs. We conducted a histological analysis of six, known-age, chemically labeled alligators previously in the care of the Florida Fish and Wildlife Commission. Because alligator bone was sectional and multiple points and growth line counts and tissue characters were then made. Aside from long bone elements commonly used in histological studies, other skeletal structures such as ribs and phalanges exhibit areas ofLAG deposition and make them potentially useful in histological analysis. From this a “map” of the alligator skeleton was constructed regarding where along skeletal elements researchers are likely to find unobstructed deposition of LAGs. The results of this study elucidate which bones are best suited for growth analysis, as well as where along those bones information is preserved. Because histological analysis is a destructive technique, this information will allow researchers to make more informed decisions with regards to which element(s) to sample, thus reducing the potential for damaging more elements than is necessary or the likelihood of success when limited skeletal material is available.

Technical Session II (Wednesday, November 2, 2:30 pm)
CRANIAL ANATOMY IN THE BASAL DIAPSID YOUNGINA CAPENSIS AND ITS RELATIONSHIP TO HIGHER RADIATION OF PERMO-TRIASSIC NEODIAPSIDA
GARDNER, Nicholas, Marshall University, Huntington, WV, USA; BHULLAR, Bhart-Anjan, Harvard University, Cambridge, MA, USA; HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA; O’KEEFE, F., Robin, Marshall University, Huntington, WV, USA

Although the archaic diapsid Youngina capensis is represented by several complete skulls, it has never been the subject of a detailed anatomical review. While previous work described the mosaic nature of its braincase, a more thorough description of its general cranial anatomy is needed to better understand its position within early diapsid phylogeny. In this study, we use MicroCT data from the holotype skull to reveal a well-preserved and articulated palate. These data, when combined with examination of other referred cranial material, permits a thorough redescriptions of Youngina cranial anatomy. Several characters present in Youngina demonstrate their appearance along the diapsid stem lineage, rather than being apomorphies of crown-Diapsida as previously thought. These include: 1) a paroccipital process-suspen- sorium contact; 2) loss of the sphenethmoid ossification; 3) a lacrimal that is taller than it is long; and 4) incipient basal tubera on the basiscapital. Additionally, Youngina exhibits a derived palatal morphology that is highly conserved in more derived diapsids, such as the pan-archosaur Procolacerta. Their palates are quite similar, differing most notably in that Youngina retains an epitypoidy participation in the palatalbasal contact, unlike crown-diapsids which exclude the epitypoidy entirely. As in many primitive diapsids, the palatalbasal and otic joints are rounded and well-developed, suggesting the potential for cranial kinesis. However, the presence of a caudal margin and multiple points and growth line counts and tissue characters suggest a lack of kinesis in Youngina. Its small, unserrat teeth and limited gape suggest it is prey that was smaller than its head, relying on puncturing its prey against its palatal teeth to aid in oral processing. This superficially lizardlike pattern of feeding was widespread among basal diapsids. Youngina’s possession of several derived diapsid characters, while retaining an akinetic skull, demonstrates that the taxon is a critical model for understanding the subsequent evolution of diapsid cranial anatomy.

Poster Session IV (Saturday, November 5)

THE MAXILLAE OF IGUANODON BERNISSARTENSIS FROM MORELLA: NEW INFORMATION ON UNKNOWN FEATURES
GASULLA, José, Uam, Madrid, Spain; SANZ, José, Uam, Madrid, Spain; ORTEGA, Francisco, Uam, Madrid, Spain; ESCASO, Fernando, Uam, Madrid, Spain

The Arcillas de Morella Formation, early Aptian in age, has yielded a diverse tetrapod fauna including amphibians, turtles, squamates, plesiosaurs, crocodyliforms, pterosaurs and dino-saurs. To date, the Mas de la Parreta quarry is clearly the most representative fossiliferous area of this Lower Cretaceous Formation. The Mas de la Parreta quarry is located at the southwest of the locality of Morella (Castellón, Spain). Most of the vertebrate fossil remains are from the Mas de la Parreta fossil sites correspond to ornithopod dinosaurs. In 2008 several cranial and postcranial bones belonging to ornithopod and theropod dinosaurs and crocodiles were found in the Mas de la Parreta quarry site CMP-11. Among other ornithopod bones, is noteworthy the discovery of two right maxillae belonging to two Iguanodon individuals. The analysis of these two maxillae as well as the small preserved maxilla, related these bones to the large-sized European ornithopod Iguanodon bernissartensis and allow adding new information on this taxon. Maxilla features shared with Iguanodon bernissartensis include the relatively long and low construction of this bone and the presence of a rostroventral process that is rostroventrally curved, a subtriangular and

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rostrrocaudally broad and ascending process, a jugal process that is caudolaterally projected and a jugal process that is caudolaterally projected and a ventral margin of tooth row, in lateral view. As in this taxon, maxillary teeth share an elongate crescent shape and mammillate marginal denticles. Besides these, other maxillary features, previously unknown in *Iguanodon bernissartensis*, such as a rostrocaudal process and a straight shape both in the maxilla and in tooth row when viewed dorsally and ventrally, respectively, are described for the first time. Thus, the specimens reported from the Mas de la Parreta quarry could add new and valuable information on the anatomy of this European large-sized ornithopod and confirm its presence in Iberian synchronous levels.

Symposium 3 (Thursday, November 3, 11:45 am)

**LATITUDINAL BIODIVERSITY PATTERNS DURING THE CAMPAÑAN OF WESTERN NORTH AMERICA**

GATES, Terry, Field Museum, Chicago, IL, USA

The North American Cretaceous Western Interior Basin (WIB) records a remarkably complete Campanian rock record spanning a distance of over 2000 km from Canada through northern Mexico. An increasingly detailed fossil record is emerging that allows for introntinental comparisons of contemporaneous vertebrate faunas at various time intervals. A genus-species level presence-absence dataset was compiled for all discernible taxa within Campanian formations of the WIB. Multivariate tests performed on the data include diversity curves, correspondence analysis (CA) and cluster analysis (CLA). These analyses demonstrate a disparity in species diversity between lower and upper Campanian localities, with the latter having a greater abundance of species. This is considered to be largely associated with greater sampling of upper Campanian localities. CA confirmed previous assertions that the faunas within the WIB likely conformed to a latitudinal diversity gradient, both in lower and upper Campanian formations. Other major axes of the CA suggest that a more complicated pattern may underlie faunal distribution through time. Notably, earlier faunas tended to group closer together compared to faunas dating between 76–75 mya from equivalent geographic areas. CLA tended to group formations into north/south geographic regions primarily, indicating some level of endemicity, but depending on the distance measure used CLA also produced groupings of similar environmental setting, irrespective of latitude. Even though latitude may have been a major driver of vertebrate geographic distribution within Campanian WIB ecosystems, changes in topography such as sea level rise and mountain building seems to have had a large effect on dinosaur diversity by chiefly dividing the WIB into centers of endemicity during shifting tectonic regimes. The WIB endemic centers are evidenced by increased dinosaur diversity and decreased geographic ranges between 76–75 mya. Therefore, it appears that dinosaurs were susceptible to speciation as a result of geographic changes to the WIB whereas the remainder of the Campanian faunas demonstrates minimal levels of endemicity and localized turnover.

Symposium 1 (November 2, 9:15 am)

**LIMB DISPARITY, COORDINATION, AND THE EVOLUTION OF TERRESTRIAL LOCOMOTION**

GATESY, Stephen, Brown University, Providence, RI, USA; POLLARD, Nancy, Carnegie-Mellon University, Pittsburgh, PA, USA

Tetrapod limbs exhibit diverse postures and movements during terrestrial locomotion. The history of kinematic evolution should be accessible to reconstruction within a phylogenetic framework, but limb disparity (proportions, degree of crouch) hampers meaningful comparison of angular data among species. If different limbs can’t move exactly the same way, any joint by joint or segment by segment assessment of angular data becomes an apples to oranges comparison. We have developed a simple, non-angular method of describing the coordination among segments as the limb reconfigures each stride. Using a ternary diagram, we create a theoretical configuration space of all possible poses a limb can achieve during the stance phase. By plotting data from extant forms in this common space, coordination patterns can be differentiated and transferred among disparate taxa. For example, we can make *Tyranosaurus rex* move using the coordination of a guineafowl, or human, or cat. But not all coordination patterns are appropriate for all limbs. Proportions and degree of crouch appear to bias limbs to follow geometrically sensible paths within the space of coordination alternatives. Using mid-stance poses identified by constraint-based exclusion, we reconstruct potential stance phase motions of the hind limb of *Tyranosaurus rex* using these geometric “rules.” Alternative parameterizations of limb movement and a coordination-based perspective have great potential for elucidating locomotor evolution.

Technical Session IV (Wednesday, November 2, 4:00 pm)

**PHYL OGENETIC ANALYSIS OF THE SLOTH FAMILY MEGALONYCHIDAE (MAMMALIA, XENARTHRA, FOLIVORA) BASED ON CRANIAL DATA**

GAUDIN, Timothy, University of Tennessee-Chattanooga, Chattanooga, TN, USA; MCDONALD, H. Gregory, National Park Service, Fort Collins, CO, USA; RINCÓN, José, Universidad de los Andes, Bogotá, Colombia; MARTÍNEZ, Manuel, Museum National d'Histoire Naturelle, Paris, France; GAMPER, Tobias, Montana State University, Bozeman, MT, USA

Audio data and cochlear morphology have been used to divide extant odontocetes into two groups: 1) type I odontocetes produce echolocation vocalizations above 100 kHz, have a cochlea with 1.5 turns, a proportionally long secondary lamina, and an expanded basal cochlear turn; 2) type II odontocetes have a cochlea with more than 2 turns, a narrower basal turn, a relatively short secondary lamina, and produce echolocation clicks below 90 kHz. Porpoises and the Amazon River dolphin (*Inia*) are type I whereas the bottlenose and panropical spotted dolphins, among others, are type II. Efforts to resolve the evolution of high frequency bearing in odontocetes have been hampered by the absence of a well-supported phylogeny for Odontoceti as well as the small number of taxa for which cochlear morphology is known. We report here microCT scans from 8 fossil and 6 extant odontocetes, including all taxa informally referred to as “river dolphins”, and have mapped aspects of cochlear morphology on a recently published cetacean phylogeny. The majority of taxa CT scanned do not fall within the morphospace delimited by type I and type II cochleae, indicating that this classification scheme is an artifact of limited sampling of extant taxa. For example, the stem, Miocene delphinid *Kentriodon pernix* has approximately 1.75 turns, in
that would be useful in turbid fluvial and coastal waters. We can confirm that the secondary lamina is long in *Inia* and *Platanista*, which inhabits the Indus and Ganges rivers, as well as *Pontoporia*, which occurs in coastal South American waters; however, the coelica of the Yangtze River dolphin is much like those of oceanic dolphins of the Family Delphinidae.

**Poster Session III (Friday, November 4)**

**COMPARISON OF IDENTIFICATION TECHNIQUES FROM QUATERNARY DEPOSITS USING FOSSIL SHREWS (Soricidae: Mammalia)**

GEORGE, Christian, The University of Texas at Austin, Austin, TX, USA

Methods for identifying small mammals from Quaternary sites traditionally rely on either similarity of morphological characteristics or quantitative measurements. Those characteristics may only be effective at discriminating species when they are applied to specimens from a narrow geographic region. The utility of apomorphies for the identification of Quaternary small mammal fossils remains largely unexplored. I examined the impact of using apomorphic characters for the identification of shrews, I chose one species that are common in Quaternary sites, generally considered identifiable, and often used to reconstruct paleoecology. The specimens come from Pit 1E of Hall’s Cave, Kerr County, Texas, a stratified deposit accumulated over the last 20,000 years. The shrews previously identified from Hall’s Cave include *Cryptotis parva*, *Blarinara carolinensis*, *Notiosorex crfordi*, and a few, rare specimens of *Sorex*. To test whether apomorphic identification would yield the same results, I assembled characters from a variety of sources, discretized them for use in a phylogenetic analysis, and then ran an analysis to determine which characters were synapomorphies. Many specimens previously identified to the species level were too fragmentary to permit species identifications using apomorphies. However, apomorphic characters could differentiate some specimens as *Blarinara hylophaga* or *Blarinara breviceadla*. Those taxa were unrecognized because originally the specimens were identified to genera based on morphology, and then were assigned to species based on modern geographic ranges. Thus, confidence in identified species was often overstated, and species diversity was underestimated. Using apomorphies to identify shrews has a significant impact on taxonomic resolution. If this approach is applied to other small mammals, it is likely to have far-reaching effects on paleoecology, biogeography, and biostatigraphy.

**Poster Session II (Thursday, November 3)**

**TRIGEMINAL NERVE MORPHOLOGY IN ALLIGATOR MISSISSIPPIENSIS: IMPLICATIONS FOR INFERRING SENSORY POTENTIAL IN EXTINCT CROCODILIFORMS**

GEORGE, Ian, University of Missouri, Columbia, MO, USA; HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA

One of the most intriguing adaptations of crocodilians is their derived sense of face touch, in which trigeminal nerve-innervated dome pressure receptors speckle the face and sense mechanical stimuli. However, the ontogeny and morphology of this system, and its relationship with other cranial tissues is poorly known hampering hypothesis testing on the origin of the modern crocodilian trigeminal system. A cross-sectional study integrating histological, morphometric, and 3D imaging analyses was conducted to identify patterns in neural and bony structures in *Alligator mississippiensis*. Nine individuals were variably imaged followed by histomorphometric sampling of mandibular and maxillary nerves. Endocard volume, trigeminal fossa volume, and maxillomandibular foramen size were compared to nerve counts from proximal and distal regions of the nerves to identify scaling relationships of the structures. These variables were also then collected from several similarly-sized fossil crocodyliforms from disparate habitats to test for ecomorphological relationships with the trigeminal system. Nerve fiber density is greater in smaller alligators and total nerve count significantly correlates with skull size. Maxillomandibular foramen diameters, endocard volume, and trigeminal ganglion all scaled significantly and negatively with skull length. Maxillomandibular foramina scaled isometrically with endocard volume and ganglion volume whereas ganglion volume scaled with positive allometry with endocard volume. These data suggest that trigeminal nerve morphology can be accurately inferred among living crocodilians. Metrics from fossil taxa indicate that whereas the eusuchian *Leichusaurus* and the dypsother* Rhabdognathus* both have trigeminal ganglia similar to that of similarly sized alligators, the *piersoni Hama-dasuchus*, a putatively terrestrial species had a much smaller ganglion suggesting a dome-pressure system was not as well developed. These findings suggest that neural osteological correlates of the trigeminal system are informative features useful for investigation of crocodilyomorphs as well as archosaur somatosensory evolution.

**Poster Session I (Wednesday, November 2)**

**ALONE ON GONDWANA: THE STORY OF THE MOROCCAN DIPLOCAULID GERMAIN, Damien, MNHN, Paris, France**

Diplocaulus minusinus, a diplocaulid lepospondyl from the Late Permain of the Argana Basin (Morocco) is revised based on a redescribion of the type material, together with a description of recently found specimens. The revised specimens, previously attributed to *Diplocau- lus*, prove to be more closely related to the genus *Diploceraspis*. However, recent observations of North American specimens raise doubts about the validity of the genus *Diploceras- pis*. They are the only known Gondwanian lepospondyls and their unique co-occurrence with paracisaurians strengthens the hypotheses of climate-controlled endemism in the end-Permain Pangaea. This unique association is not congruent with the age of other diplocaulids and implies a long ghost lineage. Moreover, two paleobiogeographic scenarios about the timing and the ways of migration on Gondwana are considered. These animals exhibit a peculiar asymmetry of the skull. Some hypotheses about the function of its peculiar skull are tested and discussed, but none appear to be conclusive.

**Preparators’ Session (Thursday, November 3, 9:00 am)**

**COLLECTION, PREPARATION, AND MOUNTING OF TWO LARGE, ORIGINAL GYROSASAR SKELETONS FROM THE KAIPOWITIS FORMATION OF GRAND STAIRCASE ESCALANTE NATIONAL MONUMENT, FOR THE NEW UTAH MUSEUM OF NATURAL HISTORY, SALT LAKE CITY**

GETTY, Mike, Utah Museum of Natural History, Salt Lake City; UT, USA; LUND, Eric, Utah Museum of Natural History, Salt Lake City, UT, USA

In November 2011, the Utah Museum of Natural History (UMNH) will reopen to the public in a brand new home at the Rio Tinto Center on the University of Utah’s campus in Salt Lake City. This facility will exhibit a number of new paleontology exhibits, including one featuring vertebrate specimens collected from the Upper Campanian Kaiapwrwts Formation of Grand Staircase Escalante National Monument (GSENM) over the past twelve years. This display will mount prepared original skeletons of two of the most complete gyrosaur specimens collected in the Kaiaporiwts thus far. These specimens, discovered in 2001 and 2007, each took three seasons to excavate in more than one hundred large field jackets, several weighing in excess of 1000 lbs. Preparation of this material has taken a team of more than 80 volunteer preparators 10,000 man hours to complete over nearly a decade. In both specimens, preparation was complicated by exceedingly hard matrix, and skin impressions which needed to be preserved.

One specimen (UMNH VP 12665) had skin impressions covering nearly all of its articulated tail and was prepared and mounted in a manner to exhibit the association of skin and bone. This specimen is mounted into the floor of an “in situ” style, recreating how the skeleton was preserved in the field. The second specimen (UMNH VP 20121) is the most complete large hadrosaur ever collected in Utah, and was prepared entirely out from its matrix and by UMNH volunteers and ultimately mounted in a life position by a paid contractor. This mounted specimen is nearly 40 feet long, 12 feet high, and consists of more than 80% original skeletal material. The collection and preparation of the specimens for these two mounts highlights the extremely effective collaboration between the UMNH and the BLM administered GSENM, as well as the significance of a highly motivated and dedicated team of volunteers in the field and lab.

**Poster Session III (Friday, November 4)**

**FAECAL LIPID BIOMARKERS FROM MODERN AND ANCIENT HERBIVORES GILL, Fiona, University of Leeds, Leeds, United Kingdom**

Biomarkers are molecules that can be unequivocally attributed to a specific biological source or process on the basis of their chemical structure. The potential of lipid biomarkers preserved in coprolites to reveal unique details of the diet, digestive processes and digestive tract microbiota of extinct animals has already been demonstrated. However, in order to fully exploit the benefits of this approach it is necessary to investigate further the controls on faecal biomarkers in modern animals and on preservation of lipids in coprolites.

Faecal lipids were analysed from a range of modern herbivorous mammals with varying digestive physiologies. For each species investigated we used a distinctive faecal lipid signature featuring the isoprenoid lipid archaeol, interpreted to derive from methanogenic archaea in the digestive tract. Results from subsequent research supported this hypothesis, as a correlation was found between faecal archaeol concentration and methane emissions in modern cattle. Archaeol has been detected in a 2500 year old ovi-caprid dung pellet, raising the possibility that this method may be used to identify and potentially quantify methane emissions from ancient faecal material. However, a recent survey of over 20 coprolites, including material attributed to Cretaceous dinosaurs (e.g. Maiasaura), Miocene perissodactyys and a range of Pleistocene megaherbivores (e.g. *Nothrottherium shastensis*, *Eueratherium collinus* and *Mammuthus primigenius*), has shown that the preservation of lipids in herbivore coprolites is highly variable and is related to factors including age, mode of preservation and diagnostec history of the material. Ancient faeces preserved by desiccation have been found to contain concentrations of lipids order of magnitude higher than those recovered from lithified coprolites. This suggests that further research efforts should focus on desiccated coprolites or exceptionally well preserved lithified coprolites with high organic carbon content.

**Poster Session IV (Saturday, November 5)**

**MORPHOLOGY AND MORPHOMETRIC AFFINITIES OF THE FIRST KNOWN CALCANES OF PROTOPITHECUS SYLVIAE FROM THE LATE EOcene OF EGYPT GLADMAN, Justin, The Graduate Center, City University of New York, New York, NY, USA; BOYER, Doug, Brooklyn College, City University of New York, New York, NY, USA; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA; SIMONS, Elwyn, Duke Lemur Center, Durham, NC, USA**

The paleogenetic position of the late Eocene anthropoid *Protopithecus sylviae* is currently unclear. A well-preserved calcanee referable to this taxon from Quarry L-41 in the Fayum Depression, Egypt, provides new evidence that might help to clarify this issue. We pres-
ent a 3D geometric morphometric (GM) analysis that includes a comparative sample of 110 primate calcanei representing most major extinct and extant radiations. Complex shape differences that reflect key aspects of systematic variation in the calcaneus (e.g. facet outline shape) are difficult to quantify using traditional linear measurements, and this study highlights the benefits of using new 3D GM methodologies to capture such information. Our morphometric analyses reveal that *P. Sylvae*’s calcaneal morphology is most similar to that of a younger Fayum anthropoid, the parapithecid *Apidium*. Principal components analyses place *Apidium* and *Proteopithecus* in an intermediate position between primitive euprimates and crown anthropoids, based primarily on landmark configurations corresponding to a moderate amount of distal elongation, a more distal position of the peroneal tubercle, and a relatively unflexed calcaneal body. *Proteopithecus* and *Apidium* are similar to cercopithecoids and other euromyids in having a more tightly curved ectal facet with a larger degree of proximal elongation, whereas other Fayum anthropoids, platyrrhines and adapiforms have a more open facet with less proximal elongation. This latter similarity between cercopithecoids is most plausibly interpreted as convergent based on a more open ectal facet found in stem catarrhines. The only similarities between *Proteopithecus* and platyrrhines are in the moderate distal elongation and position of the peroneal tubercle, features shared by other euromyids and cercopithecoids and *Apidium* exhibit derived anthropoid features, but also a suite of primitive retentions, and are best placed as stem anthropoids. The calcaneal morphology of *Proteopithecus* is consistent with cladistic analyses that place proteopithecids as the sister group of Parapithecidae.

**Poster Session II (Thursday, November 3)**

**CRANIAL ANATOMY AND ONTOGENY OF *GAVALIS GANGETICUS* USING COMPUTERIZED AXIAL TOMOGRAPHY: IMPLICATIONS FOR GAVIALID PHYLOGENY**

GOLD, Maria, University of Iowa, Iowa City, IA, USA

The phylogenetic position of the Indian gharial (*Gavialis gangeticus*) remains contested, with molecular and morphological data resulting in different tree topologies. Molecular data (nuclear DNA, proteins, mitochondrial DNA) place *G. gangeticus* as the sister taxon to *Neosclerocalyptus* (Schlegelii), within Crocodylidae. This would mean that the putatively plesiomorphic traits seen in *G. gangeticus* are secondary reversals. However, morphological data place *G. gangeticus* as the basal living member of Crocodylia, implying independent derivation of the tubular snout. Ontogenetic changes within *G. gangeticus* may be obscuring phylogenetically informative traits; therefore, examining a hatching or near-hatching specimen is critical to teasing apart the hypotheses of phylogeny. This study describes the cranial anatomy of a hatching *G. gangeticus* skull based on high-resolution computed tomographic (CT) data in comparison with an adult specimen and with stem gavials. Ontogenetic changes include re-orientation of the orbits to a more dorsal position, lengthening of the rostrum, and postero-dorsal extension of the angular. In addition, the skull table becomes more angular at the caudal temporal corners. Examination of the braincase reveals that the basi-phenoidalros- trium reorients during growth to a more dorsally pointed structure. The median Eustachian system stays relatively compact vertically and expanded antero-posteriorly during growth. In comparison, fossil relatives (e.g., the “thoracosaurs”) of *Gavialis* have Eustachian systems outwardly similar to those of other living crocodylians. While these features have yet to be tested phylogenetically, these data support a secondarily reversed state for *Gavialis*.

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**Poster Session III (Friday, November 4)**

**ENVIRONMENTAL INFLUENCES ON MAMMALIAN UNGULATE GUILD COMPOSITION IN THE LATE PALEOGENE: A TAXON-FREE APPROACH USING DENTAL MEASUREMENTS**

GLYNN, Amanda, University of Illinois, Urbana, IL, USA; MARCOT, Jonathan, University of Illinois, Urbana, IL, USA

The relationship between Cenozoic environmental change and mammalian evolution has typically focused on either taxonomic richness or morphological evolution. For example, many previous studies examine the relationship between global climate and mammalian richness on several geographic scales, and the relationship between ungulate dental evolution and the spread of grasslands is a classic example of environmental change forcing morphological evolution. The influence of environmental change on the composition structure of mammalian communities, guilds and populations is typically treated in a more qualitative manner. Here we characterize the mammalian ungulate guild through a 25 My interval between the late Eocene and early Miocene. We take a “taxon-free” approach in which we characterize constituent taxa by dental measurements. Such measurements have previously been demonstrated to faithfully reflect ecologically relevant parameters such as body size and diet. We compiled published measurements of cheek teeth of more than 20 taxa of artiodactyls and perissodactyls from the literature. We used published regression equations to estimate body size for each species. We then determine the distributions of taxon body size within 1.5My time intervals between 40 and 15Ma. A multivariate ordination of these distributions indicates substantial changes in ungulate body mass distributions immediately after the Eocene/Oligocene boundary and immediately before the Oligocene/Miocene boundary, coincident with rapid global cooling and warming, respectively. When compared with intervals in the late Eocene and early Miocene, body size distributions throughout the Oligocene have smaller means and ranges. These results highlight the Oligocene as a unique interval in mammalian history, and underscore the role of climatic and environmental change on the ecological composition of mammalian communities.

**Poster Session IV (Friday, November 4)**

**SKELETAL ELEMENT AND BOVID ABUNDANCE ANALYSES IN PALEOENVIRONMENTAL RECONSTRUCTION OF THE CHEMERON FORMATION, TUGEN HILLS, KENYA**

GOBLE, Emily, Yale University, New Haven, CT, USA; GOBLE, Emily, Yale University, New Haven, CT, USA

The Baringo Paleontological Research Project (BPRP) has focused recent research on the Chemeron Formation, Tugen Hills, Kenya (5.6 to 1.6 million years (My)). Many sites are located within the time interval from 5.5 to 2 My and are an appropriate comparison to other reconstructions of hominin paleoenvironments as well as filling in gaps in the record. The majority of specimens of any family, 74%, are isolated teeth although Baringo has been demonstrated that the entire sequence, including the Chemeron, consistently contains both complete skeletons. In the Chemeron the bovid specimens outnumber other families in terms of the majority of specimens of any family, 74%, are isolated teeth although Baringo has been demonstrated to faithfully reflect ecologically relevant parameters such as body size and diet. We compiled published measurements of cheek teeth of more than 20 taxa of artiodactyls and perissodactyls from the literature. We used published regression equations to estimate body size for each species. We then determine the distributions of taxon body size within 1.5My time intervals between 40 and 15Ma. A multivariate ordination of these distributions indicates substantial changes in ungulate body mass distributions immediately after the Eocene/Oligocene boundary and immediately before the Oligocene/Miocene boundary, coincident with rapid global cooling and warming, respectively. When compared with intervals in the late Eocene and early Miocene, body size distributions throughout the Oligocene have smaller means and ranges. These results highlight the Oligocene as a unique interval in mammalian history, and underscore the role of climatic and environmental change on the ecological composition of mammalian communities.
cortical bone and evaluated the degree of δ18O covariance between bone phosphate, carbonate, and diagenetic calcite. In this study, millimeter-scale sequential microsampling of a core removed from cortical bone in two femora and a tibia of Tyrannosaurus increased the known value of intrabone δ18OPhosphate from <1.0‰ to 1.3–3.0‰. These values increase the range in Tyrannosaurus bone phosphate from +4.3‰ to 5.2–12.9°C, if the δ18OCO2 offsets reflect relative body temperature at the time of hydroxapatite formation as postulated previously. In this range temperature falls within acceptable levels for a mass homeotherm (endothermic or ectothermic).

A comparison of δ18OPhosphate versus δ18OCarbonate indicates oxygen isotopic equilibrium is preserved in Tyrannosaurus. Oxygen isotope cyclicity and amplitude, and the minimum amount of bone deposition estimated from cortical thickness, is suggestive of a seasonal (non-anual) isotopic signal in Tyrannosaurus. Interestingly, the δ18OCarbonate-δ18OPhosphate of ~6.0‰ is >2.0–3.0‰ less than the theoretical 8.0–9.0‰ expected for unaltered modern bone apatite. This offset may reflect taxonomic, behavioral or physiological differences between Tyrannosaurus and the limited modern mammal sample from which this regression is calculated. Alternatively, diagenesis has altered the absolute δ18O values, but the ~6.0‰ offset is useful as an indicator of isotopic equilibrium in Tyrannosaurus. δ18OPhosphate vs. δ18OCarbonate analysis of modern crocodilians and ratites species indicate the δ18OCarbonate-δ18OPhosphate relationship in these extant archosaurs is statistically significant. However, the scatter about the best-fit line is greater than observed in modern mammals. In Tyrannosaurus, the regression of δ18OPhosphate vs. δ18OCarbonate does not correspond to that of modern mammals, ratites or crocodilians. Thermoregulatory strategies may be one of a variety of factors responsible. As an endothermic heterotherm, Tyrannosaurus could obtain large size and maintain a variable, but limited body temperature range compared to its environment.

Poster Session II (Thursday, November 3)

**A BASAL TITANOSAURIAN FROM THE MIDDLE CRETAcean GALULA FORMATION, RUKWA RIFT BASIN, SOUTHERN TANZANIA**

GORSCAK, Eric, Ohio University, Athens, OH, USA; O'CONNOR, Patrick, Ohio University, Athens, OH, USA; STEVENS, Nancy, Ohio University, Athens, OH, USA; ROBERTS, Eric, James Cook University, Townsville, Australia

Sauropods reached peak diversity during the Late Jurassic, with a decline in diversity by the Early Cretaceous. Titanosaurs represent the most diverse clade of Cretaceous sauropods, with a near-cosmopolitan distribution. Despite this widespread occurrence, titanosaurians are rare components of Cretaceous African faunas. Two representatives are currently recognized, Malawisaurus from the Lower Cretaceous Dinosaur Beds (DB) of Malawi and Paraltitan from Upper Cretaceous deposits near Bahariya Oasis, Egypt. Recent expeditions in the Rukwa Rift Basin (RRB) of SW Tanzania have resulted in the recovery of a semi-articulated titanosaurian sauropod from the middle Cretaceous Galula Formation. Elements recovered thus far include components of the postcranial axial (e.g., cervical and caudal vertebrae, ribs) and appendicular (e.g., scapula, humerus, ulna, ilium, and pubis) skeletons. Ongoing preparation of this material now allows an initial character evaluation of several key regions of the skeleton. A preliminary phylogenetic analysis incorporating the new specimen with 34 taxa was conducted to assess the relationship of the RRP form among sauropods. The strict consensus tree places the RRB specimen as the sister taxon to a clade consisting of Malawisaurus and all other titanosaurians. A suite of characters supports this relationship including prococelous anterior caudal vertebrae, the absence of anterior and posterior projections on the chevrons, and a squared corner on the proximolateral humerus. The RRB specimen differs from Malawisaurus in having complex and divided pleurocoels on cervical vertebrae, the absence of a ventral longitudinal groove on anterior and middle caudal vertebrae, and a long proximal anterior condyle of the ulna. Additional comparative work on ontogeny and clements collected from the RRB and the DB of Malawi is necessary for differentiating these potentially contemporaneous faunas. A detailed survey of these assemblages offers the best opportunity for characterizing sub-equantorial terrestrial faunas and is essential for developing paleobiogeographic comparisons with Cretaceous faunas known from circum-Saharan Africa and elsewhere in Gondwana.

Technical Session III (Wednesday, November 2, 2:45 pm)

**THE RATE AND CESSION OF FACIAL GROWTH IN CARNIVORANS**

GOSWAMI, Anjali, University College London, London, United Kingdom; MARTIN, Jessica, University of Cambridge, London, United Kingdom; FOLEY, Lauren, University College London, London, United Kingdom

Understanding the relationship between allometric growth and morphological diversity is hindered by the paucity of comparative allometric data. One notable example is the topic of facial allometry in carnivorans, in which the facial growth patterns of carnivorans are primarily extrapolated from studies of domestic species. Here, we present analyses of facial allometry in 52 carnivoran species, represented by 719 juvenile and adult specimens, and including fossil taxa ranging from the Oligocene (e.g., Hesperocyon) to Pleistocene (e.g., Smilodon fatalis, Canis dirus). Four facial length and four skull length measurements were analysed. Results suggest that the common generalisations are inaccurate, as isometric and allometric patterns were found interspersed throughout Carnivora. When family-level clades were compared, Canidae was significantly different from other clades, with all canid species studied showing strong positive allometry. Felidae and Viverridae surprisingly also displayed positive allometry, while the mustelid clade Latrinae was the only clade to display negative allometry. Ancestral state reconstructions of allometric coefficients suggest that both magnitude and direction of facial allometry are highly variable across Carnivora, but allometry may be the ancestral growth style. These data suggest that hypothesis linking diversity and allometry across Carnivora based on domestic species are likely incorrect.

We also scored timing of suture closure, grossly approximating termination of cranial growth, in 370 extant carnivorans, representing 25 species. Amount of suture closure is negatively correlated with body size, and facial sutures are consistently among the last to close. In contrast to facial allometry, suture closure is relatively conservative across carnivorans. Similarly, previous studies show little heterochrony in onset of cranial ossification across Laurasiatheria, although there is little comparative data within Carnivora. Combined, these results suggest that rate of growth (i.e., allometry), rather than heterochronic shifts in onset or termination, is the key variable for linking development and diversity in the carnivore cranium.

Poster Session I (Wednesday, November 2)

**FIRST FOSSIL RECORD OF A SERRASALMINE TELEOST (Pacus and Piranhas) ON THE WESTERN SIDE OF THE ANDES, FROM THE LATE MIocene OF CHILE**

GOTTFRIED, Michael, Michigan State University, East Lansing, MI, USA; SUAREZ, Mario, Museo Paleontológico de Caldera, Caldera, Chile

A single well-preserved tooth recovered from an upper Miocene (Tortonian) horizon in the Bahia Inglesa Formation, north-central coast of Chile, represents the first fossil occurrence of a serrasalmine teleost west of the Andes. In overall morphology the specimen resembles the teeth of some iguanian lizards, but analysis of the tooth’s ultrastructure confirms a fibrinous, branching, non-uniform pattern typical of fish teeth. The tooth has a raised and slightly apically rounded central cusp flanked by narrower, coarsely serrated cutting edges. The labial surface below the crown is somewhat inflated and bulbous. The lingual surface is more trenchant, with a dorsovertically oriented rounded medial ridge that separates anterior and posterior shallowly concave surfaces. In occlusal view, the tooth is labiolingually compressed, with the cutting edges of the crown curving slightly lingually at the tooth's anterior and posterior margins. The lingual surface of the tooth bears fine crenulations and ridges, while the labial side is relatively smooth. The tooth is somewhat more compressed than other serrasalmids, but otherwise strikingly similar to mandibular teeth of some pacus (e.g., Myleus), particularly in crown and labial view, but like piranha teeth it has sharp, serrated cutting edges. This suggests a morphology intermediate between the two specializations within serrasalmines — herbivory, including tough nuts and seeds, in broad-crowned pacus, and flesh-slicing carnivory in piranhas with blade-like teeth. The presence of the specimen in the Late Miocene of Chile indicates at least some level of biotic exchange between freshwater faunas of Amazonia, where serrasalmines are endemic today, and the western side of the Andes, a contention that is supported by the presence of crocodyliforms and hydrochoerine rodents in the Bahia Inglesa Formation.

Poster Session II (Thursday, November 3)

**CONSTRUCtING A ROBUST ECOMORPHOLOGICAL INDICATOR OF LOCAtOR MODE FROM THE DISTAL FEMoral ARTICULAR SURFACE MORPbOLOGY**

GOULD, Francois, Johns Hopkins School of Medicine, Baltimore, MD, USA

To make reliable inferences about the ecology of fossil animals, we need to know which morphological metrics are consistently related to function rather than other factors. The form of a joint surface is the result of different influences on the organism, such as body size, phylogeny and locomotor specialization. I collected six linear measurements from the distal femora of 45 genera of living mammals from the orders Carnivora, Rodentia, Artiodactyla, Perisodactyla and Hyaenidae. Body size range was 0.3kg to about 300kg. Each taxon was placed into one of six locomotor categories (arboreal, scanorial, terrestrial, semi-aquatic, semi-fossorial, and cursorial) based on the literature. Linear measurements were highly correlated with each other and with body size. Thus they were regressed against body size for all taxa and residuals were taken for further analysis. Three ratios were calculated from the linear measurements; none were highly correlated with each other or with body size. Multivariate ordination techniques (principal components analysis, canonical variates analysis) and statistical analyses (MANOVA, discriminant function analysis) were used to test the hypothesis that locomotor mode explains most of the variation in these size standardized metrics. Locomotor mode was a significant predictor of variation in femoral morphology both in the analysis of residuals (r=0.149, F (30, 666)=13.489, df=30, p<0.01) and the analysis of ratios (r=0.173, F (15, 527.67)=3.129, p<0.01). The discriminant functions were also highly significant, but success rates in the classification stage varied widely (carnivore tax 78.6% success rate, semi aquatic tax 27.8% success rate). Closer examination reveals that those taxa most frequently misclassified are those documented as engaging in several of the identified behaviors, or whose classification is equivocal. Arbooreal taxa are also often recovered as scanorial. Linear metrics of the distal femur do reflect locomotor specializations, but are only diagnostic of them for certain specialized behaviors. This has implications for using the distal femur to infer the locomotor behavior of fossil groups.
Technical Session XIX (Saturday, November 5, 3:15 pm)

EARLY PLIOCENE (5MA) SHARK—CECATEAN INTERACTION AT LANGEBAANWEG, WEST COAST, SOUTH AFRICA

GOVENDER, Romala, University of Cape Town, Cape Town, South Africa; CHINSAMY-TURAN, Amnusa, University of Cape Town, Cape Town, South Africa

Numerous Early Pliocene fossils have been recovered from ‘E’ Quarry at Langebaanweg on the West Coast of South Africa. This river channel deposit would have been located close to the river mouth during the Early Pliocene, and is unique in that it preserves both terrestrial and marine animals. The terrestrial component of the deposit has been extensively studied and has provided a reconstruction of the paleoecology of this area during the Early Pliocene. Although the marine taxa from the deposit have been known since the 1960s, until recently, they have been relatively understudied.

Phocid seals as well as mysticete and odontocete cetaceans represent the marine mammals at ‘E’ Quarry. The fragmentary remains of the cetaceans consist of cranial (cranum & mandible) and postcranial elements. Previous studies of the taphonomic agents involved in the Langebaanweg deposit failed to account for some of the damage evident on the cetacean remains. Damage on the cetacean bones consists of numerous superficial and penetrating scars, grooves, and ridges. Analyses presented here and in other studies in the literature suggested that this damage resulted from shark feeding activity. The shark responsible for most of the bites is the white shark, *Carcharodon sp.*, the remains of which have also been recovered from LBW. This is the first documented case of prehistoric shark and cetacean interaction off the South Africa’s West Coast.

Technical Session XIX (Saturday, November 5, 2:15 pm)

NEW FOSSIL WHALES FROM ANGOLA

GRAF, John, Southern Methodist University, Dallas, TX, USA; JACOBS, Louis, Southern Methodist University, Dallas, TX, USA; POLCYN, Michael, Southern Methodist University, Dallas, TX, USA; MATEUS, Octávio, CICEGe, Faculdade de Ciências e Tecnologia, Lisbon, Portugal; SCHULP, Anne, Natuurhistorisch Museum Maastricht, NL-6211 KJ Maastricht, Netherlands

Ongoing field work in Angola, under auspices of Projecto PaleoAngola, has yielded fossil cetaceans from deposits of Miocene age, providing new insights into the diversification of cetaceans along the western African coast. Here two new taxa of mysticete whales are described. PA 165 comprises a partial articulated skull, an unfused cervical vertebra, and a partial thoracic vertebra. The skull includes the nasals, proximal premaxillae and maxillae, the supraoccipital shield, left squamosal, exoccipital, periotic, and frontal. Portions of both dentaries are present. PA 166 comprises a partial articulated skull including the region posterior to and including the nasals. The proximal portions of the maxillae and premaxillae are present. Both specimens were recovered from what appears to be the Luanda Formation, a calcareous sandstone of late Miocene age. Phylogenetic analysis indicates these fossils represent two new taxa named with *Caperea marginita*, the pygmy right whale, in the *Neobalaenidae*, a family currently restricted to one species inhabiting cold temperature Southern Hemisphere waters. Five characters unite the new Angolan taxa with *Caperea*, including the line joining the anterior points of the orbital processes of the frontal positioned anterior to the posterior extremity of the nasals, the posterior edge of the ascending process of the maxilla situated anterior to the posterior edge of the nasal positioned just anterior to the anterior edge of the supraorbital process of the frontal, and the anterior point of the supraoccipital being in a transverse line with the anterior edge of the supraorbital process of the frontal. Three characters distinguish the Angolan taxa from *Caperea*, including the base of the rostrum being narrow, the zygomatic process of the maxilla underlying the supraorbital process of the frontal, and the lateral edges of the maxilla being parallel. *Neobalaenidae* is a sister group to *Eschrichtiidae* and *Balaenopteridae*. These new taxa are the only known fossil representatives of the genera, they are presently in the Angolan Triassic, and they extend its range into the Miocene phase of the Benguela Large Marine Ecosystem.

Romer Prize/Technical Session 5 (Thursday, November 3, 11:15 am)

TIME AVERAGING AND AMS RADIOCARBON DATING OF LATE QUATERNARY VERTEBRATE ASSEMBLAGES: IMPLICATIONS FOR HIGH-RESOLUTION ANALYSES

GRAHAM, Russell, Pennsylvania State University, University Park, PA, USA; STAFFORD, Thomas, Stafford Research, Inc., Lafayette, CO, USA; SEMKEN, JR., Holmes, University of Iowa, Iowa City, IA, USA; LUNDELIUS, JR., Ernest, University of Texas at Austin, Austin, TX, USA

Advances in AMS physics and organic geochemistry have revolutionized our ability to establish absolute chronologies on vertebrate fossils for the late Quaternary. Highly purified samples of collagen, which provides extremely accurate ages, can be extracted from single bones and teeth as small as 50 mg (individual rodent teeth). Combined with measurement precisions of ±1 to ±25 years for ages > 20,000 yr, the direct AMS 14C technique enables fossil deposits to be chronologically dissected at the level of individual specimens.

Analysis of hundreds of AMS 14C dates on individual taxa from a variety of sites and depositional environments indicates that most sites, and even excavation levels (analysis units) as small as 10 cm, can be time averaged by several thousand years at a minimum, even with the greatest care in excavation and processing of sediments. Time averaging of this magnitude to ±15 to ±25 years for ages < 20,000 yr, the direct AMS 14C technique enables fossil deposits to be chronologically dissected at the level of individual specimens.

Poster Session I (Wednesday, November 2)

DECIPHERING THE PERIODICITY OF GROWTH INCREMENTS IN THE TUSKS OF LATE TRIASSIC DICYNODONT (THERAPSIDA: ANOMODONTIA)

GREEN, Jeremy, Kent State University at Tuscarawas, New Philadelphia, OH, USA

Dicynodonts were a diverse clade of non-mammalian therapsids that thrived amidst the ever-changing environments of the Permian and Triassic periods. Many dicynodonts had a pair of enlarged, caniniform teeth (tusks) that were ever-growing without replacement or remodeling. Thus, tusks may record a more complete growth history than skeletal elements that are subject to primary tissue turnover (e.g., bone). As such, growth records derived from tusks may enhance our understanding of life history and adaptation in Permo-Triassic dicynodonts. However, periodicity of growth increments in tusk dentine must be established before growth patterns can be analyzed. This study tests the hypothesis that increments in dicynodont tusks correspond to lines of von Ebner, which are daily growth layers. Evidence for this hypothesis includes: (1) similar periodicity in individual tusks from dicynodonts; (2) similar periodicity within the same tusk from dicynodonts; (3) similar periodicity in individual tusks from different dicynodont species; and (4) daily growth lines in tusks can be identified in H. antiquus from the late Triassic of South Africa. The daily growth lines are significantly different from those found in the early Cretaceous, indicating the presence of a significant change in the growth rate, which is possibly related to environmental changes, such as the onset of repeated aridization in the late Triassic.
spectives. Overall, the sequence and histomorphology of tooth initiation are consistent with previous studies in *X. laevis* and *S. tropicalis*, but the timing is less so. The presence of bone mineralizing germs at NF 56, in contrast to a row of tooth germs reported at NF 55, suggests that NF stages may be too coarse for the comparison of some morphologies. Histology of developmentally arrested tadpoles shows that tooth initiation does not arrest when hindlimbs do, suggesting an alternate, less TH-sensitive timeline of development in pipid tadpoles which may also account for the variability in ossification sequences. These data emphasize the need to identify morphological traits which are TH-responsive and those which are less so. Identification of covarying traits will lead to a more refined understanding of mosaic evolution and development, and may allow us to infer environmental effects on development in extant and fossil tadpoles.

Poster Session II (Thursday, November 3)
THE EFFECTS OF WEATHERING ON RARE EARTH ELEMENT (REE) UPTAKE: A STUDY FROM THE PLEISTOCENE TARKIO VALLEY AND EOCENE BONES GORGE FOSSIL SITES
GRIMM, Brittany, The Pennsylvania State University, University Park, PA, USA;
GRAHAM, Russell, The Pennsylvania State University, University Park, PA, USA

Rare earth element (REE) geochemistry has been used as a tool for several decades to determine age, provenance, degree of reworking, and depositional environment in paleontological deposits. Previous studies have found depth-related variations in REE patterns in bones, but there is little research regarding the impact of weathering on REE signatures. This study presents REE signatures from a rib of the Tarkio Valley late Pleistocene bone bed sloth, *Megalonyx jeffersonii*, from western Iowa, as well as from brontothere and rhinoceros specimens collected at the Eocene Bone Gorge site in northeastern Colorado. After assigning a weathering stage to each bone or bone section, powdered samples were taken and analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The Pleistocene sloth rib shows a systematic increase in weathering from its proximal to distal end, and a corresponding increase in normalized REE concentrations is observed. The most weathered section on the medial side of the rib (weathering stage 5) is approximately four to six times more enriched in REEs than the least weathered section (stage 0.5). This may be due to increased collagen degradation and mechanical breakage before burial, creating greater void space in the bone. Then, during burial and recrystallization, there is greater surface area interaction with REE-bearing pore waters. Even with an increase in concentration, however, the ratios between each element vary only slightly regardless of weathering stage. Differentially weathered specimens from Bones Gorge, a latest Eocene site, are analyzed in the same way for a temporal comparison. This study has significant implications for interpreting REE signatures in fossil bones. Historically, REE signatures in bone were considered to be a function of depositional environment and time, but these are not the only governing factors. Uptake also seems to be a function of weathering. Thus, taphonomic process must be considered before drawing conclusions from REE data.

Poster Session III (Friday, November 4)
NEW GIRAFFID FOSSILS FROM KALODIRR (WEST TURKANA, KENYA): IMPLICATIONS FOR OUR UNDERSTANDING OF THE DIVERSITY OF EARLY GIRAFFIDAE
GROSSMAN, Areych, Department of Anatomy, Midwestern University, Glendale, AZ, USA;
SOLOUNIAS, Nikos, Department of Anatomy, New York College of Osteopathic Medicine, Old Westbury, NY, USA

Early giraffid diversity in the early Miocene of Africa remains poorly studied despite the increasing number of fossils from numerous localities. New giraffid specimens from Kalodir represent the first re-analyses of early giraffid fossils from North and East Africa, as well as comparisons with early Miocene material from Pakistan. We identified the lower second and third molars as those elements that could be directly compared among giraffids from Gebel Zelten (Libya), Moruorot and Kalodir (Kenya), and Zinda Pir and Bugti (Pakistan). We then used non-metric characters to compare these elements using the fossils from these localities. This has allowed us to re-examine the complete dental series of two of the most primitive known taxa, *Archaeonycteris trigonodon* and *Onychonycteris finneyi*. Both taxa have a dental formula of 1.1.3.3/3.1.3.3. *Archaeonycteris* differs from *Onychonycteris* in having: 11-2 similar in size and aligned mesiodistally; C1 more elongate and labiolingually compressed; P2-3 homodont and more mesiodistally appressed; upper molars with broader stylar shelves, weaker parasymphy-tylar hooks, and M1 with a much deeper ectoflexid; M3 with more elongate parastylar region, a weaker metacone, and lacking a postmetacrista; p2-3 similar in size and morphology and both unreduced; e1 relatively larger and more projecting; p4 with distinct para- and metacranids; molar trigonids undifferentiated; cristid obliqua joins postwallid more lingually producing deeper hypoflexid. These differences pose problems for establishing the primitive bat morphotype. *O. finneyi* lacks a paraconid and metaconid on p4 while *A. trigonodon* has both—which (if either) is primitive for bats? In general, but a taxon with a trichobosphatic pattern (hypoconulid centered on postcristid) are viewed as primitive, those showing a nyctodont pattern (hypoconulid lingual, connected to hypoconid) as more derived and those with a mycotid pattern (hypoconulid lingual, isolated, postcristid connects hypoconid to entoconid) as most derived. Both taxa appear to fit the primitive trichobosphatic pattern although it is difficult to be certain for *O. finneyi* in which the hypoconulid could be more lingual. These observations suggest that the early evolution of the chiropteran dentition was mosaic in nature, and that assumptions about the primitive chiropteran dentine type need to be carefully evaluated.

Poster Session IV (Saturday, November 5)
MOSSAIC EVOLUTION IN PRIMITIVE EOCENE CHIROPTERAN DENTITIONS MOSAIC EVOLUTION IN PRIMITIVE EOCENE CHIROPTERAN DENTITIONS
GUNNELL, Gregg, University of Michigan, Ann Arbor, MI, USA; HABERSETZER, Joerg, Senckenberg Forschungsinstitut, Frankfurt am Main, Germany;
SCHLOSSER-STURM, Evelin, Senckenberg Forschungsinstitut, Frankfurt am Main, Germany; SIMMONDS, Nancy, American Museum of Natural History, New York, NY, USA; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

Bats from the Messel Oil Shales (MP 11) and Green River Formation (Wa 7) are represented by some of the most complete skeletons known for fossil chiroptera. However, one of the great ironies of such exquisite preservation is that anatomical features are often obscured because skeletons are articulated. Advances in CT-scanning technology have permitted digital reconstruction of dental anatomy even where upper and lower jaws are in occlusion. This has allowed us to study the complete dental series of two of the most primitive known bats, *Archaeonycteris trigonodon* and *Onychonycteris finneyi*. Both taxa have a dental formula of 1.1.3.3/3.1.3.3. *Archaeonycteris* differs from *Onychonycteris* in having: 11-2 similar in size and aligned mesiodistally; C1 more elongate and labiolingually compressed; P2-3 homodont and more mesiodistally appressed; upper molars with broader stylar shelves, weaker parasymphy-tylar hooks, and M1 with a much deeper ectoflexid; M3 with more elongate parastylar region, a weaker metacone, and lacking a postmetacrista; p2-3 similar in size and morphology and both unreduced; e1 relatively larger and more projecting; p4 with distinct para- and metacranids; molar trigonids undifferentiated; cristid obliqua joins postwallid more lingually producing deeper hypoflexid. These differences pose problems for establishing the primitive bat morphotype. *O. finneyi* lacks a paraconid and metaconid on p4 while *A. trigonodon* has both—which (if either) is primitive for bats? In general, but a taxon with a trichobosphatic pattern (hypoconulid centered on postcristid) are viewed as primitive, those showing a nyctodont pattern (hypoconulid lingual, connected to hypoconid) as more derived and those with a mycotid pattern (hypoconulid lingual, isolated, postcristid connects hypoconid to entoconid) as most derived. Both taxa appear to fit the primitive trichobosphatic pattern although it is difficult to be certain for *O. finneyi* in which the hypoconulid could be more lingual. These observations suggest that the early evolution of the chiropteran dentition was mosaic in nature, and that assumptions about the primitive chiropteran dentine type need to be carefully evaluated.

Technical Session X (Friday, November 4, 8:00 am)
STUDIES IN TAPHONOMY OF EXTANT AND MESSEL BATS
HABERSETZER, Joerg, Senckenberg Research Institute, Frankfurt, Germany;
RABENSTEIN, Rene, Senckenberg Research Institute, Frankfurt, Germany

The unique assemblage of fossil bats at the Messel pit and its extraordinary preservation still require a taphonomic explanation. How the bats died and become deposited in the sediments of the Eocene lake is a matter of ongoing discussion. Most of the approximately 700 excavated specimens are complete, articulated skeletons. However, bone preservation differs markedly.

Beginning with bones in their natural 3D state, progressive osteolysis occurs when one sees increasing degrees of fracturing, plastic deformation, and collapse of compacta and spongia. Ultimately, the bone decays completely, leaving only thin layers of amorphous osseous substance. These stages are represented by numerous bat fossils, which show a distinct centrifugal pattern of decay originating from the abdominal region and spreading to thorax, shoulder region, neck and head, and finally including long bones of wings and legs.

Actualistic experiments on dead bats were conducted in the laboratory for comparison. Their lungs were filled with water or air and the carcasses were subjected to different temperatures. Stages of decay were documented with µ-radiographs. The majority of carcasses whose lungs were filled with water sank immediately to the bottom and became disarticulated faster than carcasses whose lungs were filled with air. In all experiments at different water temperatures, a centripetal disarticulation of the skeleton was observed. Only disarticulation but no osteolysis occurred during these experiments up to 762 days.

Observations on early mumification and putrefaction of extant bats during hours after death provide valuable clues to how long bats were floating on the water surface and how quickly they sank to the bottom of former Lake Messel. We conclude that most of the Messel bats did not drift on the water surface either primarily or secondarily, but sank into deep water immediately after death. This is consistent with the fossil record; approximately 87% are more or less complete skeletons. The remainder are isolated bones, e.g., skulls or partial jaws. These less common states of preservation should also be taken into consideration for a complete description of this fossil site.

Technical Session XII (Friday, November 4, 3:00 pm)
FLIGHT PERFORMANCE OF GIANT PSEUDODONT BIRDS
HABIB, Michael, Chatham University, Pittsburgh, PA, USA;
HALL, Justin, University of Southern California, Los Angeles, CA, USA

Some pseudodont species reached enormous size, with Miocene specimens possessing wingspans of nearly six meters. The group existed from the Paleocene through the Pliocene, with a nearly worldwide distribution (New Zealand, Europe, Africa, South America and North America). Despite their size and wide distribution, little work has been done on the
flight performance of pseudodontorns. We have estimated flight speed and launch ability for the largest Miocene pseudodontorn birds by combining bone strength metrics with quasi-steady aerodynamic analysis.

Glide angle depends on wing efficiency and is independent of body mass; using measured lift coefficients from living seabirds along with the reconstructed wing shape for Osedontornis specimens that include feather impressions, we calculate an average glide ratio of 27:1 for Osedontornis and Pelagornis. This would have made large pseudodontorns the most efficient flyers among known birds (1.35x an average albatross glide ratio and 2.5x an average vulture glide ratio). Scaling pseudodontorn body mass from regressions on living procellariform wingspan predicts a body mass of 55-60 kg for the largest specimens. Applying this estimate to beam model calculations suggests that pseudodontorns possessed relatively weak forelimbs, with similar relative hind limb strength to that seen in Diomedea. However, recent body mass estimates using a relatively complete Chilean specimen are much lower, just under 29 kg. This discrepancy appears to result from the fact that pseudodontorns had proportionately longer wings than albatrosses. Under the lower body mass estimates, the relative cantilever failure force (RCFF) value for the femur of the largest Pelagornis specimen is 2.95, which is nearly double that for a 9 kg wandering albatross. Launch in birds is hind limb driven; therefore, this high RCFF value suggests powerful launching ability in pseudodontorns. A low body mass would allow for slower flight, but would reduce wind penetration and may have precluded the use of some forms of dynamic soaring. A lighter mass would not improve overall soaring efficiency, but would improve launch performance.

Poster Session III (Friday, November 4)

A DIVERSE DINOSAUR TOOTH ASSEMBLAGE FROM THE UPPER JURASSIC OF ETHIOPIA: IMPLICATIONS FOR GONDWANAN DINOSAUR BIOGEOGRAPHY

HALL, Lee, Museum of the Rockies, Montana State University Department of Earth Sciences, Bozeman, MT, USA; GOODWIN, Mark, University of California Museum of Paleontology, Berkeley, CA, USA.

Dinosaur-bearing Gondwanan Upper Jurassic deposits are under represented in the fossil record and thus signify a gap in our understanding of the biogeographic radiation of several non-avian dinosaur clades. Here we present an analysis and description of dinosaur teeth from the Upper Jurassic (Tithonian) Mugher Mudstone Formation, Ethiopia, collected during several expeditions by the University of California Museum of Paleontology, Berkeley. Significantly, several teeth are referable to the Dromaeosauridae and represent the oldest skeletal remains of this group in Gondwana. Teeth referable to the stegosaur Paranthodon africanaus and the charismatic range of this taxon into the Late Jurassic and expand the geographic range of African stegosaurs north beyond the Tanzanian record at Tendagur. The presence of hypsilophodontid teeth suggests a more diverse dinosaur fauna than previously recognized. Although some teeth are not well preserved, they suggest the presence of several dinosaur taxa in the Mugher Mudstone Formation and highlight the importance of African faunas for understanding the radiation of non-avian dinosaurs across Gondwana.

Technical Session I (Wednesday, November 2, 11:45 am)

ANATOMY OF JEHOLOSAURUS SHANGYUANENSIS AND A PHYLLOGENETIC ANALYSIS OF BASAL ORNITHISCHIANS

HAN, Fenglu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; XI, Xiaoyi, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; BARRETT, Paul, Department of Palaeontology, Natural History Museum, Cromwell Road, London, London, United Kingdom

Jejoholosaurus shangyuanensis is a small ornithischian collected from the Lower Cretaceous Yixian Formation of the Lufangtian Location, Liaoning Province, China. Seven specimens, including the holotype, are described in detail, revealing new information pertaining to the skull and postcranial skeleton. Four autapomorphies and the presence of a unique combination of character states support the validity of Jejoholosaurus. The autapomorphies include: the presence of a row of small foramina in the neural surface of the nasals, immediately dorsal to the premaxillary articulation; grooves and ridges present on the anterolateral surface of the frontal; parapophysis absent in dorsal vertebrae 1 and 2; and a narrow, deep, mediodorsally extending fossa is present on the lateral side of the anterior ascending process of the astragals. Other notable characters that contribute to the unique combination defining Jejoholosaurus shangyuanensis include: six premaxillary teeth; presence of a quadratejugal foramen; presence of small nodes on the lateral surface of the jugal; presence of a deep concavity on the medial side of the nasals; caudal process of the jugal bifurcated distally; external mandibular foramen absent; a long axial neural spine that extends posteriorly to reach the distal end of cervical 3; presence grooves and ridge on the ventral surface of sacral and anterior caudal vertebrae

A phylogenetic analysis based on 42 taxa and 420 characters was carried out in order to establish the position of Jejoholosaurus among basal ornithischians. Both parsimony and Bayesian methods were used in the analysis. The results suggest that Jejoholosaurus shangyuanensis and Changchunosaurus parvis are more closely related to Marginocephalia than to Ornithopoda, maybe providing new evidence for the early evolution of ceratopsians. The results also support heterodontosaurid monophyly, the monophyly of Marginocephalia, and monophyly of Thyrropora, within which the positions of Scelottosaurus, Enarvusaurus, and Scelidosaurus are unstable. The Bayesian method strongly supports ornithopod monophyly, and produced a better-resolved phylogenetic tree than parsimony. In contrast to other phylogenetic analyses, the results suggest that Psittacosaurus represents the most basal ceratopsian dinosaur and that Triceratops and Chasmosaurus form a clade. There are also some topological differences between the results gained from the two methods, for example, in the positions of Leptoscelosaurus, Psisinosaurus, and Escuor. Moreover, the positions of the most basal ornithischians are unstable in the topologies produced by both methods, and more work is needed to address this problem.

Poster Session IV (Saturday, November 5)

ASHES TO ASHES, DUST TO ECM: PROTEOMIC ANALYSIS OF VERTEBRATE SAMPLES FROM THE SNOWMADSTON PROJECT

HANSEN, Kirk, University of Colorado Denver, Aurora, CO, USA; HILL, Ryan, University of Colorado Denver, Aurora, CO, USA; JOHNSON, Kirk, Denver Museum of Nature and Science, Denver, CO, USA; STUCKY, Richard, Denver Museum of Nature and Science, Denver, CO, USA

Bone samples from several vertebrates were collected from the Ziegler Reservoir, Snowmadston basin, konklin in bone and soft tissue samples which involve aqueous extractions and detergent assisted digestion. Tandem mass spectrometry was used to obtain protein se- quence coverage from proteolytic and mixed chemical-proteolytic digests. A range of bioin- formatric resources were used to obtain peptide identifications based on sequence homology and de novo methods were used to yield additional peptide sequences. Identifications were compared to recently published MS sequencing and fingerprinting results to yield consider- able overlap in results. Our analysis of bone samples resulted in some of the most complete fibular collagens sequence reported to date from paleontological samples. Additional extra- cellular matrix (ECM) and non-ECM proteins have been identified for the first time in our soft tissue samples. Protein interaction analysis reveals a network of complex interactions between identified proteins and suggests the presence of a protective niche beyond fibular collagen structures within the fossils. These results should allow us to further the phyloge- netic analysis of extinct vertebrae.

Technical Session XII (Friday, November 4, 4:00 pm)

FOSSIL AVIFAUNA OF THE PLEISTOCENE FOSSIL LAKE FORMATION (OREGON): CAN BIRDS BE USED AS A PROXY TO DETERMINE PALEOClimATIC CONDITIONS?

HARGRAVE, Jennifer, Syracuse University, Syracuse, NY, USA

Lacustrine sediments of the Pleistocene Fossil Lake Formation of Oregon, record pack- ages of upwardly fining sequences that are fossiliferous, including a large collection of bird fossils. This paleo-lake was studied to determine whether stratigraphically collected bird fossils are a useful tool to infer broad climatic conditions of ancient lacustrine systems. Depositional environments were determined for each of the eight stratigraphic packages that were deposited from 464 ka to approximately 10 ka as the lake waxed and waned. The strati- graphic relationships suggest the lake experienced gradual in-fillings followed by abrupt shallows. A subsample of over 350 stratigraphically collected bird fossils are divided into
3 eco-groups based upon their feeding preferences: diving birds, shallow-water birds, and terrestrial birds. The fossil avifauna recovered from the Fossil Lake Formation reveal changes in group abundances with changing water depth. Shallow-water birds are consistently the most abundant eco-group overall. Diving birds are at their most abundant in the finer-grained sediments, which are interpreted here to have been deposited in deeper water during wetter climates. The fossil avifauna is in agreement with the inferred depositional environments. Additionally, geochemically dated tepha units within the formation allow for correlation and comparison to nearby lakes for which climate has been determined, as well as to global Marine Isotope Stages. Based on these correlations, the inferred climate of the Fossil Lake Formation was corroborated and it was determined that the formation was primarily deposited during glacial episodes. With as many fossil collections, inferences made solely from fossil avifauna may be limited, resulting from sample size, taphonomic biases, etc. However, collections of avifauna with stratigraphic control can be combined with other datasets, such as lithologic and isotopic data, to better construct broad paleoclimatic conditions, such as warm or cold and dry or wet.

Symposium 2 (Wednesday, November 2)

CONTRIBUTIONS FROM PROJECT 23 TO OUR UNDERSTANDING OF THE RANCHO LA BREA BIOTA

HARRIS, John, George C. Page Museum, Los Angeles, CA, USA; FARRELL, Aisling, George C. Page Museum, Los Angeles, CA, USA; HOWARD, Carrie, George C. Page Museum, Los Angeles, CA, USA; SCOTT, Kim, George C. Page Museum, Los Angeles, CA, USA; SHAW, Christopher, George C. Page Museum, Los Angeles, CA, USA

The Rancho La Brea (RLB) biota contains over 600 species of Late Pleistocene animals and plants ranging in age from 9,000 to 55,000 radiocarbon years BP. Isotopic studies involving this biota during the past decade have suggested that coastal Southern California experienced extreme aridity during the late Pleistocene and that C3 plant productivity was greatly diminished during the last glacial episode. Because of its age range, the RLB biota should document responses to both global cooling and global warming. However, over half the species represented at RLB, including most of the plant, insect, and mollusk species, are known only from the Pit 91 where they document the interval –27,000 years ago. Unfortunately, the earlier 13,000 excavations recovered very little microfauna.

Sixteen asaphid fossiliferous deposits were recovered in 2006 adjacent to the RLB National Natural Landmark and during the construction of an underground parking structure for the Los Angeles County Museum of Art. The deposits were retrieved between 10 and 25 feet below ground surface and were crated and relocated to the Pit 91 compound for excavation and processing. Although their preparation is far from complete, 7 of the 23 boxes have to date yielded more than 16,000 bones and more than 80 species of vertebrates, invertebrates, and plants. These deposits have the potential to expand our understanding of the nature and diversity of the RLB assemblages before and after that from Pit 91. Meanwhile they are already providing information about the formation of the RLB deposits. Asaphid accumulations from Project 23 excavated thus far include a tabular deposit, a narrow fissure, and a meter-wide cylindrical vent extending downward for at least two meters, all packed with bones. Elements of at least some individual skeletons have clearly undergone postmortem vertical relocation within their accumulations. This in turn suggests that it may be unwise to estimate either the age or environment of individuals from any specific bone mass on the basis of their stratigraphic position within the deposit or on radiometric dates from adjacent remains of other individuals.

Poster Session II (Thursday, November 3)

INSIGHT INTO THE CENOMANIAN (LATE CRETACEOUS) TERRESTRIAL AND MARINE VERTEBRATE FAUNA OF BYLOT ISLAND, NUNAVUT

HARRISON, Luke, Redpath Museum, McGill University, Montreal, QB, Canada; VAWREK, Matthew, Royal Ontario Museum, Toronto, ON, Canada; BECKER, Michael, Department of Geography, McGill University, Montreal, QB, Canada; LARSSON, Hans, Redpath Museum, McGill University, Montreal, QB, Canada

A diverse marine selachian fauna, represented by isolated teeth and tooth fragments, is described from the Cenomanian of Bylot Island, Nunavut, Canada. The fauna consists of at least six species, including a possible Mitsukurinid, Notorhynchus sp., Archeolepis sp., and Paraorthacodus jaurensis. Fragmentary tooth plates indicate the presence of further Chimerid species. At the time it was deposited, the fauna was near its present location, well above the Arctic Circle. The locality is also one of the few known from this region of Late Cretaceous North America, providing important biogeographic information about the nearby Labrador Seaway and the paths of dispersal of these species into and out of modern populations of the Western Interior Seaway. The fauna is similar to a near contemporary fauna from Western Australia. Because many of the species are also found at lower latitudes, this could be indicative of higher water temperatures at high latitudes during this interval and the much more equitable climate present at the time.

Poster Session II (Thursday, November 3)

THE DIET OF THE MIO-PLIOCENE CARNIVORES OF LANGEBAANWEG, SOUTH AFRICA

HARTSTONE-ROSE, Adam, Penn State University, Altoona, PA, USA; SIMPLER, Elizabeth, Penn State University, State College, PA, USA; HECKLER, Amanda, Penn State Altoona, Altoona, PA, USA

Recent studies have shown that interstitial.nches (ICN) and cusp radius-of-curvature (ROC) of post-canine dentition can be used to differentiate the diets of modern carnivores along a spectrum from hypercarnivory to durophagy. These studies examined the dietary breadth of the Plio-Pleistocene carnivores from the Sterkfontein Valley, South Africa, and found that the guild from that time and region significantly overlapped the modern carnivores in their carcass-processing abilities. In the current study, we apply these techniques to evaluate the carcass-processing abilities of the carnivores from the Mio-Pliocene site of Langebaanweg (LBW), South Africa. This site has extraordinary carnivore diversity including numerous species of hyaenids and felids as well as large mustelids and Ursids and many small carnivores. The hyenas from this site have been described as representing a primitive dietary generalist grade, purportedly more canid in ecológic With Caimans, we evaluate these specimens to test whether they fall closer to the hyaenid or canid dental shape and we also examine the felids to determine where they fall relative to the modern sample. We found that the LBW hyaenids fall between the modern hyaenids and canids in terms of the sharpness (ROC) of their teeth though the ROC of their p3 (the best tooth for differentiating the diets of carnivores by this measure) overlaps the range of the modern durophagous hyenas, the means are substantially different with the LBW hyenas falling slightly closer to (though statistically different from) the more flesh-adapted canids. This pattern is more dramatically confirmed when examining the ICN. Using the ICN to sum the notch scores of the p4 (the best tooth for differentiating the diets of carnivores by this measure), the LBW hyenas are statistically more hypercarnivorous than not only the modern hyenas but most species of canids. In fact, by this measure, they appear nearly as hypercarnivorous as Cuon and Lycalopex and even approach the notch scores of some of the felids. By both ROC and ICN, the LBW felids fall within the modern cat dietary range and by some measures appear nearly as hypercarnivorous as taxa like Acinonyx (the cheetah).

Technical Session XVIII (Saturday, November 5, 2:30 pm)

NEW PRIMITIVE CAIMANINE (CROCODYLIDAE, ALLIGATORIDAE) FROM THE MIOCENE OF PANAMA

HASTINGS, Alexander, University of Florida, Florida Museum of Natural History, Gainesville, FL, USA; BLOCH, Jonathan, University of Florida, Florida Museum of Natural History, Gainesville, FL, USA; RINCON, Aldo, University of Florida, Florida Museum of Natural History, Gainesville, FL, USA; MACFADDEN, Bruce, University of Florida, Florida Museum of Natural History, Gainesville, FL, USA; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Balboa-Ancon, Panama

While extant caimans are geographically limited to the New World Tropics (NWT), their fossil record extends to the Paleocene of Argentina in South America and the Eocene of Wyoming in North America, both at higher latitudes, suggesting that the origin of Caimaninae might have occurred outside of the tropics. A new fossil skull from the Culebra Formation (early Miocene) of Panama has characteristics uniquely shared with Caimaninae, including open supratemporal fenestrae, and exoccipitals that terminate dorsal to the basioccipital tubera. Cladistic analysis of 164 morphological characters parsimonious cladograms, all of which place the new taxon from Panama as the most basal caimans and alligators, including open supratemporal fenestrae, and exoccipitals that terminate dorsal to the basioccipital tubera. Cladistic analysis of 164 morphological characters from the Paleocene–Eocene of high latitude Argentina, suggesting that caimans in Caimaninae. The new taxon from Panama is the most basal caimans and alligators, including open supratemporal fenestrae, and exoccipitals that terminate dorsal to the basioccipital tubera. Cladistic analysis of 164 morphological characters from the Paleocene–Eocene of high latitude Argentina, suggesting that caimans in Caimaninae. It falls out as more primitive than the oldest fossil records of the subfamily, Eocaiman from the Paleocene–Eocene of high latitude Argentina, suggesting that caimans originated within the NWT, entered both South and North America during the Paleogene, and persisted in the tropics into the Miocene after disappearing at higher latitudes. Alternate-
tively, caimans may have originated outside of the tropics and dispersed into Panama by the Miocene as suggested by the older records at higher latitudes. While caiman fossils have yet to be recovered from the Paleogene NWT, and no taxa as primitive as the one described here has been discovered from outside of the NWT; new fossil discoveries could test the biogeographic hypotheses presented here.

Poster Session II (Thursday, November 3)

DENTAL MICROWEAR TEXTURE ANALYSIS OF DENTIN
Haupt, Ryan, Vanderbilt University, Nashville, TN, USA; Desantis, Larisa, Vanderbilt University, Nashville, TN, USA; Green, Jeremy, Kent State University at Tuscarawas, New Philadelphia, OH, USA

Infering the dietary ecology of fossil mammals requires the use of tools such as morphological analyses, stable isotopes, and/or dental microwear. While the majority of mammals have both teeth and tooth enamel allowing for such analyses, some xenarthrans lack teeth and all enamel. Recent research has demonstrated the potential viability of using stable isotopes on dentin. However, one must first demonstrate the lack of diagenetic alteration in dentin using tools like Rare Earth Element analysis. Instead, low-magnification dental microwear of xenarthrans has recently been shown to differentiate extant sloths and armadillos, with differences between taxa largely driven by the average number of scratches. Another microwear technique, Dental Microwear Texture Analysis (DMTA) can quantify high resolution (100x) microwear surfaces in three-dimensions and without requiring the counting of individual microwear features (e.g., pits and scratches). DMTA is useful at quantifying primate, ungulate, carnivore, and marsupial diets. Therefore, DMTA has the potential to further resolve the dietary ecology of extinct and extant xenarthrans. Our preliminary results indicate a high degree of overlap among armadillos (Euphractus sexcinctus and Dasypus novemcinctus) and sloths (Bradypus variegatus and Choloepus didactylus) in both complexity and anisotropy. Furthermore, our data appear to show that C. didactylus is likely feeding on C4 plants, as objects from objects from DMTA analysis also supported by observational data. The extinct species Megalonyx leptostomus and Paramylodon harlani were also likely browsers, based on higher complexity values, an interpretation also supported by morphological studies. These results show the potential for dentin DMTA to yield paleoecological information. However, further tests quantifying differences in dentin and enamel microwear in functionally identical wear surfaces is currently underway.

Poster Session IV (Saturday, November 5)

ISO Topic RECONSTRUCTION OF MODERN SMALL MAMMAL DIETS AND IMPLICATION FOR UNDERSTANDING THE EVOLUTION OF THE C4-DOMINATED GRASSLANDS OF THE GREAT PLAINS
Havel, Andrew, University of Minnesota, Minneapolis, MN, USA; Fox, David, University of Minnesota, Minneapolis, MN, USA

We reconstruct the diets of modern small mammal communities in Minnesota and western Nebraska using carbon isotopes in hair from museum specimens to determine if small mammal diets faithfully record differences between environments. Modern small mammals from Nebraska should be isotopically heavier than modern specimens from Minnesota because western Nebraska grasslands have a greater proportion of C4 plants (warm season grasses) relative to C3 plants (trees, shrubs, cool season grasses) than do grasslands and more wooded biomes in Minnesota. We analyzed 149 hair samples of 15 species from Nebraska and three from Minnesota. After correcting raw data to 613C of diet, mean 613C value for all specimens in Nebraska (-22.0‰ VPDDB) is statistically higher than for Minnesota (-25.4‰), consistent with a greater consumption of C4 grasses on average by small mammals in Nebraska but indicating most individuals and most species in both states rely more heavily on C3 biomass regardless of the environment. For the three species that occur in both states, two species have diets with statistically higher 613C values in Nebraska than in Minnesota. Separate ANOVA’s of the data from Nebraska and Minnesota grouped by species indicate statistically significant differences among species in the consumption of C4 biomass in each region. These results suggest isotopic analyses of rodent communities may be used to assess relative changes in ancient environments, but may not necessarily reflect the absolute abundance of C4 biomass. To determine if small mammal diets suggest temporal change in the abundance of C4 biomass in a region, we compared the modern data from western Nebraska to laser ablation analyses (corrected to diet) of 79 teeth of 24 species rodents from the 2.4 Ma Big Springs Gravel Pit fauna in Nebraska. Mean 613C of modern rodents is statistically higher than the mean for Big Springs rodents (23.5%). This could suggest an increase in the relative abundance of C4 grasses in Nebraska since 2.4 Ma, but we cannot rule out differences in food selection or possibly warmer and drier conditions today shifting the 613C of C3 biomass relative to the Early Pleistocene.

Technical Session XIX (Saturday, November 5, 3:30 pm)

Bone Histology Suggests Increasing Aquatic Adaptations in Desmostylia
Hayashi, Shoji, University of Bonn, Bonn, Germany; Nakajima, Yasuhisa, University of Tokyo, Tokyo, Japan; Chiba, Kentaro, Hokkaido University, Sapporo, Japan; Sawamura, Hiroshi, Ashoro Museum of Paleontology, Ashoro, Japan; ANDO, Tatsuro, Ashoro Museum of Paleontology, Ashoro, Japan

Desmostylians are a group of extinct mammals known from the upper Oligocene through the middle Miocene marine strata of the northern Pacific Rim. The paleoecology of extinct desmostylians has been controversial since they were first discovered. The unique osteological and dental morphologies have hindered a consensus on their paleoecology. Bone histology can be used as a tool to infer aquatic adaptations of extinct animals. However, histological studies of desmostylians are not well known. Therefore, we compared the histology of Behemostops, Paleoparadoxia, Ashorosaurus, and Desmostylus using thin-sections and CT scans of ribs and humeri to better understand the desmostylian habitat and evolutionary history. With the exception of Desmostylus, thin-sections of cortical bones from ribs and humeri show multiple growth marks, indicating a similarity with siremions. All desmostylians lack medullary cavities in their limb bones and ribs. In extant mammals, this has been interpreted as an aquatic adaptation. Bone histology of Behemostops and Paleoparadoxia shows osteoporosis, while that of Ashorosaurus shows pachy-osteoporosis. Desmostylus bone histology is distinctly different from that of other desmostylians in that it shows an osteoporoitic-like pattern. In living taxa, high density bone (osteoporosis and/or pachy-osteoporosis) provides static buoyancy control suitable for a coastal habitat, while low density bone (osteoporoitic-like pattern) is associated with dynamic buoyancy control suitable for a pelagic life style. Our study suggests that all desmostylians evolved aquatic adaptations, habitats, and/or aquatic locomotion throughout their evolutionary history, but bone histology suggests that Desmostylus was the only desmostylian to have been able to employ dynamic buoyancy control.

Poster Session IV (Saturday, November 5)

Coiling Geometry of Proboscidean Tusks
Hadden, Alistair, University of Michigan, Ann Arbor, MI, USA; Fisher, Daniel, University of Michigan, Ann Arbor, MI, USA

The permanent tusks of proboscideans are greatly enlarged and generally ever-growing second incisors. They typically show a spiral form that is most clearly developed in some mammoths, but that is a fundamental geometric feature of tusks in all proboscidean taxa and possibly other teeth as well. We are investigating the theoretical morphology of proboscidean tusks by developing a model that describes their 3D geometry. Our goal is to understand the variety of tusk forms found in proboscideans and to clarify how these forms might arise through modifications of an underlying growth program. In addition, we hope to use quantitative descriptors of tusk form to test a hypothesis that some late Pleistocene mammoths of the Great Lakes region (referred by some workers to Mammuthus jeffersonii) may be hybrids between M. columbi and M. primigenius. Tusks of putative hybrids do show qualitative hints of intermediacy, but without a model to guide selection of independent descriptors, this proposition is difficult to evaluate.

To develop our description of tusk form, tusks of M. primigenius from Chukotka and Wrangel Island (northeast Siberia) were digitized and fit to mathematical models using nonlinear optimization in MATLAB. The models explored were based on those developed to describe molluscan shell coiling and include approaches relying on external reference frames and familiar geometric equations as well as alternative approaches relying on internal reference frames that better describe actual biological growth. The principal structural axes of tusks, running through the tusk from the tip to the pulp cavity, were found to fit well to 3D logarithmic spirals (2D logarithmic spirals with the third dimension defined by an additional exponential function) with the free parameters for the spirals differing between tusks. Other models of coiled form were also explored with varying degrees of success. Resolution of the
taxonomic problem that inspired this project will require larger sample sizes, but we have a foundation that appears adequate to the task.

Technical Session IX (Friday, November 4, 11:15 am)

AN ENIGMATIC DERIVED SNAKE FROM THE EARLIEST EOCENE OF EQUATORIAL SOUTH AFRICA

HEAD, Jason, University of Toronto, Mississauga, ON, Canada; BLOCAL, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; RINCON, Aldo, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BOURQUE, Jason, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Balboa, Panama

Despite being the region of highest extent diversity, equatorial latitudes are poorly sampled for fossil reptiles. This is especially true for the Paleogene greenhouse, which limits our understanding of poikilothermic vertebrates during the globally warmest intervals. Field-work in a channel lag deposit within the earliest Eocene section of the Bogotá Formation, at Muchuelo Creek, Bogotá, Colombia has produced the first Paleogene equatorial squamates associated with a diverse vertebrate fauna including mammals, crocodyliforms, anurans, and fishes. The squamate record includes small-bodied iguanian and teiid lizards, representing an understanding of derived snakes based on the simultaneous occurrence in South America and Indopakistan. The presence of a modestly diverse squamate fauna consisting of extant Neotropical clades in the Bogotá Formation indicates equatorial herpetofaunal stability between the Paleogene and Neogene, despite radically different global climate regimes.

Poster Session IV (Saturday, November 5)

MICROVERTEBRATES DRAMATICALLY INCREASE THE DIVERSITY OF THE CUMNOCK FORMATION (NEWARK SUPERGROUP: CHATHAM GROUP) IN THE SANFORD SUB-BASIN, NORTH CAROLINA

HECKERT, Andrew, Appalachian State University, Boone, NC, USA; MITCHELL, Jonathan, University of Chicago, Chicago, IL, USA; SCHNEIDER, Vince, North Carolina Museum of Natural Sciences, Raleigh, NC, USA; OLSEN, Paul, Lamont Doherty Earth Observatory, Palisades, NY, USA; SLOAD, Eric, Appalachian State University, Boone, NC, USA

The Moncur microvertebrate locality in the Cumnock Formation, Sanford sub-basin, North Carolina, dramatically increases the known Upper Triassic vertebrate assemblage from the Deep River Basin. The ~50,000 recovered microvertebrate fossils include osteichthyans, amphibians, and numerous lepidosauromorphs, archosauriforms, and synapsids, making it one of the richest Upper Triassic localities in the Newark Supergroup. The majority of the fossils are of osteichthyans, principally thousands of actinopterygian scales, teeth, skull, and lower jaw fragments, some of which are referable to Semionotidae indet. Abundant, diminutive (3-8 mm) dipluranid and carabid larvae are referable to Archaeospondylus, with less frequently recovered, equally small crushing plates possibly referable to another taxon. Temnospondyls are rare but probably represent small (juvenile) metoposaurids. Both acrodont and pleurodont jaw fragments suggest the presence of lepidosauromorphs but are otherwise indeterminate. Two fragmentary teeth are assigned to the unusual amniote Colognathus obscurus (Case), previously only known from the American Southwest. Among the many archosauriform tooth morphotypes are a diminutive Revueltosaurus-like taxon distinct from R. cullen-deri that we assign to "Pekinosaurus" olseni, another morphotype best assigned to Gyaltonia gibbidaeus, the first Newark Supergroup record of Crassosuchus barriae and several other archosauriform tooth morphotypes, as well as grooved teeth assigned to the recently named species Uachtidodon schneidersi. Synapsids represented by teeth include the "traversodontid" Boreogomphodon, the "thromberhid" Microconodon and other derived cynodonts. These new records are biogeographically important, as many of these records are new to at least the Cumnock Formation and, in many cases, the Newark Supergroup, but are known from other basins. In particular, Colognathus, Crassosuchus, and Uachtidodon are known from basins of Adamanian age in the Chine. Use of a 3D digital microscope vastly improves upon both light and scanning electron microscopy when imaging these microvertebrates and will facilitate more quantitative analyses in the future.

Preparers’ Session (Thursday, November 3, 8:45 am)

COLLECTION AND PREPARATION OF VERTEBRATE FOSSILS FROM THE EARLY PERMIAN BROMACKER QUARRY LOCALITY, CENTRAL GERMANY

HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, PA, USA; BERMAN, Dave, Carnegie Museum of Natural History, Pittsburgh, PA, USA; MARTENS, Thomas, Museum der Natur Gotha, Gotha, Germany; SUMIDA, Stuart, California State University, San Bernardino, CA, USA

The Carnegie Museum of Natural History, Pittsburgh, has been working for the past 20 years in collaboration with the Museum der Natur, Gotha, Germany, California State University, San Bernardino, and other institutions to collect, prepare, and study tetrapod fossils from the Early Permian Bromacker Quarry Locality, central Germany. The fossils occur in the Tambach Sandstone of the Tambach Formation, typically within one of two sheet flood units consisting of massive siltstone to very-fine-grained sandstone separated by an intervening unit of laminated to massive siltstone. Preservation of the fossils is excellent, with most of the skeletons being complete to nearly complete and fully or loosely articulated. The fossiliferous section is carefully quarried for fossils using hand tools such as hammers, chisels, and pry bars, and a rock saw and jack hammer are used when needed. Once a specimen is discovered, its dimensions are determined, exposing as little of the skeleton as possible to prevent loss or damage to the specimen. The fossil is then removed in one or more blocks encased in a burlap and plaster jacket.
The fine-grained, indurated matrix lends itself well to mechanical preparation. After the block is opened in the lab, removal of overburden rock is achieved with a small hammer and chisel and/or pneumatic scribe, followed by detailed exposure of the bone with a pneumatic scribe and/or small hand tools. Several problems commonly encountered during preparation of these fossils and their solutions are as follows: 1) numerous cracks run through the blocks, including the fossil bone. This is remedied by filling the cracks with polyethylene glycol. 2) Postdepositional chemical weathering of some of the bone has left it with a spongty texture that lacks surface detail and good separation from the surrounding rock. Polyvinyl butyral, cyanoacrylates, and polyethylene glycol have been used in attempts to consolidate the spongy bone, but none of them has proved to be entirely satisfactory and/or time efficient. 3) Occasionally bone is lost during the process of discovering and collecting a fossil. Casting epoxies have been applied to retaining natural molds in the rock with some success.

Poster Session II (Thursday, November 3)
HYAENIDAE: DIVERSITY AND PHYLOGENETICS IN THE LATE CENOZOIC HENSLEY-MARSCHAND, Blaire, Indiana University, Bloomington, IN, USA
The Hyaenidae is a diverse family of carnivores that originated in the early Miocene (circa 22 million years ago) with four species surviving to the present day. The group has ranged as far north as Russia, as far south as the southern tip of South Africa, and from western Europe all the way eastward around the globe to North America. I looked at the environmental factors relating to diversification and extinction in Hyaenidae by looking at species diversity through time, modeling the relation of living species to modern climate, and analyzing phylogenetic differentiation. To examine the diversity of this family over time, point occurrences of fossil specimens from the online Neogene Old World Database were analyzed. Although this family originated at least 22 million years ago, their diversity rose sharply between 10 and 7 million years ago, declining slowly since then. Their peak diversity was associated with onset of cooling after the Miocene climatic optimum, a period when C4 grasslands expanded, but they did not diversify until their full geographic diversity until the Pleistocene and Pliocene when their species diversity was beginning to decline. Geographic diversity was analyzed for extant hyaenas (dated to after 1900) downloaded from the Global Biodiversity Information Facility online. The geographic range of extant hyaenas is mainly restricted to the African continent with only one species (the striped hyena, Hyaena hyaena) extending to the Middle East. This limited distribution is in stark contrast to the aforementioned wide geographic range for the family during the Miocene, and continued climate warming is likely to reduce these habitats further based on a future climate model. Lastly, a phylogenetic analysis based morphologic characters of Hyaenidae, both extinct and extant, was conducted using Phylop. Results indicate a phylogenetic separation of the civet-like genera, the cursorial meat-and-bone-eaters, and the bone-crushers. The former group was established at the onset of the Hyaenidae family, but the latter two groups appear in the later Miocene. Therefore, morphologic and ecological diversification occurred during the time of peak genus diversity.

MESOWEAR ANALYSIS APPLIED TO LOWER MOLARS OF HORSE SPECIES HERNESSENIEMI, Elinna, University of Helsinki, Helsinki, Finland; FORTELLIUS, Mikael, University of Helsinki, Helsinki, Finland
It is possible to gain information about the dietary habits of fossil animals by studying the wear patterns of their teeth. Here we test whether a new wear-based reconstruction method developed by us can be used to deduce the diet of horse species from the wear patterns of their lower molars. This method, where the wear facets of buccal enamel bands are examined, is derived from classical mesowear analysis. Although both methods are based on a study of the facet development on the occlusal surfaces of the teeth, lower molars of horses are not suitable for classical mesowear analysis. In our method we digitally measure the angle between the surface of the enamel edge and the buccal side surface of the teeth from 3D reconstructions of the relevant parts of the lower molars. We compared our method to the classical mesowear method by analysing the lower molars and the upper molars, retrospectively, of multiple species from the middle Miocene Anchitherium, the upper Miocene Hipparion and the Pleistocene and Recent Equus. We also compared these results to results obtained in earlier studies of Pleistocene and Recent rhinoceros species, where we have previously used our method successfully. The results suggest that the angle between the surface of the enamel edge and the buccal side surface of lower molars approximates a combined effect of relief and roundness of classical mesowear analysis and our method consequently appears suitable for mesowear scoring in horse species from lower molars. We find that Anchitherium species had the largest amount of browse in their diet, Equus species had the largest amount of graze in their diet and the dietary range of Hipparion appears suitable for mesowear scoring in horse species from lower molars. We find that C3 vegetation was not available. Instead, it is likely that the fossil rodents also selected based upon serial isotopic analysis of capybara incisors, it appears that C4 vegetation is an important component of capybara diets only during and just after dry seasons. When the wet seasons begin, C3 grasses dominate capybara diets. Giant fossil rodents also appear to have had diets dominated by C3 vegetation, so much so that they are arguably exclusively C3 feeders. Given our capybara data, it cannot be assumed that C4 vegetation was not available. Instead, it is likely that the fossil rodents also selectively ate C3 grasses. Testing this hypothesis will require examining other fossil mammals and/or paleoenvironmental proxies to fully understand the environment in which the fossil rodents lived.

THE EVOLUTION OF EXOSKELETAL OSSIFICATIONS IN NOTOSUCHIAN CROCODYLIFORMS HILL, Robert, New York College of Osteopathic Medicine, Old Westbury, NY, USA; O’CONNOR, Patrick, Ohio University College of Osteopathic Medicine, Athens, OH, USA
Notosuchians are becoming increasingly well-known for their diverse craniodental specializations, many of which deviate drastically from typical crocodyliform anatomy. Postcranial apomorphies, while somewhat less bizarre, nevertheless appear to be important adaptive features of the axial and appendicular skeletons. In particular, notosuchian odontories exhibit great variability in surface morphology, histology, and three-dimensional structure. Using paleohistology and microCT, we characterized osteoderms in several notosuchians and closely allied crocodyliforms in an effort to explore patterns of character evolution in the dermal skeleton. In contrast to proximate outgroups (e.g., Araripesuchus, notosuchians such as Bauensuchus, Notosuchus, and Pakasuchus) are characterized by a general trend toward reduction of dorsal osteoderms, typically associated with an expansion of the caudal osteodermal shield. One notable exception is Simosuchus, in which the dorsal shield is extensively developed. Other trends in Notosuchia include reduction of surface ornamentation and increased internal cavitation of osteoderms. Among notosuchians, Pakasuchus exhibits the most extreme reduction of dorsal osteoderms, but possesses a robust, articulating shield of osteoderms completely surrounding the tail. Near the dorsosacral transition, reduced osteoderms appear as elongate, fusiform elements with crenulated edges. Other ossifications are tentatively interpreted as ossified tendons or intramuscular septa, based on their subtriangular cross-section and incipient development of longitudinal canals. Their arrangement indicates bifurcating or intersecting fibers, as seen in the ossified tendons of other archosaurs. Another ossification is fused to a neural spine, cranial base, and cervical vertebrae.
suggesting an origin from an epaxial enthesis. This is the first report of ossified tendons in Crocodyliformes. The trend toward osteoderm reduction may be related to the decreased mean body size and/or inferred terrestrial habits of notosuchians, and the observed interspecific variability in this system likely pertains to biomechanical, physiological, and ecological constraints of the individual forms.

Technical Session IX (Friday, November 4, 9:30 am)
CRANIAL OSTEOLOGY OF THE EOCENE AMPHISBAENIAN SPATHORHYNCHUS FOSSORIUM AS REVEALED BY X-RAY COMPUTED TOMOGRAPHY
HIPSELY, Christy, Museum fr Naturkunde, Berlin, Germany; MULLER, Johannes, Museum fr Naturkunde, Berlin, Germany

Spathorhynchus fossorum is a middle Eocene amphibaenian from the primitive North American clade of shevel-shelled worm lizards, the Rhineuridae. Although the holotype skull is exceptionally well-preserved, the lower jaw is fused to the skull floor obscuring the palatal region. Using three-dimensional X-ray computed tomography (CT), we digitally removed the mandibles to expose this area for the first time and to explore internal spaces of the skull that were previously inaccessible. The orbitosphenoids are paired as in the oligocene rhineurid Rhineura hatcheri and modern lacertids, the recently recovered sister group to Amphisbaenia, but in contrast to the fused condition found in modern worm lizards. We also confirm the presence of two separate elements, the jugal and postfrontal, forming the postorbital bar, another unique feature among both fossil and extant amphibiaenians. Contrary to the otic-occipital complex which is highly fused, the elements of the face remain discrete and connected by extensively interdigitating sutures, allowing flexibility for a burrowing lifestyle. There is no evidence of a pathway between the orbit and brain case, suggesting that the eyes were functionless as in R. hatcheri and modern rhineurids. Although the postcrania of S. fossorum appears derived with respect to the absence of a pectoral girdle and forelimbs, our revaluation of the skull using CT reveals several primitive cranial features representing the earliest amphibiaenian form. The shevel-shelled condition, already present by the Eocene, may have therefore appeared early in the evolution of worm lizards. The detailed description of this specimen and other early amphibiaenians will be crucial to uncovering the timing and sequence of evolutionary modifications leading to fossoriality and limblessness from a terrestrial limbed ancestor.

Poster Session III (Friday, November 4)
OLIGOCENE PIG-NOSED TURTLES (CARETTOCHELYIDAE: TESTUDINES) FROM WESTERN JAPAN
HIRAYAMA, Ren, Waseda University, Shinjuku-ku, Tokyo, Japan; SONODA, Teppi, Ibaraki University, Mito, Japan; KATO, Takafumi, Kurashiki University of Science and the Arts, Kurashiki, Japan; TAKAHASHI, Akio, Okayama University of Science, Okayama, Japan

Although previously abundant in the fossil record, carettochelyids (family Carettochelyidae) become extremely sparse after the Eocene epoch. Their Oligocene fossil record is particularly obscure. Recently, a non-marine late Oligocene (about 26 Ma) vertebrate fauna, including more than 100 chelonian specimens, was excavated from the basal part of the Fukui Formation of the Sasebo Group of Sasebo City, Nagasaki Prefecture, Western Japan. Although geoemydids and trionychids are dominant among the turtles, seven isolated shell elements including the nuchal, costal, and hypaplastron are identified as carettochelyids, based on characteristic radiated sculptures on the shell surfaces. These materials represent a rather small taxon (less than 20 cm long). The hypaplastron has a narrow plastral bridge as seen in the Eocene carettochelyids. There is no sulcus of scute on the shell surfaces. These features suggest that this species is most similar to Allaeochelys, an extinct genus from the Eocene of Europe.

Associated late Oligocene turtles from the Nagasaki Prefecture include the following: 1) an undescribed species of the genus Malayemys, known from a lower jaw and partial shell, 16 cm in length; 2) a large sized geoemyd taxon, with an estimated >30 cm long carapace, and very strong plastral buttresses as in living Batagur; 3) a small geoemyd taxon with a presumed hinged plastron as in Cuora, estimated at less than 18 cm in length; 4) a trionychid close to Ratiferia with an estimated shell length of 50 cm, and with reduced eighth costal; 5) small testudinids reported as geoemydids (Geoclemys matsumuraensis and Geoclemys takasagoensis). This highly diversified non-marine chelonian assemblage suggests a tropical climate during the Late Paleogene when the Japanese archipelago formed the eastern margin of the Eurasian continent.

Poster Session II (Thursday, November 3)
THE PETALODONTIFORMES (CHONDRICTHYES; EUCHONDROCEPHALI) FROM THE MARINE PERMIAN (LEONARDIAN/GUADELOUPIAN) KAIAB FORMATION, NORTHERN ARIZONA
HODNETT, John-Paul, Museum of Northern Arizona Department of Geology, Flagstaff, AZ, USA; ELLIOTT, David, Northern Arizona University, Flagstaff, AZ, USA; OLESEN, Tom, Northern Arizona University, Flagstaff, AZ, USA

The vertebrate assemblage from the Kaibab Formation is rapidly becoming one of the most diverse shark faunas in the marine Permian of North America, with thirty taxa representing ten families of chondrichthyans. One of the most diverse orders is the Petalodontiformes, which includes the skate-like Janassidae, which are the most common of this order in the Kaibab. Janassa is represented by a small taxon, which is rare in the Kaibab assemblage and a larger taxon that is slightly more common. These may represent J. angulata and/or J. unguiformis. The teeth of “mega-janassids” (crown widths 2 cm or more) are the most common in the Kaibab Formation and represent two taxa. One taxon has well-formed cusps similar to “Janassa” korni from the late Permian Kupferschiefer of Germany, with the Kaibab taxon differing in having fewer cusps and being of greater size. The largest taxon has large blunt and thick cusps, and represents a new genus and species. It is only slightly smaller than Janassa maxima from the Pennsylvania of Nebraska, which lacks the large blunt cusps seen in the Kaibab taxon. The diversity of janassids suggests feeding partitioning that mirrors modern skates and rays. The smaller Janassa species may have fed on crinoids, bryozoans, and brachiopods as with Janassa hamifrons. The large, blunt-cusped “mega-janassid” may have been a generalist, feeding on both hard-shelled invertebrates and smaller vertebrates, including the large brachiopods and gastropods that are common in the Kaibab assemblage.

The Pristodontidae is represented by Megactenopetalus kaibabanus. Two new juvenile specimens may help shed light on the ontogeny of this taxon, and re-analysis of the morphology of its teeth suggest that it was not a specialist feeder on hard-shelled invertebrates and that the sharp cutting edges of the upper and lower cusps indicate the teeth of a predator on large vertebrates. Megactenopetalus may have been a slow moving ambush predator as suggested by the body form of the related Janassa and Belianssea. Fragments of other pristodontid teeth from the Kaibab Formation could represent other juvenile Megactenopetalus specimens or an unknown smaller pristodontid.

Technical Session XIII (Friday, November 4, 3:30 pm)
THE DISTRIBUTION OF GRIT-INDUCED MICROWEAR FEATURES ACROSS THE OCCLUSAL SURFACES OF ARTIODACTYL MOLARS
HOFMAN, Jonathan, University of Wyoming, Laramie, WY, USA; CLEMENTZ, Mark, University of Wyoming, Laramie, WY, USA

Low-magnification microwear analysis of the occlusal surfaces of ungulate cheekteeth has been used to reveal evolution of diet trends and environments. The method quantifies microscopic tooth abrasion (represented by scratches) caused by plant silica (phytoliths), abiotic grit (soil, dust, ash), or both. However, variability in microwear between different enamel bands on cheekteeth, and possible correlations of this variation with diet or grit, has not been quantified. This study assesses intra- and interband microwear variability on the teeth of domestic sheep (Ovis aries) fed controlled diets to explore the potential correlation of microwear variability across occlusal surfaces with exogenous grit. Three sheep were fed hay diets with different size classes of added grit (180 to 250 microns and 250 to 425 microns), significantly larger than the diameters of biogenic phytoliths (<53 microns). Live animal tooth molding, along with the rapid rewriting of microwear features (the “Last Supper Effect”), enabled the use of repeatable test subjects that were fed each diet. Resulting casts underwent low-magnification microwear analysis by tabulating microwear features within multiple 0.4 mm x 0.4 mm search fields along the enamel bands of the upper molar. Feature counts were compared for statistical differences both between search fields along enamel bands (intradraw variation) and between enamel bands (interband variation).

No significant differences were found between search fields along enamel bands for any diet treatments. Furthermore, we found a significant difference in scratch counts between the control diet (no added grit) and diets with added exogenous grit, showing conclusively that exogenous grit affects microwear. Finally, for any given diet treatment, we saw no significant differences in feature counts between the enamel bands on the paracone and protocone. These results support the analytical methodology of low-magnification microwear analysis and suggest that microwear features caused by exogenous grit are distributed evenly across the occlusal surfaces of selendodont molars, similar to the distribution of diet-induced features.

Poster Session III (Friday, November 4)
REVISITING PHYLOGENY OF PHOLIDOTA: IMPLICATIONS FOR FERAE PHYLOGENY
FLEMING, Simon, Stony Brook University, Stony Brook, NY, USA; MARTIN, Thomas, Universität Bonn, Bonn, Germany

Molecular studies support a sister-group relationship of Carnivora and Pholidota, but this has been difficult to support morphologically. To predict basal traits and possible synapomorphies of Ferae, it is crucial to understand the relationships within Pholidota, and outgroup relationships to Paleaeodonta. Previous analyses were not able to resolve unambiguously the phylogeny of Pholidota, largely due to limited information from the Miocene Necromans. Fissure fillings near Petersbach in Southern Germany have now yielded two nearly complete skeletons and more than 400 postcranial elements, which have been used for a new phylogenetic analysis of Pholidota. The analysis comprises seven of the eight extant pangolin families and most of the fossil species, as well as two species of Palaeaeodonta. Three outgroups, the euplipotyphlan Erinaceus sp., the carnivoran Nandinia binotata, and the basal carnivoromorph “Miacis” unientes, have been used to polarize the 417 osteological characters. Paleaeodonta and Carnivora were included and excluded from the analysis to test for typologies supporting alternative ancestral state reconstructions of Pholidota. A heuristic search yielded a single MPT, thereby resolving the ambiguous position of Necromans. According to our analysis, Necromans is closely related to the American Patromammis with Cryptomys as sister taxon. Strong bootstrap values (80) and 16 unambiguous characters support this clade. The inclusion of “Miacis” improves the resolution, further supporting this alliance. Paleaeodonta is placed as the sister taxon to Pholidota diagnosed by 32 unambiguous
characters and high bootstrap values (90). When Palaeoeadonista is excluded Eomanis, Euros
manis and Eurotamaudae form a clade in which most unambiguous synapomorphies have
been previously associated with palaeoeadonistas. The crown-group Manidace resolved as the
sister group to the Patromaniadace-Neoamanti clade. The resolution within Manidace remains
low leading to a polytomy at the base of Manidace, possibly related to the derived condition
within the arboreal Phataginidae and the convergent adaptations for terrestriality in Smutsia and
Asian pangolins.

Post Session IV (Saturday, November 5)

PALEONTOLOGY OF THE MEDORA SITE (PALEOCENE: SENTINEL BUTTE
FORMATION), BILLINGS COUNTY, NORTH DAKOTA
HOGANSON, John, North Dakota Geological Survey, Bismarck, ND, USA; PERSON,
Jeff, North Dakota Geological Survey, Bismarck, ND, USA; GOULD, Becky, North Dakota
Geological Survey, Bismarck, ND, USA

The Medora site is located in highly dissected badland terrain on an isolated knoll about 3
km east of Medora, Billings County, North Dakota. Vertebrate, invertebrate, and trace fossils
are extant in a thin < 5 cm thick black to rust colored carbonaceous (lignite) mudstone
within the Paleocene Sentinel Butte Formation. The bone bed 6.5 m above the top of a
reddish cleft (HT Butte Bed) that marks the contact between the underlying Bullion Creek
and Sentinel Butte Formations (Pt. Union Group).

Several thousand fossils of a diverse vertebrate fauna have been recovered through excava
tion and screen-washing of sediments. This fossil assemblage consists mostly of disarticu-
lated remains, although two partial semi-articulated skeletons of Champsosaurus gigas have
been recovered. Teeth, vertebrae, limb bones, and scales of the crocodile Borealosuchus are
abundant. Fossil size indicates that some of the crocodiles were large, perhaps up to 4
m in length. Skull parts, teeth, spines, vertebrae, and scales document the presence of several
fish taxa including bowfin (Amia), gar (Lepisosteus), and pike (Esox). Freshwater turtles, at
least two species of birds, and the giant salamander Pecopterum were also members of this
freshwater community. Teeth and jaws of several species of mammals have also been col-
lected at the site including Tainoidea, Neoplagiaulax, and Palaearctyces erosi. Collectively
these mammals indicate a Tiffanian (T) lineage zone for the site. Abundant crocodile and fish
copepods are also preserved. Freshwater bivalve and gastropod remains are found with the
vertebrate fossils.

The sedimentology of the Medora site indicates initial deposition in a paludal environment
that later became a ponded water habitat. Paleobotanical evidence from other nearby sites
indicates that the setting was in a subtropical forest. Abundant bones and numerous, large,
well preserved coprolites indicate that this was a feeding ground for crocodiles. Numerous
depressions in the bone bed, interpreted to be crocodile foot prints, and broken bones in the
site indicate that these large animals trampled and bioturbated the swampy area while scav-
enging for food.

Post Session II (Thursday, November 3)

ON THE PHYLOGENY OF THE CHALICOTHERIIDAE (MAMMALIA,
PERISSODACTYLA)
HOLBROOK, Luke, Rowan University, Glassboro, NJ, USA; COOMBS, Margery,
University of Massachusetts, Amherst, MA, USA

The Chalicotheriidae includes a number of perissodactyl genera noted for their posses-
sion of distal unguals that bore claws instead of hooves. Chalicotheriids have historically
been divided into two subfamilies, Chalicotheriinae and Schizotheriinae. Several recent
craniodental-based studies have examined aspects of the phylogeny and evolution of the
Chalicotheriidae. We present here an assessment of chalicotheriid phylogeny combining cranioden
tal evidence. Some of these arrangements run counter to the relationships suggested by
material from previous studies with new characters and a greater sampling of schizotheriine taxa.

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been divided into two subfamilies, Chalicotheriinae and Schizotheriinae. Several recent
postcranial data, suggesting that a broader approach is necessary for a fuller understand-
ing of diversification in the Chalicotheriidae.

Technical Session XVII (Friday, November 5, 12:00 pm)

A NEW EUSUCHIAN CROCODILIFORM WITH NOVEL CRANIAL
INTEGRUM AND THE ORIGIN OF CROCODILIA
HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA; GARDNER, Nicholas,
Marshall University, Huntington, WV, USA

We describe a new, giant crocodylidan discovered in the coastal deposits of the early Late
Cretaceous (Cenomanian) Kem Kem Beds of Morocco, a region rich with crocodyliforms
and dinosaurs. The taxon, represented by cranial remains, has an extremely long, flat skull
and a novel integumentary display structure previously unknown for crocodyliforms, though
typical to that described for specimens discovered in the Cenomanian Bahariya Formation.
The frontal is ornamented by a series of thick obliquely-oriented parallel ridges which ex-
pand caudally to form a broad, circular, rough bony integumentary boss on the parietal. The
boss is surrounded by a broad, smooth, shallow fossa that communicates with deep vascular
grooves which emerge from small, constricted, vertical-walled, dorso temporal fossae. With
the midline boss, this vasculature likely contributed to forming a keratinous integumentary
display structure previously undocumented for crocodyliforms which also may have served
a thermoregulatory function. The skull bears a massive, rostrally-situated adductor tubercle,
large, sub-horizontally oriented fossae for jaw closing muscles and immense post-occipital
protruberances indicating the animal had a very flat profile. The laterosphenoid bodies have
small teardrop-shaped, isolated, vestigial epitygoids allaying the taxon with derived neo-
suchians. Applying previous regression analyses from Alligator skull table width and croco-
dyliform brain size suggest that the skull was well over 2 meters long. Separate phylogenetic
analyses using crocodyliform and crocodylian matrices found the taxon to be a derived
eusuchian and the sister taxon of crown-clade Crocodylia making this group the earliest
eusuchian crocodyliforms known from Africa suggesting modern crocodylians may have
circum-Tethyan rather than North American origins.

Post Session II (Thursday, November 3)

A VIRTUAL PHYTOSAUR (ARCHOSAURIA: CRUROTARSI) ENDOSCAT
AND ITS IMPLICATIONS FOR SENSORY SYSTEM EVOLUTION IN ARCHOSAURS
HOLLOWAY, Waymon, Marshall University, Huntington, WV, USA; O’KEEFE, F., Robin,
Marshall University, Huntington, WV, USA

Endocranial reconstructions are rarely utilized during phylogenetic analysis. Even with the
advent of modern computed tomography (CT)-based techniques to the study of the internal
cranial structures of fossil specimens, very few of the new taxa described or known taxa
recovered. This is largely due to the difficulty in creating three-dimensional images of the
endocranial cavity. By using CT in order to create a high-quality, digital endocranial reconstruc-
tion of S. adamanensis we are able to examine platynerine cranial morphology, which is very similar to that of the evolutionarily conver-
gent extant crocodilian Crocodylus johnstoni. The primary difference between the two is a
considerable dural expansion in S. adamanensis that denotes an enlarged pinal bone. This is
consistent with the histologic endocranial reconstruction of Smilosuchus gregorii but counter to
the more recently presented endocranium of P. pristinus. The presence of an enlarged pinal bone
is the most notable and readily apparent contrast between the digitally reconstructed
endocranium of S. adamanensis, C. johnstoni, and the newly described nontosuchian Simosu-
chus clarki. The overall endocranial morphologies of these taxa are highly conserved; more
so than in various clades of avian-line archosaurs, like theropods and sauropods, or between
members of those clades and crurotarsans. This highly conserved cranial endocranial mor-
phology is consistent throughout Crurotarsi, regardless of overall body morphology or ecology,
with a trend of pinal bone size reduction from the enlarged basal condition to a reduced
condition. This reduction trend mirrors that seen in theropods and sauropods.

Post Session II (Thursday, November 3)

THE OSTEONEGICAL ONTOGENY OF THE MEGALONXY JEFFERSONII
MATERIAL FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA
HOLTE, Sharon, East Tennessee State University, Johnstown City, TN, USA

Excavations of ACB-3 Cave by the habited Museum of Alabama began in June of 1985 and
continued off and on until the end of the summer in 1987. ACB-3 Cave is located in Colbert Count
of northwestern Alabama. Excavations of the site uncovered the remains of numerous Pleistocene species from multiple genera. This includes large herbivores such as deer, mastodon, and giant ground sloths. The Jefferson’s ground sloth (Megalonyx jef-
fersonii) material, which is the focus of this study, was reported as sixteen individuals by the
cave excavation team. Recent research has revealed that the number of M. jeffersonii individu-
als recovered was seven. Although these sloths were excavated in the late 1980’s, a large
portion of the material remained in plaster field jackets until the current study began.
Opening these jackets revealed relatively pristine juvenile sloths of different sizes. Overall
male sloths from the cave range in individual age from fetal to adult, and provide an excellent
sample for studying ontogeny. Four of these sloths were examined due to the presence of
comparable skeletal elements. The adult ground sloth from the sample is nearly complete
and provides an ideal representative to compare to the juveniles. Ontogenetic morphological
differences were discovered in the major limb elements and cranial material, and demon-
strate how these ground sloths change osteologically through life.

Post Session II (Thursday, November 3)

TOOTH MORPHOTYPES OF SAUROPOD DINOSAURS FROM THE CANADON
ASFALTO FORMATION (MIDDLE JURASSIC) OF PATAGONIA
HOLWERA, Femke, Durham University, Durham, United Kingdom; POL, Diego, Museo
Paleontologico Egido Feruglio, Trelew, Argentina; GROCKE, Darren, Durham University,
Durham, United Kingdom; RAUHUT, Oliver, Bayerische Staatssammlung fur Palaeontologie
und Geologie, Munich, Germany
The sauropod fossil record of the Cañadón Asfalto Formation (Middle Jurassic) of Patagonia includes two described taxa (Patagosaurus and Volkheimeria) and two undescribed taxa. Both named taxa plus one of the undescribed species occur at the locality of Cerro Cónor Sur. The taxa are mainly known from postcranial material. For this study, cranial material and isolated teeth recovered at Cerro Cónor Sur and isolated teeth recovered at the nearby Las Chacritas locality were used. The teeth are here described in terms of size, shape, and enamel wrinkling, presence and orientation of wear facets and microwear. The aim of this study is to present an analysis of teeth morphotypes to assess the sauropod dental diversity at these sites.

The analysis reveals presence of three different teeth morphotypes in the sample taken from the Cerro Cónor Sur locality, which are characterized by a unique combination of characters related to the pattern of enamel wrinkling and crown shape measurements. The presence of three different morphotypes at Cerro Cónor Sur matches the known sauropod diversity of this site based on postcranial evidence.

The cranial material studied included fragmentary cranial and mandibular remains that have been assigned to Patagosaurus in previous studies. The teeth present in the maxilla originally referred to Patagosaurus are markedly different to those present in the mandibular remains referred to the same taxon, and represent different morphotypes, and thus probably different taxa. The latter interpretation is supported by the association of the maxilla with postcranial remains that also differ from the postcranium of Patagosaurus.

Finally, statistical microwear analysis on the only tooth that has a mesial and a distal wear facet revealed different directions of the striae located on the mesial and distal facet. There are no further statistically significant differences in microwear between the wearfacets of different teeth. The low variance between them may suggest the absence of clear niche differentiation for the Middle Jurassic sauropods known from the Cañadón Asfalto Formation.

Technical Session IV (Wednesday, November 2, 2:45 pm)

ROLE OF VOLCANIC ACTIVITY IN THE EVOLUTION OF HYPSOSELDONTY IN APLODONTID RODENTS

HOPKINS, Samantha, University of Oregon Department of Geological Sciences and Clark Honors College, Eugene, OR, USA

The evolution of hypsodonty has been well-studied in large herbivores, both within lineages and in ecological associations. The evolutionary course of hypsodonty in small mammals, however, remains relatively unknown. In large herbivores, the convergent evolution of hypsodonty is rampant in the mid-Tertiary. However, ever-growing teeth (hypsodonty) very rarely appear in large mammals. Small mammals, on the other hand, have several times evolved hypsodonty not only in the incisors, but also in the cheek teeth responsible for processing foliage. Driving factors hypothesized for the evolution of hypsodonty include grazing on abrasive plant parts and ingestion of exogenous grit. It is important in considering the evolution of hypsodonty in small mammals to consider the differences in how such drivers might affect them relative to larger herbivores. Ideally, a study aimed at understanding the evolution of hypsodonty would consider all aspects of the ecological context both within a lineage and in the environment in which it occurred, with reference to phylogenetic history. While few small mammals have adequate phylogenetic data to enable such consideration, the Aplodontidae offers an ideal study system, with well-studied ecology, phylogeny, and ecological context. Within this clade, hypsodonty has evolved in parallel twice, once in mylagaulids and once in aplodontines. Detailed study of the evolution of hypsodonty in aplodontines shows that the most extreme hypsodonty and eventual hypselodonty evolved in one of the single part of the geographic range, in Oregon and North-west Nevada during the Middle Miocene. Populations from even a small distance to the south, even in dry habitats, were characterized by much smaller degrees of hypsodonty at the same time. The origin of hypsodonty in this lineage, then, seems to have been a response to a relatively local phenomenon, possibly the extensive volcanic activity from the Yellowstone Hotspot and the Columbia River Basalts. Whether this is a phenomenon unique to this lineage or a response to volcanic activity common to a number of small mammals remains to be studied in other lineages.

Technical Session IV (Wednesday, November 2, 2:45 pm)

NEW ASTRAPOTHERE POSTCRANIAL REMAINS FROM THE LATE MIOCENE OF VENEZUELA

HOROVITZ, Ines, Department of Ecology and Evolutionary Biology, University of California, Los Angeles, CA, USA; SCHIEFER, Torsten, Paläontologisches Institut und Museum, Universität Zürich, Zürich, Switzerland; CARLINI, Alfredo, Division Paleontología de Vertebrados, Museo de La Plata, La Plata, Argentina; AGUILERA, Orangel, Museo Paracasne Emilio Goeldi, Coordenação de Ciências da Terra e Ecologia, Belém, Brazil; SANCHEZ-VILLAGRA, Marcelo, Paläntologisches Institut und Museum, Universität Zürich, Zürich, Switzerland

Postcranial remains of an aptotherium have been recovered from the Lower Member of the Urumaco Formation, of Late Miocene age, documenting more on the anatomy and diversity of this group in the northern Neotropics. They consist of a right femur, ibia and astragalus in anatomically appropriate association. The astragalus is slightly larger than that of a previously discovered one from the Early Miocene of Venezuela but smaller than Granastropotherium from the Middle Miocene of Colombia. The astragalus is typically aptotherian in its lack of a neck and the dorsoventral depressed shape of the body. There is no markedly concave surface for the medial malleolus of the ibia, unlike the typical condition in other astrapotheres. The head is a dorsoventrally and mediolaterally convex surface; this is a primitive mammalian feature also present in Colombian and Venezuelan astrapotheres and it distinguishes them from Late Oligocene/Early Miocene Patagonian Parastrapotherium where the astragalar head is dorsoventrally flat. The trochlea is substantially deeper in the new astrapotherium than in the astragals from the Early Miocene of Venezuela. There is no distinct facet for the cuboid, however we do not discard the possibility that such contact existed and that both facets for navicular and cuboid are indiscernible from each other in the specimen. The femur and ibia resemble the same bones in Astrapotherium from the Early Miocene of Patagonia in that the femur is longer and much wider than the ibia. The femur is much wider than anteroposteriorly deep and it displays a prominent lesser trochanter.

An analysis of the bone histology of the ibia was undertaken for an astrapotherium for the first time. The trabeculae within the marrow cavity are extensively remodelled and consist only of secondary lamellar bone and secondary osteons. The compacta completely consists of Haversian bone. We calculated several compactness parameters in order to infer lifestyle for this astrapotherium. The application of two discriminant functions yielded in this case an amphibious lifestyle whereas the other one was inconclusive between terrestrial and amphibious.

Poster Session III (Friday, November 4)

THE SYSTEMATIC POSITION OF CHLEUASTOCHOERUS

HOU, Sukan, Institut of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; DENG, Xiaozhi, Museum of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

Chleuastochoerus was a small endemic suid, widely distributed in the Late Miocene ‘Hipparion Red Clays’ of China, and more recently recorded in Russia. Chleuastochoerus has been considered a terminal taxon of an unknown lineage, descended from the Oligocene Palaeochoerus. The taxonomic position of Palaeochoerus, however, is highly controversial, assigned either to the Suidae or the Tayassuidae. Thus the taxonomic position of Chleuastochoerus is also debatable. Though Chleuastochoerus is more commonly attributed to the Suidae, subfamilial attribution to the Hytheriniare or Suinae is still controversial.

We studied new material of Chleuastochoerus from Linxia Basin, Gansu Province, China, and compared this genus with other suoids. Based on the following characters, Chleuastochoerus undoubtedly belongs to the Suidae: 1) incise foramen open to the nasal cavity; 2) palato-maxillary suture clear in old individuals; 3) choana broad and round, separated far from pterygoid fossa by pterygoid plate; 4) lacking pre- and postglenoid process; 5) tympanic bulla prolate, projecting antero-downwardly; 6) post-tympanic process of squamosal narrow, lower than glenoid; 7) lower border of mandible straight; 8) condyle of mandible triangular, extending postero-downwardly; 9) three pairs of upper incisors; 10) sexual dimorphism noticable in upper canines and canines arched nine; 11) P1/p1 reserved, P4/p4 semielloriform; and 12) Mt III and Mt IV not fused proximally.

Chleuastochoerus is similar to Hytherium in having the canines arched nches, the prezygomatic plate, and the posteriorly shifted metacoon of p4, and it differs from the Suinae in having the same profile of the skull and the same shape of the tympanic bulla. The taxonomic position of Chleuastochoerus is a subject of debate in many papers, but the new material from China is a new clue for the taxonomic position of Chleuastochoerus. The taxonomic position of Chleuastochoerus and the taxonomic position of the other suoids are also discussed in this paper.

Poster Session II (Thursday, November 3)

A NEW, SMALL-BODIED ALLIGATOROID FROM THE HELL CREEK FORMATION (LATE MASTRICHTIAN) OF MONTANA

HOUSEHOLDER, Mindy, Burpee Museum of Natural History, Rockford, IL, USA; WILLIAMS, Scott, Burpee Museum of Natural History, Rockford, IL, USA; TREMAINE, Katie, Burpee Museum of Natural History, Rockford, IL, USA

Crocodylian remains are relatively common within the Hell Creek Formation (late Maas- trichian) of western North America, especially within microvertebrate localities. Two croco-
dylon taxa are currently recognized from the Hell Creek Formation: the crocodylid Bore-
alosuchus sternbergi and the alligatoroid Brachychampsa montana. Ongoing excavation of a microvertebrate locality within the Hell Creek Formation of Carter County, Montana over the past few years has yielded a relatively complete, associated skeleton of a small-bodied alligatoroid. Despite its small size (<1 meter), the postcranial sutures are closed in the caudal, sacrals, and most of the dorsal vertebrae, and the neurocentral sutures in the anterior-most dorsal vertebrae and all of the cervical vertebrae are fused, though not completely closed. This evidence is indicative of a mature or nearly mature individual based on comparisons to extant crocodylians. While the generalized morphology of the skull (e.g., broad, robust snout) and dentition (i.e., blunt, “button-shaped” posterior teeth) bears similarities to B. montana, the fourth maxillary alveolus is the largest in the tooth row, unlike in B. montana, where the fifth alveolus is the largest. This condition is also seen in other small-bodied alligatoroids, including the middle Campanian Albertochampsa langstoni (Oldman Formation), the early Maastrichtian Stangerochampsa mccabei (Horseshoe Canyon Formation) and the Paleocene Wannaganosuchus brachymanus (Tongue River Formation). This new specimen also shares with S. mccabei a recessed groove along the maxilla/jugal suture posterolateral to the maxillary tooth row, a character previously thought to be autapomorphic for S. mccabei. However, the new taxon differs from S. mccabei in that it lacks a pronounced hypopophysis on the axis. Thus, this specimen represents a distinct taxon, increasing the crocodylian diver-
sity within the Hell Creek Formation. This new taxon is the southern-most occurrence of a...
small-bodied alligatoroid within the Western Interior Basin of North America during the Late Cretaceous.

Poster Session IV (November 5)

APPLICATION OF NONSTATIONARY MODELS OF SEQUENCE EVOLUTION TO HIGHER-ORDER AMNIOTE AND SQUAMATE SYSTEMATICS

HSIANG, Allison, Yale University, New Haven, CT, USA

Phylogenetic systematics and “tree-thinking” are indispensable to the study of evolution and the history of life. The robustness and accuracy of phylogenetic analyses are highly dependent upon the inference methods used and on model selection. Although a large number of nucleotide substitution models exist – 64 total under the commonly used General Time Reversible (GTR) family of models – the question of whether these models and their implementations represent biological reality is not trivial. One particular limitation of current popular programs for phylogeny estimation is their inability to implement nonstationary models of sequence evolution, whereby different branches and lineages are allowed to evolve at different rates and under varying models. The use of nonstationary models is desirable, as constraining sequence evolution to a single rate over all taxa is unlikely to be representative of biological reality, particularly when dealing with questions of higher-order systematics and/or reconstruction of phylogenies that include clades with deep divergence times. Nonstationary models as implemented in the Phylogenetics And Sequence Evolution (PHASE) software under a Bayesian framework were tested using a variety of genes and taxa, in particular for determination of: 1) higher-order amniote relationships, with particular focus on the position of turtles; and 2) higher-level squamate relationships. Preliminary analyses using nonstationary models for Recombination Activating Gene 1 (RAG-1), the most well sampled nuclear gene across tetrapods, recover turtles as sister to Archosauria and thus, represent the earliest Paleocene of North Dakota of mammalian taxa whose presumed descendents diverged during the Paleocene recovery. We discuss these mammalian occurrences within the context of the timing and geography of the recovery.

Technical Session V (Thursday, November 3, 3:00 pm)

GAINING UNDERGROUND: NEW RECUMBIROSTRANS (LEPUSCOPHYLLIDAE) FROM THE LOWER PERMIAN OF KANSAS AND NEBRASKA AND EARLY MORPHOLOGICAL EVOLUTION OF THE GROUP INFERRED BY MICRO-CT

HUTTENLOCKER, Adam, University of Washington, Seattle, WA, USA; SMALL, Bryan, University of Washington, Seattle, WA, USA; ANDERSON, Jason, University of Calgary, Calgary, AB, Canada

‘Microsaur’ fossils (Lepuscodophyllum) were likely a paraphyletic group of small tetrapods with a fossil record spanning the Visean to the Cisuralian (Early Permian). Characterized by their small body size and holospinous vertebrae, they have at times been implicated in the origins of extant lissamphibians, especially the fossorial caecilians. Although they are especially common in the well-sampled Texas-Oklahoma redbeds, little is known of the conservative recumbirostran ‘microsaur’ from the northern midcontinent (Kansas–Nebraska). Data on a new, well-preserved recumbirostran skull from the Cisuralian Eskridge Formation, Nebraska, reveals affinities to the purported gymnarthrid ‘Eurydos’ bonneri from the Spearfish Shale, Kansas. High resolution micro-CT reveals important endocranial data, including the presence of an ossified synotic tectum (‘supraoccipital’) that is apparently absent in gymnarthrids, dorsal sinuses separating the synotic tectum from the dermal skull roof as in ostodolepids, ventral flanges of the frontals articulating with the dorsolateral surface of the sphenethmoid, and a tall, ossified epipterygoid, thereby providing useful comparison with derived recumbirostrans. Cladistic analysis of 99 tetrapod taxa and 220 characters supports a sister taxon relationship between ‘E. bonneri’ and the new Eskridge Formation specimen in a monophyletic Recumbirostrum. The analysis also supports a relationship between gymnarthrids and the burrowing ostodolepids, both derived members of the Recumbirostra clade and putative outgroups to caecilians. The studied specimens share with other gymnarthrids and ostodolepids: lateral dorsal process; long prefrontal extending to orbit; occiput straight to convex with a large, quadrangular postparietal; parietal foramen absent; and palatal indentation reduced compared to marginals. However, as the specimens occupy a relatively basal position in recumbirostran phylogeny, they are only distantly related to Eurydos, a relatively derived gymnarthrid. Given the generalized cranial morphology, these forms may represent the ground plan from which more specialized, perhaps fossorial forms (gymnarthrids and ostodolepids), evolved.

Technical Session VII (Thursday, November 3, 2:00 pm)

EARLIEST EVIDENCE FOR THE MAMMALIAN RECOVERY FAUNA IN THE PALEOGENE OF NORTH DAKOTA

HUNTER, John, Ohio State University Newark, Newark, OH, USA; PEARSON, Dean, Pioneer Trails Regional Museum, Bowman, ND, USA; BERCOCIVI, Antoine, Key Laboratory of Biogeology and Environmental Geology of Ministry of Education, China, University of Geosciences, Wuhan, China

Ongoing interest in the extinctions that mark the Cretaceous–Paleogene (K/Pg) boundary has fueled collecting efforts to document mammalian faunas ever closer to the boundary. With out such faunas, it is impossible to say on direct evidence which mammalian taxa persisted within a few thousand years of the K/Pg boundary and are among the oldest, post-K/Pg mammals to have been discovered. The mammalian fauna includes a new species of Mesodon, and species of Sigmodon, Xeromys, Procerberus, Oryzomys, and Mimaton that are among the oldest and most primitive known. These mammalian fossils document the presence in the earliest Paleocene of North Dakota of mammalian taxa whose presumed descendents diversified during the Paleocene recovery. We discuss these mammalian occurrences within the context of the timing and geography of the recovery.

Technical Session VIII (Thursday, November 3, 3:00 pm)

AERODYNAMIC CHARACTERISTICS OF FEATHERED DINOSAUR SHAPES MEASURED USING PHYSICAL MODELS: A COMPARATIVE STUDY OF MANEUVERING

HUYNH, Tony, University of California, Berkeley, Berkeley, CA, USA; EVANGELISTA, Dennis, University of California, Berkeley, Berkeley, CA, USA; CHANG, Chun, University of California, Berkeley, Berkeley, CA, USA; KONG, Aimin, University of California, Berkeley, Berkeley, CA, USA; TSE, Kyle, University of California, Berkeley, Berkeley, CA, USA

Aerial maneuvering was likely a pervasive force shaping the evolution of flying animals. Regardless of how aerial behaviors might have arisen, we can analyze the physical effects of structural changes on aerial maneuvering as they present themselves in fossils and along evolutionary lineages. To accomplish this, we measured the aerodynamic maneuvering characteristics of a series of models based on Mesozoic birds and avian ancestors to determine whether or not measures of aerodynamic performance correlated with morphological changes. Maneuvering characteristics during glides were quantified by measuring static stability (Cc/dm, the tendency to experience righting moments when deflected from equilibrium) and control effectiveness (Cc/dk, the amount of force or moment generated for each degree of freedom of a limb or control surface). We found that changes in planform, such as the presence or absence of a feathered tail or of leg feathers or the reconstructed posture of the animal, can drastically alter static stability. In addition, appendage function (e.g. as an elevator, rudder, or aileron, generating control forces and torques in different directions) also depends on posture and glide angle, and the function of appendages can shift dramatically due to reversal or cross-coupling effects. We then mapped the results of our aerodynamic study onto a phylogenetic tree of Avialae, using Mouse (Dromaeosauridae) and Anchisaurus (Troodontidae) as outgroups, in order to test whether or not changes in maneuvering characteristics correlated with changes in morphology during early bird evolution. We specifically examined the performance effects of the shortening of the tail and control effectiveness of leg and tail plumage compared to that of the forelimb wing. We also briefly examined similar trends in the pterosaurs and bats, which also appear to show reduction in
tails in derived forms. Our analysis offers a biomechanical perspective to the evolution of avian flight that integrates morphological evidence from fossils with modeled performance in a phylogenetic framework.

Poster Session I (Wednesday, November 2)

NEW DATA ON SPINOSAURIDS (DINOSAURIA: THEROPODA) FROM AFRICA
IBRAHIM, Nizar, University College Dublin, Dublin, Ireland; SERENO, Paul, University of Chicago, Chicago, IL, USA

Spinosaurid theropods are an important, specialized component of large-bodied predatory dinosaurs in faunas on Africa throughout the Cretaceous, yet their morphology and systematics have been obscured by the destruction of original material and the abundance of more complete associated specimens. Here we report on new fossil material of Suchomimus from mid Cretaceous time in Nigeria and of Spinosaurus from early Upper Cretaceous horizons from Morocco. For Suchomimus, complete snout and braincase material reveals a unique and endocanine morphology of a spinosaurid. The resting orientation of the head on the semicircular canals suggests an inclined posture for the skull. The prefrontal is large and inset into the frontal, which is in turn very narrow and deep anteriorly. The form of the frontal allows identification of isolated frontal specimens elsewhere as spinosaurid. The basal tubera are particularly stout. Many cranial and postcranial features settle the taxonomic controversy surrounding Suchomimus and Baryonyx in favor of their recognition as distinctive genera. New vertebral remains of Spinosaurus from the Cenomanian of Morocco, likewise, allow comparisons with the type material of Spinosaurus from Egypt. Based on these more extensive comparisons, there is no basis to distinguish spinosaurid remains at generic or specific levels from eastern and western localities in coeval Cenomanian-age rocks on Africa.

Poster Session III (Friday, November 4)

BONE BED OF BABY OVIRAPTOROSAUR AND HADROSAUROID DINOSAURS FROM THE BAYSHANRE Formation (LATE CRETACEOUS) IN SOUTHEASTERN MONGOLIA
IIJIMA, Masaya, Hokkaido University, Sapporo, Japan; SATO, Tamaki, Tokyo Gakugei University, Koganei, Japan; WATABE, Mahito, Hayashibara Museum of Natural Sciences, Okayama, Japan; TSOGTBAATAR, Khishigjav, Mongolian Paleontological Center, Ulaanbaatar, Mongolia; ARIUNCHIMEG, Yarinpel, Mongolian Paleontological Center, Ulaanbaatar, Mongolia.

The Bayshanre Formation (Cenomanian-Santonian), cropping out in southeastern Mongolia, is rich in dinosaur fossils. The type locality of this formation, Bayan Shire, has yielded embryonic caenagnathans, ornithopods, and theropods. In 1996, Hayashibara Museum of Natural Sciences and Mongolian Paleontological Center Joint Paleontological Expedition found egg nests associated with a pair of large elongatoolithid eggs, many eggshells and disarticulated bones in an area of 1 m x 1 m in bluish white fine-grained sandstones of fluvial deposits at this locality. Among more than fifty bony remains, at least two individuals of baby oviraptorosaur and hadrosaurid dinosaurs for each taxon are recognized. An articular-sarungular-coronoid (ASC) complex of an oviraptorosaur is preserved and shows synapomorphies of Caenagnathoides: transversely wide and convex articular facet, which is elevated above the coronoid (ASC) complex of an oviraptorosaur is preserved and shows synapomorphies of Caenagnathoides: transversely wide and convex articular facet, which is elevated above the coronoid process. Many cranial and postcranial features settle the taxonomic controversy surrounding Suchomimus and Baryonyx in favor of their recognition as distinctive genera. New vertebral remains of Spinosaurus from the Cenomanian of Morocco, likewise, allow comparisons with the type material of Spinosaurus from Egypt. Based on these more extensive comparisons, there is no basis to distinguish spinosaurid remains at generic or specific levels from eastern and western localities in coeval Cenomanian-age rocks on Africa.

Poster Session II (Thursday, November 3)

INFLUENCE OF VERTISOL DEVELOPMENT ON SAUROPOD EGG TAPHONOMY AND DISTRIBUTION IN NESTING GROUND DEPOSITS
JACKSON, Frankie, Montana State University, Bozeman, MT, USA

Detailed mapping during excavation of a sauropod egg-bearing interval in fluvial overbank deposits of the Upper Cretaceous Anacleto Formation at Acua Maheuvo, Argentina reveals pedogenic features associated with vertisol development. These features include abundant, polished, randomly oriented slickensided surfaces and concave-up, low-angle curved planes that intersect at opposite angles. The resulting pattern of microhighs and microlows (glaia) are 1.0 to 1.5 m wide. Some slickensided surfaces cut and displace portions of eggs by approximately 3-5 cm along sub-horizontal and sub-vertical surfaces; ornamentation of eggs associated with these slickensides is “sheared” in the same direction. These pedogenetic processes affected changes in both individual egg morphology and three-dimensional egg distribution. These changes resulted primarily from vertical and lateral components of movement within the overbank sediments due to clay mineral expansion and contraction driven by phases of wetting and drying during palaeosol development.

At the scale of individual sauropod eggs, pedogenic sediment movement produced egg and eggshell fracture and displacement, mechanical abrasion of egg ornamentation, and alteration of egg size and shape. Movement of either individual eggs or subsets of eggs along slickensided surfaces 1) modified the number and relative position of eggs within individual clutches, 2) combined eggs of one or more clutches produced by different females, and 3) combine eggs from one or more nesting horizons, producing a time-averaged deposit. Pedogenic movement (pedoturbation) facilitated by water-driven shrinking and swelling of expandable clay minerals during vertisol development produced egg “clusters” that are not representative, either in terms of clutch size or morphology, of the true reproductive behavior of the individual female sauropods during egg-laying. Thus, it is imperative that taphonomic and paleobiological studies of egg-bearing mudrocks incorporate analysis of their pedogenic overprints.

Poster Session III (Friday, November 4)

MAMMALIAN FAUNAL DYNAMICS OVER DEEP TIME II: COMPARISON BETWEEN CARNIVORES AND HERBIVORES
JANIS, Christine, Brown University, Providence, RI, USA; FIGUEIRIDO, Borja, Brown University, Providence, RI, USA; PÉREZ-CLAROS, Juan, University of Málaga, Málaga, Spain; PALMQVIST, Paul, University of Málaga, Málaga, Spain

A Q-mode factor analysis reveals six sequential evolutionary faunas in the fossil record of the large mammals of the North American Cenozoic. Presence/absence taxonomic data (at the level of subfamily) were binned into 26 subequal time intervals; factors with eigenvectors greater than one were subsequently extracted and rotated by the interactive procedure of VARIMAX. We further explore these evolutionary patterns in considering separately the carnivorous and the herbivorous mammals.

While the large mammals combined yielded six significant faunalgroupings, the herbivores alone were clustered into seven different sequential assemblages, and the carnivores were clustered into five. In both groups, the final three faunas (the first of these commencing in late middle Eocene, with a peak of diversity in the mid Oligocene) are identical, both to each other and to the faunas obtained from the entire dataset. But in the earlier Cenozoic the patterns do not coincide. The carnivores show two distinct faunas in the Paleocene and in the early to middle Eocene, while the herbivores show four distinct faunas (essentially two separate faunas for each of the carnivores). The early Cenozoic was a time of tremendous climatic fluctuations and vegetational change in the higher latitudes, which may have affected carnivores and herbivores in different ways. Herbivores would be greatly affected by climate change and their teeth show profound shifts in diet over this time. In contrast, meat is meat, whatever the prey animal consumed, and a switch in the taxonomic composition of the herbivores might have little effect on evolutionary dynamics of carnivorous mammals.
Studies of bone microstructure of extant vertebrates have revealed distinctive signals that pertain to growth and biology. Applying such studies to histological surveys of nonmammal therapsids has enabled extrapolation of various aspects of their biology. Previous studies of several nonmammal therapsid families have focused on the postcranial skeleton, which permitted an assessment of their histological variation and allowed deduction of their overall growth strategy. In the present study, the mandibular and dental histology of Trijityodon, a derived herbivorous cynodont from southern Africa, is described from serial thin sections. These histological features provide direct information that permit a reconstruction of mandibular growth during ontogeny.

The dentary mainly consists of fibrolamellar bone, with occasional thin layers of lamellar bone. Growth lines are not evident, indicating uninterrupted growth in this individual. The enamel has a variable thickness across the crown of the postcanine teeth, and incremental lines are evident. The dentine is also well preserved, preserving fine details such as incremental lines and dentinal fibers. The presence of Sharpey’s fibers within the surrounding cementum indicates that the teeth were attached to the jaw by a periodontal ligament.

Several histological features of the mandible can be used to track the growth of the lower jaw. For example, we are able to trace how the postcanine teeth drifted medially during growth. There is also evidence of the relocation of the mental foramen which coincides with the posterior lengthening of the mandible. Our study provides a unique perspective on the histology and growth dynamics of the Trijityodon dentary.

**Technological Insights**

**Microstructural Analysis and Growth of the Trijityodon Mandible**

**JASINSKI, Sandra,** University of Cape Town, Cape Town, South Africa; CHINNAMY-TURAN, Amusa, University of Cape Town, Cape Town, South Africa

Studies of bone microstructure of extant vertebrates have revealed distinctive signals that pertain to growth and biology. Applying such studies to histological surveys of nonmammal therapsids has enabled extrapolation of various aspects of their biology. Previous studies of several nonmammal therapsid families have focused on the postcranial skeleton, which permitted an assessment of their histological variation and allowed deduction of their overall growth strategy. In the present study, the mandibular and dental histology of Trijityodon, a derived herbivorous cynodont from southern Africa, is described from serial thin sections. These histological features provide direct information that permit a reconstruction of mandibular growth during ontogeny.

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**Because of the maximum age and distinct taxonomic character of the Room 2 fauna, evaluation of the assemblage in a broad geographic and environmental context is challenging. No analogous faunas occur in the Great Basin, and few other North American localities allow for temporally equivalent comparisons. Abundance change across lower portions of excavated sedimentary levels may reflect faunal responses to perturbations in the local environment that coincide with the occurrence of a deep-lake event in the eastern Great Basin (i.e., Little Valley lake cycle). Microtus and Lemmiscus alternate in relative abundance across lower excavation levels. Ochotona and Sylvilagus sp. also show alternating patterns of abundance at similar excavation levels. Those data indicate the need for further work on the Room 2 fauna, particularly with respect to exploring possible causes for observed abundance shifts.**

**Poster Session II (Thursday, November 3)**

**EVIDENCE OF ENDOCHONDRAL OSSIFICATION IN SPINE MATERIAL FROM THE UPPER DEVONIAN, SCAV GRIACO LOCALITY, SCOTLAND**

**JERVE, Anna,** Uppsala University, Uppsala, Sweden

The Upper Devonian (Upper Frasnian) Scat Craig locality near Elgin, Scotland, is known for its unique and well-preserved vertebrate fossils. Among these are the diverse remains of several fish taxa, including *Holopterus, Bothriolepis* and *Cosmatasaurus*, in addition to *Elginerpeton pancheni*, an early tetrapod. Remains from this site usually appear as disarticulated pieces that can be incomplete but show excellent preservation, making them useful for studying morphology and histology. Of particular interest are spine-like elements that have been previously identified informally as “acanthodian” material. These specimens consist of longitudinally striated spines, several centimeters in length as preserved but invariably incomplete, which are sometimes attached to asymmetrical basal plates of smooth bone. Both spines and bases contain well-developed endochondral ossification, which can be observed macroscopically and is confirmed by the presence of bony trabeculae in synchrotron scan data. The spines differ from the bases in having thicker cortical bone with a distinctive histology. Endochondral ossification, a defining osteichthyan feature, has not been observed in the spines of acanthodians, sarcopterygians or actinopterygians, nor in other early gnathostomes such as placoderms or chondrichthyan fins. Spines are normally composed of dentine and/or dermal bone. The Scat Craig spines appear to belong to an osteichthyan but represent a unique morphology that is difficult to accommodate within the known osteichthyan body plan, either as fin supports or as other endoskeletal elements such as branchial components.

**Poster Session I (Wednesday, November 2)**

**PRELIMINARY RESULTS OF PHYLOGENETIC ANALYSIS OF TRIASSIC ICHTHYOSAURS**

**JI, Cheng,** Department of Geology and Geological Museum, Peking University, Beijing, China; **HANG, Da-yong,** Department of Geology and Geological Museum, Peking University, Beijing, China; **MOYLAN, Ryojuke,** Department of Geology, University of California Davis, Davis, CA, USA; **HAO, Weicheng,** Department of Geology and Geological Museum, Peking University, Beijing, China; **SUN, Zuoyu,** Department of Geology and Geological Museum, Peking University, Beijing, China

Although research on ichthyosaurs dates back to the 18th century, Triassic ichthyosaurs had been poorly known due to the fragmentary nature of the materials and their relative scarcity until the 20th century. The phylogeny of Stenasteridae, one of the most famous Triassic ichthyosaur families, is still controversial because of the incompleteness of specimens. However, during the last decade, over five species of ichthyosaurs have been reported from the Shastasaurids from China, and another taxon from China, formed a clade with several species made this analysis the most inclusive of similar phylogenetic analyses. It resulted from the cladistic analysis of 20 ichthyosaur species (18 Triassic, 2 Jurassic) based on 69 morphological characters was conducted using maximum parsimony. Inclusion of 4 Chinese species made this analysis the most inclusive of similar phylogenetic analyses. It resulted in six more parsimonious trees. The strict consensus tree supported the monophyly of Shastasauridae which formed a sister group to the other Early Triassic and Jurassic ichthyosaur species. *Cymbospondylus* appeared outside of these sister clades. The two new suspected stenasterids from China, *Gueihouichthyosaurus* and *Guanglingsaurus*, were both included in this group while the relationship within Stenasteridae is still not strongly supported. *Quinichthyosaurus*, another taxon from China, formed a clade with *Torectosuchus* from North America, while they together are basal to Jurassic ichthyosaurs. In contrast to the previous study, *Collaya*ichthyosaurus which displayed some derived morphology features as the absence of maxilla dorsal lamina, presence of parietal ridge showed closer affinity to Jurassic ichthyosaurs than to Stenasteridae. The new phylogenetic hypotheses suggested close ichthyosaurian affinity between South China and North America during the Triassic.
The specimen resembles *volzi*. Its age is the Pelsonian (middle Anisian), being slightly younger than that of a recent discovery of *Incertae sedi*, an enigmatic marine reptile from the Lower Muschelkalk (Bithynian, Anisian, Middle Triassic) of Gogolin, Upper Silesia in the Germanic Basin was originally thought to be closely related to placodonts. Some considered it a Placodontia. Some considered it a Placodontia. *Sinosaurosphargis* is the first definite record of *Saurosphargis* from China.

Postcranial skeleton with scattered scalelike osteoderms, and a skull supposed to belong to *Saurosphargis* cf. *S. volzi*. The enigmatic marine reptile *Saurosphargis* volzi from the Lower Muschelkalk (Bithynian, Anisian, Middle Triassic) of Gogolin, Upper Silesia in the Germanic Basin was originally considered to be closely related to placodonts. Some considered it a Placodontia. Some considered it a Placodontia. "Sinosaurosphargis" is the first definite record of *Saurosphargis* from China, referred to as *Saurosphargis* cf. *S. volzi*.

The presence of *Saurosphargis* in the Panxian Fauna reinforces the close affinity of this fauna with the Lower Muschelkalk fauna during the Anisian. *Saurosphargis* probably spread from the Muschelkalk basin to southwest China in Anisian, while *Sinosaurosphargis*, more derived having a "carapace" composed of osteoderms, was only found in southwest China so far.

The Triassic saw the emergence of more than six groups of marine reptile clades, mostly derived having a "carapace" composed of osteoderms, was only found in southwest China so far. It is the first definite record of *Saurosphargis* from China.

Poster Session IV (Saturday, November 5)

**NO EVIDENCE OF CAVIOMORPH RODENTS IN A NEW, LATE EOCENE TERRESTRIAL VERTEBRATE LOCALITY IN NORTHWESTERN OAXACA, SOUTHERN MEXICO**

JIMENEZ-HIDALGO, Eduardo, Laboratorio de Paleobiología, campus Puerto Escondido, Universidad del Mar, Puerto Escondido, Mexico; SMITH, Krist, Dept. of Paleoanthropology and Mammal Research, Senckenberg Research Institute, Frankfurt, Germany; GUERRERO-ARENAS, Rosalia, Laboratorio de Paleobiología, campus Puerto Escondido, Universidad del Mar, Puerto Escondido, Mexico; ALVARADO-ORTEGA, Jesús, Departamento de Paleontología, Inst. Geología, Universidad Nacional Autónoma de México, Mexico D. F., Mexico

The hypothesis of transatlantic dispersal of the ancestors of South American rodents and primates is founded on the sister-taxon relations of living groups and the absence of fossil relatives in mid-latitude North America. Yet, it has also been argued that ancestors of these groups occurred in Central America, where fossils are unknown. We report here the first rich Paleogene fossil locality in tropical North America. The fossiliferous beds pertain to the Yanhuilán Formation, which crops out in the Oaxacan Highlands of the Sierra Madre del Sur morphotectonic province. Previous radiometric dates on intrusives associated with this formation suggested an age of around 43 Ma, but other radiometric ages and faunal composition suggest a late Eocene (Chadronian) age for this local fauna.

Twenty species (3 reptiles, 17 mammals) have been identified in the fauna thus far. The reptiles are two testudinids and a rhinodire. The mammal fauna includes a sciuroid and three geomorph rodents (Gliridae); a tapiroid, an amynodontid, a rhinocerotid, and a "chalicotheriid" (Perissodactyla); a leporid, a tapinotid, a proprobolodont, and a "bullceratid" (Artiodactyla); two caniforms (Carnivora); and a hyaenodontid creodont. Geographically, the closest coeval local fauna in North America is the Rancho Gaitán l.f. of Chihuahua, northern Mexico, which is about 1500 km farther north.

The abundant rodents of this new site have exclusively North American relations, thus undermining the last argument against long-distance transoceanic dispersal. The rodents, particularly the Geomyoidea, are more typical of post-Eocene assemblages from middle latitudes and confirm an ancient history of the group in the Neotropics, long inferred to be their center of radiation. Continuation of research on this Oaxacan Eocene locality will provide further insight into species richness patterns, endemism, and niche partitioning. It may also provide crucial new data bearing on the origin of platyrhine primates.

Symposium 1 (Wednesday, November 2, 8:45 am)

**EVOLUTION OF PAIRED FINS AND THE LATERAL SOMITIC FRONTIER**

JOHANSON, Zerina, Department of Palaeontology, Natural History Museum, London, United Kingdom

Determining homologies between jawed vertebrate paired fins and the wide variety of fins or fin-like structures in fossil jawless vertebrates (Anaspida, Thelodonti and Osteostraci) has been problematic. Determining these homologies is important when describing the evolutionary steps by which the paired fins evolved. Paired fins (pectoral, pelvic) in the jawed vertebrates are characterized by several features; they are generally narrow-based, positioned posterior to the branchial arches and consist of basals and radials supported on a girdle. Difficulties occur because fin-like structures in the jawless vertebrates can be elongate along the flank, with no indication of a supporting girdle. The fin-like structures can also be supra-branchial in position (over the branchial arches) or extend beneath the branchial arch series. An exception is the Osteostraci. Taxa such as *Norseaspis* possess a pectoral girdle with a single fin radial articulation surrounded by depressions for muscle attachments and foramina (over the branchial arches) for brachial nerves, homologous to the jawed vertebrate pectoral girdle. Recently, the vertebrate embryo has been divided into primaxial and abaxial domains, separated by the lateral somitic frontier. The primaxial domain derives from the somitic mesoderm, while the abaxial domain comprises a region where somitic cells develop in the presence of lateral plate mesoderm. Most of the pectoral girdle (except dorsal portions in some taxa) and the pelvic girdle derive from lateral plate mesoderm. As a novel interpretation of paired fin homology, it is suggested that paired fins characterizing the Osteostraci and jawed vertebrates evolved when fin competency (including girdle development) evolved in the lateral plate mesoderm, which coincided with the evolution of the primaxial and abaxial regions and the lateral somitic frontier in these groups.

Poster Session IV (Saturday, November 5)

**A NEW RANCHOLABREAN (LATE PLEISTOCENE) FAUNA FROM THE SOUTHEASTERN EDGE OF THE TEXAS SOUTHERN HIGH PLAINS**

JOHNSON, Eileen, Museum of Texas Tech University, Lubbock, TX, USA; MORETTI, John, Museum of Texas Tech University, Lubbock, TX, USA; HURST, Stance, Museum of Texas Tech University, Lubbock, TX, USA

Investigations at Post Locality 100 have documented a diverse late Pleistocene (Rancholabrean) fauna. Located near the southeastern edge of the Southern High Plains, the locality has produced a fauna containing extinct and extralimital taxa. The fauna, deposited in a fluvial setting of a small drainage system, is associated with a radiocarbon date of 11,500 radiocarbon years before present, obtained from a periotic removed from a *Bison antiquus* skull. Extinct forms include *Equus mexicanus* (stout-legged horse), *Bison antiquus* (ancient bison), *Mammuthus columbi* (Columbian mammoth), *Platygonus compressus* (flat-headed peccary),
Terrapene carolina putnamii (Putnam’s eastern box turtle), and Hesperotesstudo (=Geoche-
lon) (giant tortoise). Extralimital extant forms include Symaptomys cooperi (southern bog
lemming) and Ondatra zibethicus (muskrat). Extrat extant forms living on the Southern High
Plains today include Trachemys scripta (pond slider) and Casia latiss (coyote). A soricid
and an icthyurid are extant forms that may or may not be extralimital. As yet unidentified
small birds, frog, other fish, and snake also are present at the locality.

This assemblage of environmentally restricted taxa is similar to those found in the Rancho-
lauben fauna of Lubbock Lake and Blackwater Draw, supporting the view of a humid and
equitable climate on the Southern High Plains during the latest Pleistocene. Geomorphology
and wetland adapted taxa indicate a marsh-like setting, perhaps on the margin of a stream.
The presence of the extinct box turtle in association with bog lemming and muskrat supports
the interpretation that this subspecies inhabited marsh and low-lying grassland. Horse, an
cient bison, Columbian mammoth, and peccary indicate a grassland ecosystem.

Hesperotesstudo material indicates a large size species rather than the regionally expected
small, smooth-shell Hesperotestudo. Remains of the extinct box turtle Terrapene carolina putnamii
are common in the deposit, with several partial and complete carapaces being recovered.
Individual shell elements are the most common of all specimens found in excavation, consis-
tuting the largest sample of T. c. putnamii in the region.

Romer Prize/Technical Session 5 (Thursday, November 3, 10:15 am)
ZIEGLER RESERVOIR AND THE SNOWMASTODON PROJECT: OVERVIEW
AND GEOLOGIC SETTING OF A RECENTLY DISCOVERED SERIES OF HIGH-ELEVATION PLEISTOCENE (SANGAMONIAN) ECOSYSTEMS NEAR
SNOWMOUNTAIN VILLAGE, COLORADO


On Oct. 14, 2010 a bulldozer operator discovered a young female mammoth while excavat-
ing Ziegler Reservoir on the divide between Snowmass and Brush creeks near Snowmass
Village, Colorado. Subsequent investigation by the Denver Museum of Nature & Science
between Oct. 29 and Nov. 16, 2010, revealed an amazingly well-preserved sequence of high-
relief Ice Age ecosystems. In 18 days, DMNS excavated more than 600 bones comprising
parts of more than 20 individuals (Mammuthus columbi, Mammuthus americanum, Bison latifrons, cf. Odocoileus, Megalonyx jeffersoni, and numerous microvertebrates) and
exceptionally preserved plant, insect and aquatic invertebrate fossils. The deposit sits in a
small ridgetop catchment with no inflowing streams suggesting that the Pleistocene lake
filled slowly with input primarily from morainal slumpedown and zeolitic sediment. Lower
units of the ~10m section contain isolated bones of Mammut, Bison, cf. Odocoileus, and
Megalonyx in subaqueous debris flow deposits. Upper units contain articulated skeletons of
Mammuthus, Bison, and cf. Odocoileus in a well-preserved seep pond. As a whole, the site
represents the first completely relative sequence of Pleistocene (Ice Age) ecosystems at high
elevation in the Rocky Mountains. The Ziegler Reservoir site is significant for 5 reasons:
1) it is located at 2,671 m above sea level and high elevation Pleistocene sites are rare; 2) it
contains several fossil-bearing horizons, which will allow for the reconstruction of a series
of ecosystems; 3) it contains a broad diversity of plant, vertebrate, and invertebrate fossils,
which will allow for more complete ecosystem analyses; 4) the preservation of the fossils
discovered at Ziegler Reservoir is exceptional; and 5) radiocarbon dating indicates that all
of the sediment in Ziegler Reservoir site is more than 45,000 years old and local glacial
geology indicates that the lake-bounding Bull Lake moraine is 130,000 to 150,000 years old.
This presents the possibility as much as 100,000 years may be represented by the lake
sediments. Extensive excavations are planned for May 15-July 1 to recover more data before
the planned reservoir completion in October, 2011.

Technical Session X (Friday, November 4, 9:30 am)
PREMOLAR EVOLUTION IN THE EARLIEST EU PRIMATES OF WYOMING

JONES, Katrina, Johns Hopkins University, Baltimore, MD, USA; ROSE, Kenneth, Johns Hopkins University, Baltimore, MD, USA

The early Eocene was a time of great faunal and climatic change in North America. The first
Eu Primates appear abruptly at the beginning of the Eocene as two clades: tarsier-like omomyids
and lemur-like lémuriforms. The derived morphologies of these two groups of primates
reflect the molarization of p4 in some omomyine primates during the Bridgerian, associated
with increased body size and likely folivory. These results suggest that the two groups of
euprimates may have been sharing resources prior to the disappearance of North American
adapoids in the mid Eocene.

Technical Session IX (Friday, November 4, 10:15 am)
The FIRST RECORD OF MIDDLE TRIASSIC LEPIDOSAURS

JONES, Marc, University College London, London, United Kingdom; HIPSLEY, Christy, Museum für
Naturkunde Humboldt-Universität, Berlin, Germany; ANDERSON, Caja, University of Gothenburg, Gothenburg, Sweden; SCHROER, Rainer, Staatliches Museum für
Naturkunde, Stuttgart, Germany; HIPSLEY, Christy, Museum für Naturkunde Humboldt-
Universität, Berlin, Germany

Lepidosaurus is a diverse group of reptiles represented today by over 7000 species globally
distributed and filling a wide variety of niches. Unfortunately the fossil record of this clade is
frighteningly patchy. The earliest known fossil lepidosaurs are Late Triassic ( Carnian) in age
and include partial jaws from India and USA and natural moulds of the rhynchocephalian
Brachyrhinodon from the Losissoum Sandstone Formation of Scotland. The derived morph-
ology of this Carnian material suggests that lepidosaur origins lie in the Early or Middle
Triassic, but nothing has been documented from these epochs, limiting molecular clock
calibration and our ability to reconstruct early patterns of diversification, biogeography,
and ancestral ecology.

Here we report two partial dentaries from the Middle Triassic Unterer Graue Mergel (lower
grey marls) of the Lower Keuper (Erfurt Formation) of Germany (Vellberg). The material
was examined and character coded using scanning electron microscopy, computed tomog-
raphy and binocular microscopy. Phylogenetic analysis places the jaws within Rhychoce-
phalia, with several characters indicating a close phylogenetic affinity to Diphidodontosaurus
(known from the Late Triassic of the UK but also reported from USA and Italy) a small
coroid expansion; teeth that are weakly pleurodont anteriorly and labiolingually com-
pressed and acrodont posteriorly.

At 240 million years old (mya), the Vellberg material predates previous lepidosaur fossil
records by over 10 million years and also molecular clock estimates for the origin of lepi-
dosaurus based on haemoglobin amino acid chains (233 mya). However, some age estimates
based on mitochondrial DNA and nuclear genes are substantially older suggesting there
remains an unrecorded ghost lineage.

This new material helps bridge a notable gap in the record of Lepidosauriforma. Moreover, very
few Middle Triassic localities yield well preserved remains of small vertebrates. There-
fore, the source locality of Vellberg has global importance in its potential to help bridge other
conspicuous gaps in the fossil record such as those of frogs and salamanders.

Poster Session II (Thursday, November 3)
WHO IS EATING MY TEETH? BIOEROSIONAL TUNNELING IN FOSSIL
MAMMAL DENTITIONS

KALTHOFF, Daniela, Swedish Museum of Natural History, Stockholm, Sweden; ROSE, Kenneth, Johns Hopkins School of Medicine, Baltimore, MD, USA; VON KONOW, Walid, Wighart, Steinmann Institut (Paliontologie) der Universität Bonn, Bonn,
Germany

The early Eocene genus Tubulodon (Epocictheriidae) from Wyoming is one of a few primi-
tive genera of the Palaenodonta that retained tooth enamel. The enamel of Tubulodon is
relatively thin and therefore often transparent. Thus, unusual tubes in the orthodentine are
often visible. These tubes were initially interpreted as primary dental structures, being pre-
stages to the hexagonal dentinal prisms in aardvarks, and they inspired the name Tubulodon.
Our detailed scanning electron microscopic study showed that individual tubes are surround-
ed by a hypermineralized rim and enclose a cluster of much smaller elongated structures, or
filaments, each residing in a small tunnel. The tubes and filaments do not belong to the natu-
ral orthodentine structure and are here interpreted as early post-mortem bioerosional phe-
nomena. Size and morphology of the filaments affiliates them with actinomyctic bacteria
which commonly colonize mucous membranes of warm-blooded vertebrates. Bioerosional
destruction is not unique to Tubulodon. Additional evidence that this is a widespread tapho-
nomical phenomenon comes from numerous specimens of other early Eocene teeth from
the Willwood Formation of the Bighorn Basin, Wyoming, as well as diverse mammalian
taxa from different stratigraphic levels and geographic locations where we observed varying
degrees of tunneling, and even substantial tube development in the dentary itself. In contrast
in the orthodentine, the enamel is not altered.
that the enlarged INT in these extinct rhinos could have served a similar role in locking the shoulder. Optimization of the INT character onto a rhino cladogram suggests that this trait evolved multiple times, however the extent of homoplasy is contingent upon which published phylogeny is used. Although an osteological shoulder lock is not present in living rhinos, *Diceros* and *Ceratotherium* retain a small, broad INT like that of earlier rhinos. This condition appears to be insufficiently developed to function as a lock; however, it serves to dissipate the proximal biceps tendon anteriorly, giving the muscle greater mechanical advantage in extending the shoulder joint and preventing flexion during standing. We suggest that increased mechanical advantage of the biceps is the initial functional role of the INT, and the structure was later co-opted as part of a locking mechanism complex in smaller subsets of rhinos and horses.

**Poster Session I (Wednesday, November 2)**

**GISWEAR: 3D AND GIS DIET ANALYSIS METHOD FOR BUNODONT OMNIVORE GROUPS SUINA AND HOMINIDAE**

KARME, Aleksis, University of Helsinki, Helsinki, Finland; EVANS, Alistair, Monash University, Melbourne, Australia; FORTEIILUS, Mikael, University of Helsinki, Helsinki, Finland

The method presented here, GISWear, uses automated three-dimensional surface scanning and GIS (Geographic Information Systems) methods for occlusal surface analyses in order to perform quantitative and objective diet analysis. GISWear uses characters similar to traditional mesowear but in three dimensions by looking at the sharpness and relief of the whole occlusal surface, resulting from both attrition and abrasion. GISWear is introduced to extract dietary information from animals with bunodont tooth form. Suoids (pigs and peccaries) and hominids (great apes) were the main groups analysed. Dietary categories were classified within the omnivore group to distinguish the tendency to favour certain foods. The material examined consists of extant and extinct species. Recent species were used to generate a method and palaeo-species were then classified to diet categories using the generated method. The factors used were mean slope and surface sharpness (proportion of steep parts on the tooth surface). A decision tree was selected as the analytical tool. It divides large groups into smaller subgroups with absolute values. These groups are defined by their diet classification. Decision trees were made both manually and automatically.

The manual decision tree divided specimens into four groups using mean slope. This is the same number of groups that mesowear has, even though the diet categories are not the same. The automated decision tree divided specimens into eight groups using mean slope and surface sharpness. GISWear is ready to use for independently acquired 3D dental data by simple conditional sentences with two clear factors: relief and sharpness.

**Technical Session VIII (Thursday, November 3, 2:15 pm)**

**JOINT PATTERNING AND THE EVOLUTION OF SIZE PROPORTIONS IN FINGERS AND TOES**

KAVANAGH, Kathryn, University of Massachusetts Dartmouth, North Dartmouth, MA, USA

Phalanges (finger and toe bones) originate from a single condensation that grows and segments sequentially along each digit, repeatedly deploying the same activator-inhibitor gene network as each element is formed and each joint is initiated in sequence. In our model of this patterning, the size of each phalanx depends on the size of the proximal adjacent phalanges. Experimental evidence from chick embryos supports the model of dependence and further suggests that variation in timing is an important mechanism producing variation in initial condensation size for a given phalanx. Comparative analyses show that, across many vertebrate lineages, there is a predictable suite of variations in phalanx size proportions that have arisen multiple independent times in evolution. Our studies support the idea that non-unital pedal phalanges are integrated and act as a developmental module whose variations are biased toward certain patterns; these biases are reflected in evolutionary patterns in all vertebrate groups across both shallow and deep evolutionary time.
brain flexure angle decreases. This feature was verified by the linear measuring method. It was found that the brain of Archaeopteryx had a relatively extended and anteverted posture in relation to its brain size, measured by the linear measuring method. A residual of any particular animal from the regression line of allometric morphological size change presumably reflects its relative eye size in relation to brain size. Therefore, it is considered that Archaeopteryx had small eyes relative to its brain size. It is known that there are various associations between eye size compared to brain size and the behavior of Aves. The small eyes of Archaeopteryx might relate to its behavioral patterns, such as its technique for capturing prey, or the degree to which it was nocturnal.

Technical Session I (Wednesday, November 2)

HOLOCENE LOSS OF LAGOMORPH SPECIES RICHNESS IN THE GREAT BASIN OF NORTH AMERICA
KEMP, Melissa, Stanford University, Stanford, CA, USA
We are only beginning to understand what impact modern rates of climate change will have on the biodiversity and ranges of extant biota. Nevertheless, analyses of faunal responses to previous climatic events can inform how species will react to future environmental alterations. The Great Basin of western North America plays host to one of the world’s most important Neogene small mammal deposits, rendering it an optimal system in which to study how species richness is affected by climate change. The geographic range and diversity of these small mammals were impacted as the Great Basin became drier and warmer since the Late Pleistocene. Here, we use a fossil assemblage to evaluate species richness from the Late Holocene. We focus on seven species in the order Lagomorpha that are still found in the Great Basin today. Our analyses of multiple paleontological sites within the Great Basin shows a general decrease in species richness throughout the Holocene, with more rare species in the assemblages of Late Holocene communities than in earlier ones. This notion of range contraction is concordant with modern geographic data for Great Basin lagomorphs, two of which are a conservation concern. The pertinence of this result is underscored by the expectation that the western United States will continue to increase in temperature at an even greater rate than the global mean temperature will increase.

Poster Session I (Wednesday, November 2)

ECOLOGY AND EVOLUTION OF COSMOPOLITODUS HALSTALIS AND CARCHARODON CARCHARIAS
KIM, Sora, University of Wyoming, Laramie, WY, USA
The ability of the modern white shark, Carcharodon Carcharias, to regulate its body temperature allows it to exploit a wide range of habitats and food sources that are not available to most other chondrichthysans. Fossils from the Pisco Formation (Fm.) of Peru record a
transition from Cosmopolitanodus hastalis and an unnamed Carcharodon species to the mod-ern C. carcharias during the mid-Cenozoic to early Pliocene. Tooth morphology suggests these two earlier species were piscivorous, whereas fossil teeth from C. carcharias exhibit attributes consistent with the ability to hunt marine mammals. To better understand potential ecological differences that may have influenced this dietary and evolutionary shift, fossils from these three species were selected for biogeochronological analysis. Oxygen isotopes from enamel phosphate were analyzed from the three shark species throughout the 5 vertebrate fossil layers containing in the Pisco Fm. Previous studies have shown that oxygen isotopes in bioapatite form in equilibrium with body water at body temperature, which is similar to am-bient water temperature in invertebrates and ectothermic vertebrates. Comparison between the mean values and standard deviations of the C. hastalis and C. n. sp. teeth illustrated a small shift in mean oxygen isotope values, but a large reduction in standard deviation sug-gest that habitat preferences or environmental conditions did not dramatically change during this transition. Finally, C. carcharias teeth had higher oxygen isotope values, which indicate colder water temperatures and potentially a habitat expansion with the evolution of partial endothermy.

Poster Session II (Thursday, November 3)
EFFECT OF THE GENETIC BOTTLENECK ON THE SEXUAL DIMORPHISM OF THE BLACK FOOTED FERRET (MUSTELA NIGRIPES)

KING, Leigha, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA

Sexual dimorphism is common in mammals, particularly within the Mustelidae. However, few studies have focused on the exact details of those differences. Therefore, we sought to characterize sexual dimorphism in the crania of Mustela nigripes (the black-footed ferret) through the use of geometric morphometrics. Similar analyses conducted on mammals and reptiles have proven to be useful in understanding shape change within and between species. Since M. nigripes underwent a genetic bottleneck throughout the 20th century, culminating in its near extinction in the 1980s, we further sought to characterize what effect this genetic reduction has had on the dimorphism of the species. Landmarks were placed on the skull in dorsal, ventral, and lateral views, and were selected based on ease of replication or their known association with dimorphism. For example, some landmarks captured the shape of the canine, carnassial, and sagittal crest. Landmarks were then analyzed statistically, as well as through thin plate splines. Principal component analysis revealed a clustering of individu-als bred after the bottleneck, while those born before spanned the entire plot. A stepwise dis-criminant analysis was also used to determine which landmarks best represented the changes occurring between sexes, as well as those before and after the bottleneck. In lateral view no landmarks best explained the change in either sex or from the bottleneck. Those landmarks with the greatest differences in dorsal view represented changes in the rostrum and zygomatic-arch length. Significant differences were indicated in these variables. The majority of differences between the sexes were observed in the lateral plane with dorsal rotation of the rostrum and lengthening of the sagittal crest in males. The dorsal and ventral splines of post-bottleneck males revealed shortening of the sagittal crest, postorbital widening of the skull, and shortening of the P4. Post-bottleneck females underwent a shortening of the sagittal crest, shifting of the P4, and lengthening of the braincase in dorsal and ventral views. Overall, it is apparent that the genetic bottleneck had profound effects on the sexual dimorphism of M. nigripes.

Poster Session II (Thursday, November 3)
SHARK COPROLITES AS PALEOENVIRONMENTAL AND PALEOECOLOGICAL INDICATORS AT THE ARLINGTON ARCHOSAUR SITE, WOODBINE FORMATION (CENOMANIAN), NORTH CENTRAL TEXAS

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The Arlington Archosaur Site (AAS) is a North Texas fossil locality that preserves fossil ele-ments of a Mid-Cretaceous ecosystem from a low lying coastal plain. The site lies within the Cenomanian (~95 Ma) rocks of the Lewisville Member of the Woodbine Formation of North Texas, Tarrant County. The depositional environment is a coastal delta plain; fine grained sediments, some of which are rich with organic material; wood and coal transitioning into coastal shelf environment, possibly a brackish tidal flat. This project reports the unique occurrence of an abundance of coprolites found in the Woodbine Formation and uses them as ecological indicators of transitional environments from a coastal peninsula that jutted out into the southeastern interior seaway. The coprolites here are being used to denote environ-mental fluctuation and possible ecological interactions. A collection of (140+) coprolites have been recovered from the AAS. The shark coprolites demonstrate variable morpholo-gies suggestive of multiple taxa. The morphologies of the specimens are cylindrical, spiral and scroll. The syndiageneric coprolites are interpreted as crocodilian intestinal tracts, based on size, morphology and content. The spiral specimens have a pronounced external spiral that coils to the end: isopolar and amphidoboth. Both the scroll and spiral coprolites are indicative of sharks. Many researchers refer to two basic types of valves: spiral and scroll. However, there are some that split the more primitive valve into the ring valve and the spiral valve and for this research were grouped together as spiral. The spiral valve shape is found primarily in the Lamnidae. The scroll valve resembles a loose roll of paper and is considered more advanced. It is found primarily in the Carcharhinidae, but there are some carcharhinds that have a spiral valve. The specimens recovered to date are preserved intact, not flattened, or deformed and retain the original shape. This is indicative of rapid burial in a low energy environment, immediately after defecation and close to the bottom of the depositional envi-ronment. This will be the most decisive analysis of Woodbine coprolites to date.

Poster Session I (Wednesday, November 2)
ISOTOPIC EVIDENCE OF PALEOENVIRONMENTS AND NICHE PARTITIONING OF EARLY MIocene FOSSIL FAUNA FROM NAPAK AND MOROTO, UGANDA

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Early Miocene fossil fauna from sites along the flanks of the extinct Moroto (~20.6 Ma) and Napak (~20 Ma) volcanoes in Uganda document the early stages of a transition to modern East African faunal communities, including the evolution and diversification of catarhines. Ongoing research at these sites includes characterizing the environmental context of taxo-nomic shifts. Isotopic analyses of bulk C and O isotopes of herbivore enamel from 130 specimens of variable taxa from multiple sites were used to constrain dietary patterns and by inference paleovegetation physiognomy. The general goal was to target taxa well represented in assemblages from most sites (including suiforms, picrocercus, rhinoceros, proboscideaes, and anthropoideaes) to examine dietary changes spatially and temporally in the sequences. Despite the fact that the paleohabitats were dominated by C3 vegetation, isotopic signatures of fossil taxa reveal highly variable and complex foraging patterns suggesting habitat hetero-genity. The data provide an opportunity to explore potential ecological differences associ-at-ed with the developing volcanic edifices, and the basis for differential faunal representation at various sites. Overall, the C isotopic dietary signatures of enamel range from -6permil to -1permil, indicating relatively open forest ecosystems at some sites, especially those as-soociated with early stages of volcanism, and are unlike dietary values documented in modern closed canopy habitats. Although O isotopic profiles overlap those of other Miocene/Plio-cene fossil sites and modern values, the enamel signatures at Napak and Moroto tend to be more depleted, perhaps indicating different regional climatic regimes with varying moisture sources/isotopic values or reduced local evapotranspiration. Ultimately, characterizing iso-topic variability in fossil herbivore enamel, reflecting environmental factors such as canopy effect, relative evapotranspiration, and water stress (as well as varied foraging behavior of taxa), will provide a means of correlating ecological variability and change with taxonomic variability and change over time and space.

Poster Session IV (Saturday, November 5)
MESCALEROLEMUR HORNERI: A NEW ADAPIFORM PRIMATE FROM THE MIDDLE EOCENE OF WEST TEXAS

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In 1973, the adapiform primate Mahgarita stevensi was discovered at the Duchesnean (lat-est middle Eocene) Teppee Canyon locality in the Devil’s Graveyard Formation of West Texas. Subsequent phylogenetic analyses revealed that Mahgarita is more closely related to Eurasian and African adapiforms than to other North American adapiforms. Since 2005, renewed collecting of vertebrate fossils in the Devil’s Graveyard Formation has yielded ad-ditional primate fossils from the late Uintan (late middle Eocene) Purple Bench locality. The Purple Bench primate community includes two omomyiforms, Diablomomys and Myotinops, and a new adapiform: Mescalerolemur horneri. Mescalerolemur is currently known from a partial palate, several partial mandibles, and several isolated teeth. Ranges of manda-bular first molar area on body mass for living primates suggest that Mescalerolemur was a relatively small adapiform with a body mass of about 370 g. This estimate is smaller than the body masses reconstructed for Diablomomys (440 g), Myotinops (870 g), and Mahgarita (700 g). Comparisons of dental anatomy demonstrate that Mescalerolemur and Mahgarita share a number of derived features, including loss of the first premolars, extreme reduction of the second premolars, and crowding of the antemolar dentition. Both genera also share a unique configuration of the mandibular and maxillary fourth premolar crowns that distinguish them from all other known adapiform taxa. A parsimony analysis of 360 dental characters demons-trates that Mescalerolemur and Mahgarita are closely related sister taxa that are more closely related to Eurasian and African adapiforms than to North American notharchines. The presence of both genera in the Big Bend region of Texas after notharchines had become locally extinct provides further evidence of faunal interchange between North America and East Asia during the middle Eocene. The fact that Mescalerolemur and Mahgarita are both unknown outside of Texas also supports prior hypotheses that low-latitude faunal assem-blages in North America demonstrate increased endemism by the late middle Eocene.
NEW THEROPOD CRANIAL MATERIAL FROM THE YELLOW CAT MEMBER, CEDAR MOUNTAIN FORMATION (BARREMIAN-BASAL APTIAN,CRETACEOUS), STIKES QUARRY, NORTH OF ARCHES NATIONAL PARK, EAST-CENTRAL UTAH

KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; LOEWEN, Mark, Utah Museum of Natural History, Salt Lake City, UT, USA; DEBLIEUX, Donald, Utah Geological Survey, Salt Lake City, UT, USA; MADSEN, Scott, Utah Geological Survey, Salt Lake City, UT, USA; CHOINIERE, Jonah, American Museum of Natural History, New York, NY, USA

The Stikes Quarry is a dense and intertwining accumulation of well-preserved bones in a 1-m-thick lenticular bonebed that is at least 10 m wide. At least two associated iguanodont skeletons at the top of the bonebed overlie a small theropod, first identified during initial excavation in 2004. Salvage of disrupted blocks following a massive rock fall revealed portions of a larger theropod with significant skull material. Comparison of overlapping material (surangular, premaxillary tooth, and astragalus) suggests this specimen may represent the coeval Utahraptor.

The small and large dentaries preserve procumbent anterior teeth and a ventrally positioned lingual groove. The small jaw’s teeth, lack serrations and only the first of the large jaw’s teeth preserve weak serrations. The thickened and inclined symphysis of the lower jaw bears two Meckelian fenestrae. The marginal teeth are conical, pointed and slightly curved posteriorly; their bases do not bear distinct dorsoventral grooves indicating the shell at a chosen water depth and flow velocity to simulate fluvial processes. Differences in the mode and distance of movement were observed between the different shell morphologies. Lower shell profiles are prone to breakage due to longer burial times. These experiments suggest that intact turtle shells are more common in fluvial deposits of fluvial origin. Frequently, these turtle specimens are find complete, or the entire turtle shell is recovered intact with little or no additional skeletal material, such as those commonly found in the Kaiaporkis Formation (Campanian) of southern Utah. However, some varieties of turtles are frequently found with better preservation than other varieties. It is hypothesized that this difference in preservation is due to differences in the morphology of the shell. To test this hypothesis, actualistic experiments were conducted to compare the shell morphology and biostatigraphy of various turtle species to identify patterns that would lead to preferential preservation. Several extant turtle shells of different sizes and shapes were each placed within a laboratory flume to observe the transport and deposition of the shell at a chosen water depth and flow velocity to simulate fluvial processes. Differences in the mode and distance of movement were observed between the different shell morphologies and numerous recorded trial results. The resulting data demonstrates a clear link between shell profile, shell transportability, and speed of burial. Lower shell profiles are prone to rapid burial with little transport while higher shell profiles are transported more easily and prone to breakage due to longer burial times. These experiments suggest that intact turtle shells with lower profiles should be buried more easily, and therefore, be more common in fluvial deposits. Turtle shells with higher profiles should be preserved more frequently in fluvial deposits due to increased damage caused by transport and long exposure prior to burial. In support of these results, nearly all of the intact fossil turtle shells collected from the Kaiaporkis Formation have a low profile, while turtles with higher profiles are commonly represented by fragments.
Nigerian basal sauropod, Jobarica tiguidensis. For example, the basisphenoid of Spinopho-
rosaurus and Atlasaurus bears basipterygoid processes that are elongate and strongly swept 
caudally. The Spinophorosaurus braincase was CT scanned, and 3D renderings of the brain 
decor and inner ear were generated. The endocard resembles that of most sauropods 
in having well-marked posterior and cerebral flexures (about 45°) and a large and oblong 
putatory fossa. It is progressive in having the brain stricture obscured by the former existence 
of relatively thick meninges. Caudodorsal to the brain region is a mushroom-shaped dural 
expansion that opens dorsally at the postparietal fontanel. This latter attribute is sometimes 
regarded as a feature of diplodocids, but is also found in some basal sauropodomorphs.

The configuration of the labyrinth is also primitive in having, in particular, the semicircular 
canals long and proportionally slender rather than being short and thick as in most sausau-
ropods. This condition is strikingly different from that in Camarasaurus, for instance, and is 
more reminiscent of that of the basal sauropodomorph Massospondylus. Therefore, the 
paleoneuroanatomy of Spinophorosaurus provides an important transitional morphology 
between that of basal sauropodomorphs and more advanced sauropods, which is concordant 
with previous assessments based largely on the postcranial skeleton.

Poster Session IV (Saturday, November 5)

PARENTAL CARE IN A CRETACEOUS CHORISTODERAN DIAPSID 
KOBAYASHI, Yoshitugu, Hokkaido University Museum, Hokkaido University, Sapporo, 
Japan; LU, Junchang, Institute of Geology, Chinese Academy of Geological Sciences, 
Beijing, China; WEI, Xuefang, Institute of Geology, Chinese Academy of Geological 
Sciences, Beijing, China; LIU, Yongqing, Institute of Geology, Chinese Academy of 
Geological Sciences, Beijing, China

Parental care has evolved numerous times in vertebrates. Among extant amniotes, it is pres-
ent in some squamates, crocodilians, birds, and mammals. However, evidence of this behav-
ior is extremely rare in the fossil record, especially in pre-Cretaceous ornithischian dinosaurs 
(Psittacosaurus, Ornithopods, and Maiasaura) and a varanopid pelycosaur. Intensive 
parental care is known in modern archosaurs (crocodiles and birds), and it has been argued 
that parental care is a homologous character of this group. Here we report new evidence of 
maternal care in an Early Cretaceous diapsid, the monjurosuchid choristoderan Monjuroso-
chas, from the Yixian Formation of China. This taxon belongs to the Jehol Biota, known for 
its highly diversified fossil record including the major clades of Lower Cretaceous terrestrial 
and freshwater vertebrates. The sample contains seven individuals of Monjurosuchus (one 
adult and six juveniles). All juveniles are in contact, or near contact, with the adult and are 
of essentially identical size (one-fourth of the adult in length), indicating that they belong to 
one family unit and that the juveniles remained in the vicinity of the adult to receive care.

The sacral ribs of the adult are not fused to the sacral proximally or to the ilia distally, so 
that the pelvis is mobile as in the female Kiechousaurus hai, implying that the adult of Monjuro-
suchus is also female. This is the oldest record in non-dinosaurian/crocodilian diapsids with 
evidence of parental care and supports maternal care as an ancestral condition in archosaurs. 
The viviparity of the choristoderan Hypalosaurus, closely related to Monjurosuchus, from 
the same rock unit, and the parental care of Monjurosuchus suggest that the choristoderes, at 
least in the Jehol Biota, may have had both viviparity and parental care to maximize their 
maximation rates, which is probably because the young were exposed to great stress by preda-
tors such as other aquatic animals, dinosaurs, and birds in and out of the water.

Technical Session VII (Thursday, November 3, 4:00 pm)

STABLE ISOtosPORE RECORD OF MIDDLE Eocene TO EARLY MIOCene. 
CLIMATE, GRAN BARRANCA, SOUTHERN ARGENTINA 
KOHN, Matthew, Boise State University, Boise, ID, USA; STROMBERG, Caroline, 
University of Washington, Seattle, WA, USA; MADDEN, Richard, Duke University, 
Durham, NC, Argentina; DUNN, Regan, University of Washington, Seattle, WA, USA; 
CARLINI, Alfredo, Universidad Nacional de La Plata, La Plata, Argentina

Gran Barranca, in southern Argentina, exposes one of the most complete and paleontologi-
cally important sections of middle Eocene (41 Ma; Barrancan) to early Miocene (19 Ma; 
Colhuachuan) terrestrial strata in South America. Fossil tooth enamel and bone were 
collected from approximately 75 horizons through the section and analyzed for C- and O-
stable isotope compositions. Oxygen isotope compositions are consistent with previous 
early isotopic studies of the same species and show amplified parallel changes to the benthic marine record: a ~1% increase during middle Eocene to earliest Oligocene 
global cooling, a 2% decrease during late Oligocene warming, and a ~1% increase during 
early Miocene cooling. Carbon isotope compositions show a consistent gradual decrease 
of ~1% through the section. The oxygen isotope record is consistent with expected tempera-
ture-induced shifts to precipitation compositions, and instead could reflect either changes to 
aridity or water sources, e. g. variations in the intensity of an Andean rainshadow. The carbon 
stable isotope record, however, suggests a long-term increase in mean annual precipitation from 
c. 7000 to 5000 mm/myr, a 1000-1500 mm/myr decrease between the Miocene and early Miocene. An early Miocene increase in open habitat grasses does not appear to reflect a decreased mean annual 
precipitation, and may instead reflect increased precipitation seasonality. Similarly, 
increases in hyposdony in the late Eocene and late Oligocene do not obviously correlate 
with isotopic indicators of aridity. Thus, changes to floral ecosystems and tooth morphology 
may reflect drivers other than mean annual temperature or precipitation.

Symposium 3 (Thursday, November 3, 9:30 am)

TWO NEW SPECIMENS OF AN ENIGMATIC MOSASAUR (SQUAMATA) 
PROGNATHODON OVERTONI FROM THE UPPER CAMPANIAN OF SOUTHERN 
ALBERTA, CANADA WITH GUT CONTENTS 
KONISHI, Takaya, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; 
BRINKMAN, Donald, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; 
MASSARE, Judy, SUNY College at Brockport, Brockport, NY, USA; CALDWELL, 
Michael, University of Alberta, Edmonton, AB, Canada

Currently known from the early Campanian to late Maastrichtian (Late Cretaceous), Prog-
nathodon constitutes a group of mosasaurs mosasaurs that typically possessed massively-
built jaws with robust teeth. Despite their robust nature, only a few articulated skulls are 
known to date and the information concerning their postcrania is minimal. Moreover, 
Campanian specimens of Prognathodon are extremely rare and generally incomplete. Two new 
specimens of Prognathodon oertoni from the early Campanian (ca. 74.5 Ma) 
Baroncho La Brea Formation exposed near Welling, southern Alberta, Canada, are the first fully 
articulated skeletons of the genus and provide new insights into the evolutionary history 
and paleoecology of the group. Detailed morphological assessment of these and referred 
materials indicates that many cranial characters are shared between P. oertoni and the 
generic type P. solvayi from the early Maastrichtian of Belgium, including: (1) premaxillary-
maxillary suture short; (2) frontal table short and triangular, lacking nasal emargination; (3) 
frontal posteroventral flanges short and widely separated; (4) coronoid process deep with 
long, shallowly inclined posterior border; and (5) blind-ended median opening on mandibular 
floor of basioccipital present. These are interpreted as generically diagnostic characters and 
the first one in particular distinguishes Prognathodon from Liodon and other long-snouted 
mosasaures. In marked contrast to the robust skull architecture unique to the genus, 
the postcranium of P. oertoni is lightly built, and differs little from that of Cliostoma, a basal 
mosasaur with a gracile cranial anatomy. Marginal teeth are carinate with fine crenula-
tions distinguishing their proposed predatory behavior. In addition, most of the fully 
erupted teeth exhibit a similar degree of apical wear, which indicates that the taxon 
may have regularly handled prey items that involved crushing. To augment these dietary infer-
ces, gut contents from one of the new specimens included fragments of two different sized 
fish, a sea turtle, and possibly a cephalopod.

Poster Session II (Thursday, November 3)

EFFECTS OF THE LATE PERMIAN EXTINCTION ON THE PERMIAN-TRIASSIC 
SHARK FAUNA 
KOOT, Martha, University of Plymouth, Plymouth, United Kingdom; TWITCHETT, 
Richard, University of Plymouth, Plymouth, United Kingdom; CUNY, Giles, Natural 
History Museum of Denmark, Copenhagen, Denmark; HART, Malcolm, University of 
Plymouth, Plymouth, United Kingdom

Sharks are predominantly marine top predators that are believed by some to have been 
relatively unaffected by the Late Permian mass extinction: a view supported by an apparent 
radiation of fish families across the boundary. In contrast, others have stated that chondrich-
thyans diversity closely follows diversity fluctuations in other aquatic organisms, including 
a drastic decline during the Late Permian and a subsequent Early Triassic recovery. To 
ascertain which view is correct, detailed local elasmobranch records from Permian-Triassic 
(P-T) oceanic basins need to be correlated and compared in terms of preservation and bio-
diversity. Anomalies in the quality of the fossil record, as well as changes in the global shark 
community can then be identified, and ultimately significant evolutionary developments as 
seen in other aquatic taxa. Here we describe the first dating of the earliest post-Pennsylvanian 
eutrobranch faunas expanding our knowledge on distribution patterns and diversity, and also shows a 
clear divide between local Permian and Triassic shark communities, suggesting at least some 
influence of the extinction on evolutionary patterns.

Poster Session III (Thursday, November 3) 

DESCRIPTION OF THE DIRE WOLF FORELIMB CANIS DIRUS GUILDAYI 
FROM RANCHO LA BREA 
KOPER, Lindsey, Northern Illinois University, DeKalb, IL, USA

The extinct Western Dire wolf, Canis dirus guildayi, was the most common predator at 
Rancho La Brea during the Pleistocene. The species Canis dirus was originally described as 
being similar to the timber wolf, although somewhat heavier and more robust, based upon 
the features emphasized in the cranial and dentition of this species. As the phylogeny of 
this canid has been described consistently from the skull and teeth, this study will focus on 
the postcrania. In this descriptive analysis, the bones of the upper forelimb, specifically
the external features of the scapula, humerus and ulna of *C. arctos* showed increased robustness when compared to *Canis lupus*. The caudal border of the dire wolf scapula was more pronounced than that of the grey wolf, specifically at the origin of the teres major and minor muscles. The deltid tuberosity of the dire wolf humerus was more robust, and the proximal end of the humerus had a greater articular surface than in the grey wolf and coyote. On average the grey wolf ulna was of greater length than that of the dire wolf, but significantly more gracile. Dissections of the forelimbs of *C. lupus* and the extant coyote *Canis latrans* provided comparative muscular information for construction of species-specific muscle maps. Examination of ridges, rugosities and other features reflecting alteration of bone surfaces by muscle attachment were shown to correlate with the osteological patterns on forelimb bones. These results allow for the interpretation of the significance of muscle scars on the fossils as a means of identifying locomotor and other behaviors. Comparisons with extant canids allow not only an understanding of the muscular soft tissue anatomy in closely related extinct species, but also permit extrapolation of function to the extinct predator.

Technical Session XII (Friday, November 4, 3:15 pm)

**EVIDENCE FOR MULTIPLE CENOZOIC INVASIONS OF AFRICA BY PENGUINS (AVES, SPHENISCIFORMES)**

KSEPKA, Daniel, North Carolina State University, Raleigh, NC, USA; THOMAS, Daniel, University of Cape Town, Cape Town, South Africa

Africa was the last major Southern Hemisphere landmass to be colonized by penguins. Although the continent hosts only a single breeding species today, the fossil record reveals that at least four extinct penguin species co-existed along the African coast during the early Pliocene. We present a new study of these species based on over 200 specimens, including new material, collected from the Pliocene Muisfontein Phosphatic Sand Member of the Varswater Formation. Multiple specimens show extremely poor ossification and lack of fusion in the carpometacarpus and tarsometatarsus. Stages of ossification observed in these fossils match those seen in unfledged chicks of extant penguins, suggesting these individuals were washed out to sea from nesting colonies in the vicinity.

A total evidence (morphology + molecular sequence data) phylogenetic analysis reveals that contrary to previous hypotheses, the Pliocene species do not represent an endemic radiation or direct ancestors of the living *Spheniscus demersus* (Black-footed Penguin). Biogeographic reconstructions using parsimony and Bayesian approaches implemented in RASP support the inference of at least three separate dispersal events to Africa during the Neogene. Ancestral area reconstructions suggest the now-extinct Pliocene lineages arrived from either South America or Austro-New Zealand, and were likely assisted by the eastward flowing Antarctic Circumpolar and South Atlantic currents. Divergence dates inferred from both a time-calibrated cladogram minimizing ghost lineages and from previous molecular sequence-based divergence dating studies indicate that the extinct African species *Spheniscus demersus* arrived at the time of deposition of the Muisfontein Phosphatic Sand Member and so may not have overlapped with any of the extinct species. As has been proposed for the South African marine avifauna in general, pronounced regional sea level fall (~90m) may be implicated in the deep decline in penguin diversity.

Poster Session I (Wednesday, November 2)

**DISTINGUISHING FORAGING RANGE AND DIVING HABITS AMONG MARINE VERTEBRATES USING CARBON ISOTOPES AND WT. % CARBONATE**

KUYKENDALL, Samantha, Texas A&M University, College Station, TX, USA; ROBBINS, John, Texas A&M University, College Station, TX, USA

Calculated weight percent carbonate values extracted from marine vertebrate tooth enamel potentially provide an independent proxy for deep-diving behavior. The increased storage of oxygen in the blood and tissues relative to the lungs in diving vertebrates leads to a greater amount of respired CO2 in the blood compared to that of non-divers. If this leads to higher wt.% carbonate values in teeth, then diving taxa may be expected to have higher wt.% carbonate values. This scenario is identified when comparing the wt.% carbonate values of a diving sea snake (*Pelamis platurus*; 6.8%) to a non-diving marine iguana (*Amblyrhynchus cristatus*; 3.3%).

Low δ13C values in marine vertebrate teeth reflect both the decrease in primary producer δ13C (δ13CPOC) with increasing distance from shore and the increased respiratory CO2 in the blood related to diving behavior. There is an excellent correlation between δ13C of an individual and the amount of respired CO2 in their blood which behavior is explained by the low δ13C of an individual’s food. Current research combines low δ13C values with the presence of avascular necrosis (considered evidence of deep/frequent diving) to describe diving behavior. Inclusion of wt.% carbonate values may provide further evidence for separating diving behavior from offshore foraging in marine vertebrates.

Based on paleo-pathology, morphology, and isotope data, some genera of mosasaurs were likely deep/frequent divers. It is expected that the wt.% carbonate values of the tooth enamel of diving individuals will be higher in divers compared to non-divers. Individuals from southern Sweden exhibit significant differences between taxa, where the non-diver *Clidastes* has the lowest value (4.4%), while the suspected divers *Tylosaurus* (5.5%), *Prognathodon*

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but differs in the presence of a lateral flange on the dentary. The pterygoids are fused medi-

Unusual shovel-tusked gomphothere material from the late Clarendonian Black Butte local-

is strongly curved posterodistally, and the triangular obturator process is positioned at its

"boot" is deeply concave, comprising a "cup-like" morphology. The shaft of the ischium

Manual unguals exhibit a conspicuous proximodorsal "lip." The distal surface of the pubic

in a pygostyle-like conformation consisting of three greatly modified but unfused vertebrae.

The oviraptorosaurian theropod clade Caenagnathidae has long been enigmatic due to the

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Technical Session XIV (Saturday, November 5, 11:45 am)

A NEW CAENAGNATHID OVI-RAPTOROSAUR (THEROPODA: MANIRAPTORA) FROM THE UPPER CRETACEOUS (MAASTRICHTIAN) HELL CREEK FORMATION OF THE WESTERN UNITED STATES

LANAMNA, Matthew, Carnegie Museum of Natural History, Pittsburgh, PA, USA; SUES, Hans-Dieter, National Museum of Natural History, Washington, DC, USA; SCHACHERR, Emma, University of Utah, Salt Lake City, UT, USA; LYSON, Tyler, Yale University, New Haven, CT, USA

The oviraptorosaurian theropod clade Caenagnathidae has long been enigmatic due to the

NEW SHOVEL-TUSKED GOMPHOThERE (PROBOSCIDEA) FROM THE CLARENDONIAN OF OREGON

LAMBERT, W. David, Oxbow Bridge of the Palm Beaches, West Palm Beach, FL, USA

Unusual shovel-tusked gomphothere material from the late Clarendonian Black Butte local

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known leptoceratopsid neoceratopsian and a trionychid turtle. Additions to the fish assemblages include new specimens of previously unknown dinosaur taxa, including a new squamates, one champsosaur, three crocodylomorphs, 16 non-avian dinosaurs, one possible non-hadrosaurid hadrosauroid, triconodont mammals) represent the last occurrences of taxa that are not found subsequently in Alberta. This study supports previous conclusions that the early radiation of which is characterized by high levels of homoplasy, revealing a mosaic pattern of character transformation. This may severely affect taxonomic/phyletogenetic inferences, and the origin of the main dinosaur groups may represent a segment of evolutionary history that is particularly hard to reconstruct. Indeed, the currently poorly constrained phylogenetic position of various basal members of the group is not surprising.

Poster Session IV (Saturday, November 5)
NEW INFORMATION ON THE VERTEBRATE ASSEMBLAGE OF THE SANTONIAN-AGED MILK RIVER FORMATION OF ALBERTA (CANADA) AND THE EMERGENCE OF LATEST CRETACEOUS VERTEBRATE COMMUNITIES IN NORTH AMERICA
LARSON, Derek, University of Toronto, Toronto, ON, Canada; BRINKMAN, Donald, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA
The fossil assemblage from the Deadhorse Coulee Member of the Milk River Formation of Alberta provides important information about Santonian-aged vertebrates from North America, which are poorly documented in the fossil record. A continental deposit between the underlying Upper Colorado Group and the overlying Pakowki Formation marine deposits, the Milk River Formation provides the earliest record of a Late Cretaceous vertebrate assemblage in a series of well-known terrestrial fossiliferous strata in Alberta. The collection of additional material from this formation and an update of work by previous authors has allowed for the recognition of a diverse assemblage with at least 101 vertebrate taxa from the formation, consisting of 18 fish (including 10 teleosts), seven amphibians, 11 turtles, 14 squamates, one chondrichthys, three crocodylomorphs, 16 non-avian dinosaurs, one possible bird, and 30 mammals. A new field survey resulted in the recovery of a number of important new specimens of previously unknown dinosaur taxa, including a new Pterosaurus-grade pachycephalosaurid that represents the oldest known pachycephalosaurid from North America, a possible non-hadrosaurid hadrosaurid, and a new baenid turtle. New taxa have been identified from previously collected but undescribed specimens and include the oldest known leptoceratopsid neoceratopsian and a trionychid turtle. Additions to the fish assemblage include a diverse teleost assemblage, and the oldest North American occurrences of a polyodontid fish and the vidalaminid amial McManus. Many of these clades are represented later in the Cretaceous by common and well-known taxa, but others (goniopholid crocodylomorphs, possible non-hadrosaurid hadrosaurids, triconodont mammals) represent the last occurrences of taxa that are not found subsequently in Alberta. This study supports previous work suggesting that the Milk River Formation represents a transitional assemblage crucial to our understanding of the evolution of later Campanian and Maastrichtian North American assemblages.

Symposium 1 (Wednesday, November 2, 10:45 am)
INTEGRATING THE GENOTYPE; PHENOTYPE MAP ACROSS THE ORIGIN OF BIRD WINGS
LARSSON, Hans, McGill University, Montreal, QB, Canada; DECECCCHI, Alexander, University, Montreal, QB, Canada; HARRISON, Luke, McGill University, Montreal, QB, Canada
Evolution of the genotype–phenotype map is one of the fundamental goals of evolutionary biology because it describes the interface between phenotype and genotype. Macroevolutionary transitions of phenotype are expected to be paralleled by similarly large-scale changes to genotype. In this regard, the fossil record may offer insights into the behavior of the genotype-phenotype map that traditional microevolutionary research cannot. Here we discuss a test case using the non-avian to avian theropod forelimb transformation from an arm to a wing. Phenotypic changes are documented with discrete and continuous skeletal characters to identify phylogenetic and anatomical regions of significant evolutionary change. Peaks of phenotypic change in the forelimb, relative to ‘background’ rates of skeletal evolution, occur during digit losses in tetanurans and biomechanical changes within derived maniraptorans. Genotypic changes are inferred from sequence data from extant birds, crocodilians, and other reptiles. We use RAG-1 and RAG-2 protein coding sequences to calibrate ‘background’ rates of genotypic change along the Archosauria - Aves branch. Coding and, where known, regulatory sequences from a selection of genes involved in the limb gene regulatory network were assembled from representative extant taxa. This data is used to explore for significant evolutionary changes to these sequences across the Archosauria – Aves branch and we suggest methods to estimate temporal calibrations to these changes. Some of these temporally calibrated sequence changes appear to be associated with phenotypic changes. This work, although preliminary, presents a novel method to associate large-scale phenotypic and genotypic changes and attempts to infer how evolutionary processes effect the genotype-phenotype map.

Poster Session I (Wednesday, November 2)
THE ENDOCRANIAL ANATOMY OF THE MONGOLIAN THERIZINOSAURID DINOSAUR ERLIKOSAURUS ANDREWSI AS REVEALED BY 3D VISUALIZATION
LAUTENSCHLAGER, Stephan, Department of Earth Sciences, University of Bristol, Bristol, United Kingdom; RAYFIELD, Emily, Department of Earth Sciences, University of Bristol, Bristol, United Kingdom; WITMER, Lawrence, Department of Biomedical Sciences, Ohio University, Athens, OH, USA; ALTANGEREL, Perle, National University of Mongolia, Ulaanbaatar, Mongolia
Therizinosaurs are one of the most enigmatic and peculiar clades among theropods, exhibiting an unusual suite of characters, such as lanectalete teeth, a rostral rhamphotheca, long manual claws, and a wide, opisthophotic pubis. Although their fossil record is generally rather poor, numerous discoveries have expanded our knowledge of this group in the last 20 years. However, the holotype skull of Elikosaurus andrewsi from the Late Cretaceous of Mongolia still remains the only complete, articulated and three-dimensionally preserved skull of a therizinosaur.
Here, we present the first results of the endocranial anatomy of Elikosaurus based on computer tomographic scanning. The endocast, the cranial nerves and the endosseous labyrinth are digitally visualized, revealing these structures for the first time for any therizinosaur.

Poster Session III (Friday, November 4)
TURTLE EGGS AND EMBRYOS IN A CLUTCH FROM THE UPPER CRETACEOUS (CAMPANIAN) JUDITH RIVER FORMATION OF MONTANA
LAWVER, Daniel, Montana State University, Bozeman, MT, USA; JACKSON, Frankie, Montana State University, Bozeman, MT, USA; HORNER, John, Montana State University, Bozeman, MT, USA
Turtle eggs are unique among amniotes in that the eggshell consists of aragonite, whereas all other amniote eggs are comprised of calcite. This mineral composition and distinctive microstructure allow for confident identification of turtle eggs within the fossil record. Interpretations of paleoecology are possible from fossil turtle eggs because of the presence of modern analogs.
The Judith River Formation contains numerous dinosaur eggs and eggshell localities; however, fossil turtle eggs and eggshells are rare from this formation. A clutch of unchitted turtle eggs (MOR 710) consists of at least 13 eggs, some containing embryonic remains. These mostly intact specimens were discovered at the base of the outcrop and therefore provide little taphonomic information about nest construction. The relatively smooth, cream-colored eggs measure 3 x 4 x cm and exhibit minor lithostatic compaction. The rigid eggshell consists of a single structural layer comprised of radiating, acicular aragonite crystals that form interlocking shell units, which flare slightly toward the outer shell surface. The shell unit width-to-height ratio is approximately 1.2. At least one egg displays abnormal, double eggshell layers, a condition reported in at least nine species of modern turtles. The embryonic remains are partially articulated and show a late stage of ossification, suggesting that they were close to hatching at time of death. Histological thin sections of the embryonic bone show enlarged vascular spaces, within the cortex, surrounding the marrow cavity. Vascular spaces are orientated longitudinally and are mostly circular in transverse section. Numerous osteocytes are preserved but show little organization. The distinctive shape of the premaxilla suggests that the eggs were laid by a trionychid turtle. Modern trionychid turtles inhabit aquatic environments and the presence of the fossil turtle eggs in fine-grained overbank deposits is consistent with a similar paleoenvironmental interpretation. Finally, based on data from modern trionychid turtle species, the shape and number of eggs suggests they were laid by a mid-sized turtle with a carapace length between 20 and 30 cm.
Crocodyliformes are the only group of Archosauriformes that have enclosed the antorbital fenestra of Metriorhynchidae has been recently questioned, an internalized antorbital fenestra of Edentosuchus, the Fruita Form), most transformations are focused in certain mesoeucrocodylian clades. In notosuchians, a closed antorbital fenestra is observed in derived notosuchians (including sebecosuchians). However, the presence of an antorbital fenestra in Notoecus creates an ambiguous optimization for this character. Furthermore, the presence of a small fenestra in some Cenozoic sebecosuchians (Bergsaurus and Iberosaurus) implies a reopening of the fenestra in the evolution of this group. Among neosuchians, two independent events of closure are optimized on the phylogeny, in Pholidosauridae=Odyosauridae and in Gonioholibidae=Eusuchia. This optimization is due to the condition of basal Thalattosuchia and Apatosauroidae, as both have small antorbital fenestra. Given that the homology of the antorbital fenestra of Metriornyhynchidae has been recently questioned, an internalized antorbital fenestra could represent an ambiguous synapomorphy of the longirostrine clade composed by Thalattosuchia=Gonioholibidae=Pholidosauridae.

The evidence at hand indicates the antorbital fenestra of Crocodyliformes is one of the most homoplastic analyzed characters of the group, suggesting not only the closure of this opening in multiple groups but also the independent reappearance of a fenestra (that would not be homologous from a phylegetic point of view) in some notosuchians and, possibly, in basal thalattosuchians.

Technical Session XIV (Saturday, November 5, 9:30 am)

VARIATION IN BONE HISTOLOGY AND GROWTH OF THE NOASAURID THEROPOD MASIASKAURUS KNOPPLELI

LEE, Andrew, Midwestern University, Glendale, AZ, USA; O’CONNOR, Patrick, Ohio University, Athens, OH, USA

Bone histology and growth patterns among non-avian theropods have been extensively studied in coelurosaurians. In contrast, similar data from non-coelurosaurian theropods are only known from the small-bodied Coelophysidae rhodesiensis and the large-bodied Allosaurus fragilis. Moreover, interspecific comparisons of growth rates and growth durations among theropods necessarily focus on mean values, precluding assessments of intraspecific variation. Here, we present an intraspecific analysis of bone histology and growth in the small-bodied noasaurid Masiaskaurus knoppleri. The study sampled a size-diverse range of four femora and three tibiae. By measuring the sequence of growth lines in each bone and applying a mixed-effects nonlinear regression, we found that the femur and tibia had similar mean circumferential growth rates (reaching a maximum of 7 mm per year) and mean growth durations (12–13 years). However, substantial intraspecific variation exists, with individual growth rates ranging between 3–10 mm per year and individual growth durations ranging between 7–24 years. Moreover, fibrolamellar bone, as is frequently reported in other theropods, is not the predominant bone tissue type. Instead, fibrolamellar bone occurs most prominently in faster-growing femora and tibiae whereas a mixture of fibrolamellar and parallel-fibered bone occurs in slower-growing bones. The results reveal that the complex expression of fibrolamellar bone is related to individually variable growth rates and suggest that growth patterns among non-avian theropods exhibit more intraspecific variation than previously thought.

Technical Session I (Wednesday, November 2)

THEROPOD TRACKWAYS ASSOCIATED WITH ORNITHOMIMID SKELETONS FROM THE NEMEGT FORMATION (MAASTRICHTIAN) AT BUGIN TSAY, MONGOLIA

LEE, Hang-Jae, KIGAM, Daejeon, Korea, South; LEE, Yuong-Nam, KIGAM, Daejeon, Korea, South; ADAMS, Thomas, SMU, Dallas, TX, USA; KOBAYASHI, Yoshitsugu, Hokkaido Univ. Museum, Sapporo, Japan; JACOBS, Louis, SMU, Dallas, TX, USA

A theropod tracksite was discovered in the Nemegt Formation (Maastrichtian) at Bugin Tsay, Mongolia, by the Korea-Mongolia International Dinosaur Project in 2009. Among 67 theropod tracks, 15 trackways are recognized except for eleven isolated tracks, which are the first theropod trackways reported in the Nemegt Formation. Fifteen trackways are divided into a didactyl trackway, a small bird-like trackway, and 13 tridactyl trackways. These different theropod trackways indicate that at least three different theropod dinosaurs lived in Bugin Tsav region in the same period. This tracksite consists of an alternation of grey mudstone and light brown sandy mudstone probably deposited in the floodplain environment. During excavation of the track horizon, an articulated ornithomimid right foot was found in the mudstone beneath the track-bearing sandy mudstone layer. The site was excavated by illegal poachers for several ornithomimids judging from the number of dug pits and scattered bone pieces of ornithomimids. Based on the stratigraphic relationship between the position of the ornithomimid foot and tracks, theropod tracks were made on the sandy mud deposited after ornithomimids were buried in the mud.

Technical Session IV (Saturday, November 5)

THE PLATACANTHOMYINE RODENT NEOCOMITES FROM THE MIOCENE OF SOUTH KOREA AND ITS PALEOBIOGEOGRAPHICAL IMPLICATIONS

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A left first lower molar of Neocomes from the Bukepyeong Formation, South Korea is more similar to N. similis and N. cf. similis from Europe than to N. orientalis from Thailand, and is therefore referred to Neocomes aff. similis. The new discovery of Neocomes is important in that it is the first evidence in Asia to show close faunal affinity to European Neocomes. It has important paleobiogeographical significance for the Subfamily Platacanthomyinae, because it represents the easternmost occurrence of this subfamily in Eurasia, implying there was continuous gene flow between the Neocomes populations of eastern Asia and Western Europe. The paleoclimatic interpretation for the Bukepyeong Formation based on the palynomorphs implies that Neocomes had wider climatic tolerances than either of the two extant platananthomyine genera. The evolutionary stage of Korean Neocomes is comparable to material from European localities correlated with MN 4 and MN 5, which constrains the age of the Bukepyeong Formation to between 18 and 15.2 Mya.

Technical Session XVI (Saturday, November 5, 11:45 am)

VASCULARIZATION AND DORSOVENTRAL ASYMMETRIES IN THE PECORINAR PELVIS OF TIKTALIK ROSEAEE SHED LIGHT ON THE FIN TO LIMB TRANSITION

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CT imaging and 3D visualization software provides a detailed and non-destructive way to analyze and reconstruct the internal morphologies of well-preserved fossils. The finned eptostegalian, Tiktaalik roseae, from the Frasnian Stage of the Late Devonian of the Canadian Arctic is known from several partially-articulated specimens. This taxon is important for understanding the fin-limb transition because of its phylogenetic position as the sister group to limb forms, and the well-preserved skeletal anatomy of the pectoral fin. One specimen in particular, NUFV 110, preserves a complete right pectoral fin with dermal and endochondral elements in situ. This fin was CT-scanned and segmented from the gelenoid facet to distal lepidotrichia. This study shows that the overlap of the lepidotrichia (fin rays) and endochondral skeleton is asymmetrical in Tiktaalik. Specifically, the dorsal hemitrichia extend to the boundary of a transverse joint immediately distal to the ular and intermediate; whereas the ventral hemitrichia do not overlap the mesomers or intermediate. This asymmetry is also observed in mechanically-prepared T. roseae specimens (NUFV 108 and NUFV 109). Additionally, the lepidotrichia that overlap the radius are robust and functionally distinct from other lepidotrichia. Based on data from extant saccopeterygians, we hypothesize that the proximal extent of the lepidotrichia marks the distal extent of fin musculature. This observation is supported by the presence of grooves for nerves and blood vessels on the ventral surfaces of the endochondral bones where lepidotrichia and scales are absent, as well as an extensive network of vascularization that runs through the ventral ridge of the humerus. The dorsal hemitrichia asymmetries of hemitrichia, grooves and vascularization indicate a pectoral fin with relatively large ventral musculature, which has functional implications for an aquatic animal living in contact with the substrate. These features help us address questions about how the fin rays were lost during the fin to limb transition, a key adaptation in the evolution of tetrapods.

Technical Session XVII (Saturday, November 5, 2:15 pm)

DECREASING LIMB INERTIA AMONG NORTH AMERICAN UNGULATES ACROSS THE PALEOGENE NEOGENE BOUNDARY

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The proportions of the limb bones of tetrapods determine the energetic costs of locomotion; consequently, they can be used to classify locomotor type and can inform hypotheses about an animal’s primary habitat. We examined mechanical advantage in the limbs of North American Oligocene and Miocene ungulates (Artiodactyla and Perissodactyla), with the expectation that the distribution of values would change with the spread of grass-dominated plant communities; that is, we expected a transition to greater cursoriality with more open habitats. We assess changes in the occupation of locomotor ecomorphospace (LEMS) using measurements of the lengths of proximal and distal limb bones in species of North American ungulate herbivores. Log-transformed distal/proximal (d/p) limb bone ratio is inversely proportional to oscillatory inertia (and hence the energy required to swing the limb): positive d/p ratios are often associated with cursorial animals that can move efficiently over long distances. Analysis of LEMS reveals significant changes in dominant ungulate locomotor morphology between Oligocene and Miocene faunas. Oligocene ungulates show less variation in LEMS than Miocene ungulates, with greater occupation of the cursorial (low inertia) niche.
oscillatory inertia) morphospace (hindlimb and forelimb d/p ratios both >0) in the Miocene. Artiodactyls show a significant shift in limb proportions (P< 0.05): only two species occupy the non-cursorial (high oscillatory inertia) zone in the Miocene (hindlimb and forelimb d/p ratios < 0). Perissodactyls maintain similar levels of disparity in limb proportions in the Miocene as in the Oligocene (P< 0.70), but more perissodactyls occupy the cursorial zone in the Miocene than the Oligocene. Our results suggest the floral regime transition at the Oligo-Miocene boundary is associated with a substantial change in the locomotor mechanics of ungulate species. Through this transition, we find that artiodactyls increased in cursoriality to a greater degree than contemporaneous perissodactyls.

Poster Session IV (Saturday, November 5)

BONE HISTOLOGY AND GROWTH OF CHASMOSAURINE CERATOPSID DINOSAURS FROM THE LATE CAMPANIAN KAIARPWITS FORMATION, SOUTHERN UTAH

LEVITT, Carolyn, University of Utah, Utah Museum of Natural History, Salt Lake City, UT, USA

Ceratopsian dinosaurs are one of the most diverse dinosaur groups in the Cretaceous, and an outstanding question is how growth strategies of this group evolved in relation to their shift from small bipedal basal ceratopsians to larger quadrupedal ceratopsids. Bone histology and growth has previously been investigated for several basal ceratopsians, and two centro-saurine ceratopsids (Centrosaurus and Pachyrhinosaurus), but chasmosaurine ceratopsid dinosaurs have yet to be investigated. New chasmosaurine specimens from the late Campanian Kairarwits Formation of southern Utah are ideal for such a study because they preserve multiple ontogenetic stages of at least two different taxa.

I conducted histological analysis of numerous ulnae, femora, tibiae, ribs, and ossified tendons from multiple specimens of two species of chasmosaurine ceratopsian dinosaurs, Kosmoceratops richardsoni and Uaceratops gettyi, to examine bone microstructure indicators of growth rate and maturity. The cortex of all elements is relatively thick with varying degrees of trabecular in the medullary cavity. All specimens examined are dominated by fibro-lamellar bone tissue indicative of fast growth rates. All elements are highly vascular. Observed vascular canals are oriented radially indicative of fast bone growth. Dense osteocytes throughout limb bone cross sections also suggest fast growth.

Larger limb bones preserve a small number of annual growth lines. No growth lines are apparent in the ribs and ossified tendons samples, where they have probably been obscured by remodeling in the form of dense secondary ostearthes (“Haversian canals”). Overall, the bone microstructure of these taxa is similar to those of centrosaurine ceratopsids, indicating similar growth strategies for these two groups of large quadrupedal ceratopsians. The presence of fibro-lamellar tissue and high vascularity is consistent with the hypothesis that these animals had an elevated metabolism.

Technical Session VI (Thursday, November 3, 2:30 pm)

A RE-EXAMINATION OF THE CRANIAL MORPHOLOGY OF CONFUCIUSORNIS SANCTUS

LI, Dongsheng, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; ZHANG, Fucheng, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

As one of the most widely known Mesozoic birds, the Chinese Early Cretaceous confuciusornithid Confuciusornis sanctus has been extensively studied from many different perspectives. The structure of the skeleton has been described in more detail in this species than in most other basal or derived birds. However, the sutural contacts among the rostral bones appear particularly firm, which may indicate that C. sanctus was capable of forcing biting and/or pecking. The maxilla is more primitive than in other birds, except Archaeopteryx, whereas the nasal is nearly triangular and the lacrimal is approximately C-shaped. A prefrontal is present, perhaps indicating that this bone either disappeared later in avian evolution than previously believed or secondarily re-appeared in C. sanctus. We tentatively reconstructed the palate of C. sanctus as part of our study. The palate is characterized by absence of the ectopterygoid, reduction of the palatine and presence of a relatively primitive pterygoid. Comparisons with theropod dinosaurs, Mesozoic birds and extant birds suggest that the palate of C. sanctus should be interpreted as more primitive than in any other known bird except Archaeopteryx. All new findings, but especially the palate, reinforce the relatively basal phylogenetic position of C. sanctus. The specimens included in this study show considerable variation in some skull features, such as the length of the frontal process of the maxilla. Due to the poor preservation of many of the available specimens, many details of the cranium of C. sanctus remain enigmatic and will need to be elucidated in the future on the basis of better material.

Poster Session IV (Saturday, November 5)

AN EXCEPTIONAL ORNITHISCHIAN TRACKSITE FROM THE EARLY MESOZOIC OF SHAAANXI, CHINA

LI, Jianjun, Beijing Museum of Natural History, Beijing, China; LOCKLEY, Martin, University of Colorado Denver, Denver, CO, USA; MATSUKAWA, Masaki, Tokyo Gakuin University, Tokyo, Japan; ZHIGHANG, Bai, Peking University, Beijing, China

A site with eight well-preserved trackways of an Early Mesozoic quadrapedal ornithischian dinosaur is the first report of Deltosaurus- and Moyenisiartips-like trackways from Asia. The tracks occur in the Fuxian Fm, near the Triassic-Jurassic boundary in Shenniu County (Shaanxi Province, China), geographically close to the discovery site of the first dinosaur track (Sinoichnites) reported from China. Size and morphology suggest that Sinoichnites,
based on a holotype pes which is now lost, also represents an ornithischian. Study of all eight trackways indicates the track maker produced DePATopus-like tracks, with indistinct pes digit traces and sub-circular manus traces when the substrate was soft, and Moyenosaurus-put-like tracks, with clear tridactyl pes and pentadactyl manus traces when the substrate was firmer. The tridactyl Sinoichnites pes suggests an intermediate mode of preservation.

These observations have global ichnological significance because Moyenosaurusputrus is well-known in the Lower Jurassic, and DePATopus, of presumed stegosaurian affinity, is now increasingly well-known from the Middle and Upper Jurassic. If, as we suspect, these two ichnogenera represent different modes of preservation pertaining to the same or similar trackmakers, then Sinoichnites, Moyenosaurusputrus and DePATopus are merely different expressions of a generalized ornithischian morphology common throughout the Jurassic in Europe, Asia, Africa and North America. Sinoichnites and DePATopus are too-poorly preserved to match any diagnostic foot morphology and could have been made by almost any ornithischian. In contrast Moyenosaurusputrus has a tridactyl pes and small pentadactyl manus, whereas the Shaanxi morphotype has a tridactyl pes and large pentadactyl manus, possibly representing ornithopod and stegosaurian trackmakers respectively. The whole tracksite (~8 x 10 m) was excavated and reassembled for display at the Shemu Museum. This is one of the largest excavation and reassembly efforts in the history of vertebrate ichnology.

Poster Session III (Friday, November 4)
THE OLDEST MORPHOLOGICALLY MODERN SOFT-SHELLED TURTLE (TESTUDINES, PAN-TRIONCHIDAE) FROM THE JEHOL BIOTA OF CHINA
LI, Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LIU, Jun, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; JOYCE, Walter, Department of Geosciences, University of Tbingen, Tbingen, Germany; TONG, Haiyan, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

A new turtle from JiuFutong Formation of western Liaoning, China, represents the first species of soft-shelled turtle of Jehol Biota and the oldest morphologically modern pan-trionychid. The new taxon is diagnosed by the combination of the following characters: neural bone less than four times wider than long; suprascapular fontanelles open and confluent; prenarial absent; reversals of the orientation in the neural series at neurals V; costals VIII reduced; postorbit bar narrow, around one-fourth of orbit diameter; jugal contact squamosal; foramen jugale posterius excluded from fenestra postotica by descending process of opisthoch, which reaches pterygoid; neural spine weakly developed on anterior cervicals; phalangeal formula for pes 2-3.4-3.7. The new taxon is furthermore different from all modern soft-shelled turtles by possessing a complete row of neurals that fully hinders any medial contact of the costals and by having parietales that do not contribute to the processus trochlearis oticum. The new taxon can therefore be diagnosed as being situated outside of crown Trionychidae.

Poster Session III (Friday, November 4)
A REEVALUATION OF THE RELATIONSHIPS AMONG BASAL ORNITHUREINE BIRDS FROM CHINA AND NEW INFORMATION ON THE ANATOMY OF HONGSHANORNIS LONGICRESTA
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The past five years have seen the discovery of an array of new Early Cretaceous ornithurine birds from northern China. However, the relationships among these taxa have been unresolved in many recent analyses. Other analyses have recovered conflicting hypotheses concerning the relative placement of key taxa. Whether or not a clade comprising several ornithurine taxa from the Early Cretaceous of China is supported and could represent a small endemic, Asian radiation is debated. Specimens of Hongshanornis longicresta provide valuable information on the relationships and morphological evolution of basal ornithurines. Here, the morphology of Hongshanornis is reevaluated through examination of the holotype specimen, in which most bone is preserved as impressions, and newly-available latex peels. Longicrestavis houi, which was proposed as the sister taxon of Hongshanornis longicresta is also reevaluated. As well as comprising the best-preserved ornithurines from Yixian Formation, the two specimens come from nearby localities, Shifou in eastern Inner Mongolia and Longi in western Liaoning Province (Longicrestavis). Phylogenetic analysis utilizing a new dataset for Mesozioc avialans evaluates the placement of these taxa as well as other early Cretaceous ornithuromorphs (e.g. Archaeorhynchus, Jianchangorhynchus and Gansus). A change in hind limb proportions related to an ecological shift toward a “wading”, or more generally terrestrial, habitus has been proposed in Hongshanornis and other investigated taxa. In addition, a functional transition has been identified across this part of bird evolution after the origin of flight. Evidence bearing on avian hind limb evolution, both meristic data and discrete quantitative characters, is considered for basal Ornithurae in light of the phylogenetic results. A shift is identified, but the relationship between this shift and a particular ecology for early ornithurines is questioned.

Poster Session II (Thursday, November 3)
MORPHOLOGICAL RESPONSES OF THE DIRE WOLVES (CANIS DIRUS) OF RANCHO LA BREA OVER TIME DUE TO CLIMATIC CHANGES
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This study demonstrates the lack of morphological response of Canis dirus, the dire wolf, to climatic shifts during the late Pleistocene, a period of extreme climatic variability, ranging from glaciations to temperatures approaching modern maximums. To test if climate change caused morphological change in Canis dirus many variables were measured on hundreds of fossils from the Rancho La Brea collections, including femur, tibia, humer, and astragal. These measurements were then grouped based on mean radiocarbon age from each of five differently dated bone-producing pits. The correlation of pit ages to paleoclimate allowed the temporal and climatic aspects of the hypothesis to be tested. The resulting data was not normally distributed so a non-parametric test for significance of differences was used, the Kruskal-Wallis test. Individual tests were performed on each of the data sets. The results of the test (with the exception of the aberrant results from the population dated at 16,000 years ago) indicate that over nearly 25,000 years, there has been morphological stasis over time in dire wolves, despite significant climatic shifts.

Poster Session II (Thursday, November 3)
THE EFFECTIVE USES OF POLYESTER QUILT BATTING FOR CONSTRUCTING PLASTER JACKETS
LINN, Tom, South Dakota School of Mines and Technology, Rapid City, SD, USA; WELSH, Ed, South Dakota School of Mines and Technology, Rapid City, SD, USA; CARR, Jason, South Dakota School of Mines and Technology, Rapid City, SD, USA

Polyester quilt batting has been tested for advantages over other jacketing media particularly burlap, plaster-infused gauze bandages and fiberglass air filter. Polyester has proven itself in industry as being stronger and more durable than natural fibers. Burlap and gauze jackets require additional layers and weight to decrease flexibility; while fiberglass and polyester air filters can be used to construct lightweight, rigid jackets. Fiberglass has restricted use to laboratory and collections settings due to the preventative measures that must be taken to prevent adverse health effects, such as irritation to skin, eyes, digestive system, and respiratory system. Polyester quilt batting is composed of a similar mesh as is fiberglass air filter, and is similarly effective in creating lightweight, inflexible jackets. There are no known adverse health effects with polyester. Polyester quilt batting is also more affordable than alternative materials, reducing the need to buy multiple materials for varied jacketing techniques.

Comparison of the jacketing material included egg drops with eggs contained in burlap and quilt batting jackets. Jackets were constructed with conventional means for common field and lab settings, using toilet paper as a cushion and separator. Drops were performed at a uniform height of 80 centimeters, resulting in slightly less egg breakage in quilt batting jackets. This is likely due to the reduced mass and force of impact. Some human error included eggs breaking while opening jackets and imperfections in the interior surface of jackets leading to cracks in eggshells. The overall benefits of using polyester quilt batting, to cost as well as material integrity and versatility makes it preferable to most other materials, especially fiberglass air filters.
CONTRACTIONS ON THE FORMATION OF MARINE BONE CONCENTRATIONS

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Marine bone concentrations can occur as distinct widespread stratigraphic intervals approximately 2m -1m thick, for example the Shark Tooth Hill bonebed, CA (Miocene), Zone 12 in the Calvert Fm (Miocene), and the PaleoAngola bonebed in Africa (Cretaceous). Fossil specimens from these intervals are abundant and diverse. However, before reliable paleoecologic information can be interpreted from them, we need a firm understanding of bonebed genesis to account for temporal and ecologic mixing and other taphonomic biases. To date, two hypotheses are generally proposed for non-catastrophic bonebed origin: (1) an offshore concentration where bone input > sediment input; or (2) a winnowed and/or transported lag caused by eustatic sea-level change or storm events. Here, we scrutinize conditions necessary to generate an offshore bone concentration caused by sediment starvation through the use of a quantitative model to evaluate the feasibility of bonebed hypotheses. We developed a theoretical model using published parameters of bone decay, sedimentation rates, and skeletal input rates for a variety of offshore environments to evaluate the time necessary to generate a 50 cm bonebed (bone fraction >30%). In the absence of bone decay, we found that sedimentation rates must be lower than 1 cm/1000 years and the equivalent of one large whale or more must die every 1000 km2 per year. Under these conditions, a bone bed .5cm thick will take a maximum of 110,000 years to a minimum of 30,000 years to form. How- ever, when bone decay rates observed on recent whale fall skeletons and shipwrecks (10% - .01% loss of bone mass per year) are introduced to the model, even large whales will degrade faster than the maximum possible sedimentation rates can bury them, making it impossible to generate a bonebed under the given assumptions. Our results indicate that marine bone concentrations are unlikely to develop in sediment-saturated environments without the aid of other unidentified processes (bioturbation, differential decay?). Thus, we tentatively propose that sediment winnowing and/or bone transport processes are necessary in order to generate an attritional marine bone concentration.

THE EARLY DIVERSITY OF NON-CYPRINID CYPRINIFORMS (OSTARIOPHYLI, CYPRINIFORMES) IN THE EOCENE OF EAST ASIA AND NORTH AMERICA

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Cypriniform fossils are very rare prior to the Eocene. Only fragmentary bones and teeth of a putative ‘cyprinid’ from the Cretaceous of South America and a catostomid from the Paleocene of Canada are known. Cypriniforms diversified globally during the Eocene, though their Eocene occurrences were without exception assigned to either Cyprinidae or Catos- tomidae. Furthermore, whereas Eocene cyprinids were reported from Europe and Asia, the non-cyprinids were only found in East Asia and North America. Three Eocene catostomid genera are known: Amyzon, Plesiomyxocyprinus, and Vassnetzovia. Amyzon, with at least four species, was distributed widely in western North America. One species of Amyzon was also reported from Hunan, southern China. The monospecific Plesiomyxocyprinus was reported from Jilin, northeastern China. The Siberian Vassnetzovia, if valid, would be the third genus in East Asia. Adding to the known diversity, Jianghanichthys, a problematic cypriniform from Hubei, southern China, probably represents a new family of Cypriniformes. It had earlier been assigned to a modern genus of Cyprinidae, and later named as a new genus of uncertain family status. Later, we suggested it belonged to Catostomidae based on syn- taxonomic information. Some new specimens from the same locality, which clearly can be referred to Scymnocybus, are described in detail. Based on available specimens, Sinophecynus yumenensis only differs from Scymnocybus acidentatus by a larger size and a more pachy- osteod orbit region. The latter taxon is regarded as a junior synonym of the former. Phylo- genetic analysis shows that Sinophecynus is an anteosuran dinocephalian.

BIODIVERSITY OF MARINE REPTILES FROM THE MIDDLE TRIASSIC LUOPING BIOTA, YUNNAN, CHINA

LIU, Jun, The University of Hong Kong, Hong Kong, China

The pattern of diversification history of Mesozoic marine reptiles, apex predators of Mesozoic oceans, has received increasing attention recently. Fossil Lagerstätten that preserve nearly complete ecosystems provide us almost unbiased snapshots of the diversification history of life. Significant absence from current research of Mesozoic marine reptiles is the compilation of a database of biodiversity from intensively sampled fossil Lagerstätten and a quantitative comparison. Here I present a preliminary review of the diversity of marine reptiles from the Luoping biota and compare the ecological guilds of this Lagerstätte with other well studied Mesozoic marine communities. The Luoping biota is a recently discovered marine Lagerstätte from the Middle Triassic Guanling Formation in eastern Yunnan Province, China and has received intensive collection by the China Geological Survey. Detailed conodont analyses and SHIRMP zircon U-Pb age from interbedded tuff suggest a late Anisian age for this Lagerstätte. All of the main lineages of marine reptiles have already been recorded in the Luoping biota. Ichthyosaurs are exclusively mososaurids, which are the most abundant reptiles in this fauna. Three morphotypes have been recognized. These are Mososaurus cf. paxianensis, Phalerodon atavus, and another phylogenetically indeterminate taxon. Sau- ropterygians include one placodont and several pachypleurosaurids and nothosaurs. The only placodont is identified as Placodus sp. One of the pachypleurosaurids has been named as Dinopachysaurus dangi. The other is currently under study by colleagues from other institutions. Nothosaurs include Larissaurus sp., Nothosaurus sp. and Nothosaurus cf. gigante- ur. Protopterus comprise two morphotypes. One of them is identified as Dinopachysaurus orientalis. The other has much thinner cervical vertebrae and is tentatively identified as cf. Dinopachysaurus. Other reptiles include Sinoursoupsphargis yuanyiensis, one phylogeneti- cally undetermined thanatassocar, and several archosaur teeth. Six or seven ecological guilds, as defined by Judy Massare on tooth morphology and swimming ability, have already been present in Luoping biota based on my investigation. Comparison with other Mesozoic mar- ine faunas suggests that complex marine ecosystems have already been re-established at least by the end of Anisian.

NEW BAENID TURTLES FROM THE KAIPAROWITS FORMATION OF SOUTHERN UTAH: IMPLICATIONS FOR LARAMIDIAN BIOGEOGRAPHY

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New discoveries demonstrate that the late Campanian dinosaur assemblages of each basin in western North America (Laramidia) were distinct from each other. However, the paleo- biogeographic patterns of other vertebrate groups are less well known. We study examine members of the turtle clade Baenidae, one of the most abundant and diverse clades of fresh- water turtles during the Late Cretaceous, from the Upper Cretaceous Kaiparowits Formation of southern Utah. Previously reported taxa from the Kaiparowits Formation include Neuran- kylus, Boremys, Denzainenmys, and Plesiobauena. Neurankylus, one of the basal members of the clade, exhibits a cosmopolitan distribution, ranging from Alberta to Mexico. Boremys, a member of the derived baenid clade Baenodda, contains two species, one from northern Lar- amidia and the other from southern basins. Denzainenmys has only been recorded in southern Laramidia, from the Kaiparowits Formation, the San Juan Basin in New Mexico, and the Agua Basin of Texas. A fourth baenid from the Kaiparowits is highlighted by a newly discovered specimen that includes a nearly complete skull, shell, vertebral column, girdles, and limb elements. This new taxon is assignable to the subclade Baenodda based on a wedge-shaped skull, short frontals, and exposure of the suprappyal on the posterior carapace margin. Pre- liminary analysis indicates that this species is closely related to Plesiobauena antiqua from the Campanian of Alberta and Montana. However, some plesiomorphic characters – par- ticularly large nasals – suggest that it may be basal within the clade containing the northern Laramidian Plesiobauena and Palatoauena. The shell of this specimen is indistinguishable from other Kaiparowits specimens previously referred to Plesiobauena. This species is known only from the Kaiparowits Formation, and thus is distinct from related northern taxa. Indi- vidual taxa of the Kaiparowits baenid assemblage do not exhibit a uniform biogeographic distribution, but appear to support a division between northern and southern late Campanian biogeographic provinces of Laramidia.
patterns are influenced by the rock record more generally remains unquantified. Today, as in Agassiz’s time, perspectives on fish evolution are strongly influenced by the well-studied UK record, which yields a series of important faunas ranging from Silurian (Llandovery) to latest Eocene (Priabonian) in age. We assembled a database spanning this interval, comprising 1678 species occurrences from 100 localities spanning 70 geologic formations and representing 443 genus-level lineages encompassing a diverse taxonomic assemblage spanning “agnathans” to fin-bearing members of the tetrapod stem lineage.

Some patterns revealed by our UK survey match features in fish data derived from Sepkoski’s genus-level and Benton’s (Fossil Record 2) family-level global compendia, most strikingly an increase in taxonomic diversity approaching the Recent. Unlike those analyses, we sampled our data in-bin and excluded extant taxa, suggesting the observed rise is not attributable to a “Pull of the Recent”. Furthermore, we show that when accounting for potential sampling bias - through rarefaction, shareholder quorum subsampling or a modelling approach using either the number of fish-bearing formations or localities as a rock record proxy - this signal remains, with a prominent Paleogene peak.

Breaking out the two largest extant clades - Chondrichthytes and Ostechitthytes - shows that these groups have similar post-Devonian patterns, both to each other and to the cumulative “fish” curve. However, we do show the bony fishes make more statistically significant excursions from a model that assumes true diversity is constant and observed diversity is driven purely by sampling. Overall, although correlations between taxonomic diversity and our rock record proxies are significant, fish diversity appears to be less biased by sampling than many terrestrial vertebrate groups, such as dinosaurs.

Poster Session II (Thursday, November 3)

CROCOS NOT THEROPODS WERE LIKELY TOP PREDATORS ON THE CRETACEOUS DINOSAUR FREEWAY: IMPLICATIONS OF A LARGE TRACK CENSUS

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The track-rich, Cretaceous Dakota Group has yielded few vertebrate body fossils. However, more than 70 tracksets have been documented in Colorado, New Mexico, Kansas and Oklahoma, providing a census estimate of at least 1380 individual vertebrate track makers, for the region known as the Dinosaur Freeway, representing the coastal plain of the Cretaceous Western Interior Seaway. Orichnophod tracks (Currituchichnus of the eponymous Currituchichnites ichnocoenoses/ichnoassemblages dominate (at 71% of sites) but large theropod tracks are conspicuously absent, and small theropod tracks (Magnosauropus) of likely ornithomimid affinity represent predators too small to have preyed upon large ornithopods. However, crocodylian walking and swim tracks occur at ~28% of the localities and include representatives of large animals (~4 m long). The walking crocodylian trackway Melheimia was the first crocodylian track reported from the Cretaceous of North America, and the first, of presumed crown group affinity, given a formal ichnontaxonomic name, both in the early 1930s. The lost, historically-important holotype track was recently relocated in the University of Colorado Museum of Natural History collections. Crocodylian swim tracks (ichnogenus Hatcherichnus) are also abundant and represent the Hatcherichnus ichnoassemblage. This suggests that crocodylians were very likely the top ambush predators on the Dinosaur Freeway where cren-efused waterways interpenetrated the ornithopod foraging grounds in a coastal plain ecosystem bordering the Cretaceous Western Interior Seaway.

Symposium 3 (Thursday, November 3, 10:45 am)

CAMPANIAN THEROPOD EVOLUTION AND INTRACONTINENTAL ENDEMISM ON LARAMIDIA

LOEWEN, Mark, Utah Museum of Natural History, Salt Lake City, UT, USA; ZANNO, Lindsay, The Field Museum, Chicago, IL, USA; RMIS, Randall, Utah Museum of Natural History, Salt Lake City, UT, USA; SERTICH, Joseph, Denver Museum of Nature and Science, Denver, CO, USA; SAMPSION, Scott, Utah Museum of Natural History, Salt Lake City, UT, USA

Laramidia (western North America) was isolated from Asia and Appalachia from ~95-70 Ma. The Campanian vertebrate record of this island continent is richly diverse. Until recently, much of our understanding of this diversity came from the north. However, recent discoveries in the south, together with improved geochronologic control, suggest that many groups of vertebrates exhibited latitudinally arrayed, restricted geographic ranges during this time. A lack of any identifiable, persistent physiographic barrier to dispersal between northern and southern faunas on Laramidia has led to hypotheses invoking differences in climate and flora to explain the apparent endemicity in many groups of ornithischian dinosaurs, crocodylians, and turtles.

Theropod dinosaurs present a unique test of the endemicism hypothesis because the sensitivity of several subclades to climatic and floral changes was mitigated by a carnivorous diet. Much of our understanding of this diversity came from the north. However, recent discoveries in the south, together with improved geochronologic control, suggest that many groups of ornithischian dinosaurs, crocodylians, and mammals. All proboscidean body fossils from the Barstow Formation are late Barstovian (Ba2) in age. Early Barstovian (Ba1) records of Zygolophodon and Gomphotherium are reported from northwest North America (including central California and Oregon) and Mexico, areas that geographically bracket the Barstow Formation sites. Why proboscidean skeletal elements are not known from early Barstovian strata of the Barstow Formation after nearly a 100 years of prospecting is unclear, but it is likely not a factor of inadequate sampling.

Poster Session I (Wednesday, November 2)

A NEW SPECIES OF PARAPLACODUS (SAUROPTERYgia: PLACONDONITIDAE) FROM THE MIDDLE TRIASSIC OF SOUTHWESTERN CHINA

LONG, Cheng, Wuhan Institute of Geology and Mineral Resources, Wuhan, China; XIAOHONG, Chen, Wuhan Institute of Geology and Mineral Resources, Wuhan, China; JUN, Liu, Institute of Vertebrate Paleontology and Palaeoanthropology, Chinese Academy of Sciences, Beijing, China; XIONGWEI, Zeng, Wuhan Institute of Geology and Mineral Resources, Wuhan, China

Many placodont fossils have been collected from the Triassic of Guizhou and Yunnan provinces, southwestern China, but only one unarmored placodontid was reported. Recently, a placodontid specimen was collected from the Middle Triassic Anisan in Luoping County, Yunnan Province and was identified as a new species of Paraplagodus. It was the first record of Paraplagodus from outside the western Tethys. This specimen shared many synapomorphies with Paraplagodus broili: skull relatively high and narrow, each premaxilla carrying three elongated, slightly curved, strongly procumbent teeth, the retroarticular process being much smaller than in Zygolophodon, strongly procumbent; the anteriorsuperior and anteroposteriorly; and clavicle slender and strongly curved. It differs from Paraplagodus broili by slender dorsal rami, and each gastric rib composed of single curved element. In our phylogenetic analysis, Paraplagodus had a basal position within Placodontia.

Poster Session IV (Saturday, November 5)

NEW INSIGHTS INTO THE VERTEBRATE FAUNA FROM THE MIocene OF CALIFORNIA (GreeCE)

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In July 2010, we prospected in Chios Island for vertebrate remains, both in Mesozoic and Cenozoic strata. No vertebrates were found in the Mesozoic outcrops inspected. However, after intensive sampling of various levels in the ‘Michalos pit’ zone, we were able to uncover two layers with Miocene vertebrates. The ‘Michalos pit’ is a quarry situated SSE of Thymi- ana, about 8 km from Chios city. All of the vertebrate specimens known so far from the Miocene of Chios come from the exposure of the Kerameia Formation in or close to this quarry. The upper fossiliferous horizon yielded only a cranial fragment of a large indeterminate mammal. Nevertheless, the lower one, which presents a completely different lithology (clayey versus sandy), produced a diverse vertebrate fauna after screen-washing and sort-
ing. The assemblage is largely dominated by mammals. Rodents and, to a lesser extent, lagomorphs are best represented. Rodents are largely represented by cricids, in particular species probably belonging to the genera *Cricetodon*, *Megacricetodon*, and *Democricetodon*. Additional potential rodent taxa include a sciurid and a pedetid. Preliminary identification of the specimens of lagomorph suggests the presence of *Prolagus*. The insectivore record consists of *Galeric*-like teeth and an incomplete mandible. Remains of larger mammals were also found. They include a phalanx of an indeterminate ruminant, a possible tooth fragment of *Caenotherium* and another of *Sanitherium*.

This assemblage is consistent with a Middle Miocene age. The excavation site does not correspond to any of the localities previously sampled, though the fauna collected is reminiscent. The stratigraphy suggests that it is not coeval with any of the previously recognized horizons called ‘Thymiana A’, ‘Thymiana B’, and ‘Thymiana C’, all of which may be more recent.

**Technical Session XVII (Saturday, November 5, 3:00 pm)**

**DIVERGENT TOES: EVOLUTION OF AFRICAN ANTELOPE PROXIMAL PHALANGES AND IMPLICATIONS FOR DIVERGENCE OF SHAPE AND SIZE**

LOUVYS, Julien, Liverpool John Moores University, Liverpool, United Kingdom; MONTANARI, Shaena, AMNH, New York, NY, USA; PLUMMER, Thomas, CUNY & NYCEP, New York, NY, USA; HERTEL, Fritz, California State University, Northridge, CA, USA; BISHOP, Laura, Liverpool John Moores University, Liverpool, United Kingdom

Morphological convergence amongst species inhabiting similar environments but having different evolutionary histories is a concept central to evolutionary biology. Cases of divergent evolution, in which the morphological divergence of closely related species when these species begin to exploit different environments are less well studied. Here we show divergent evolution in the morphology of the proximal phalanges of several closely related species of African antelope inhabiting different environments. This pattern was consistently observed in both an unbiased morphospace and an ecologically weighted morphospace. Divergence, but not convergence, was also observed when size, independent of shape, was considered. Both convergence and divergence were observed when shape, independent of size, was considered. Convergent evolution of the morphology of the proximal phalanges was observed, but only in the ecologically weighted morphospace. Size shows less correlation with phylogeny (r=0.144, p=0.0124) than does shape (r=0.2975, p<0.0001). Therefore we suggest that divergence in size will occur more readily when a species encounters new environmental conditions than divergence in shape. These findings are compatible with Foster’s rule. We further suggest that once a species begins adapting to a different environment, morphological convergence with distantly related species inhabiting that environment would proceed firstly by shape changes, and subsequently by changes in size.

**Posters Session I (Thursday, November 3)**

**VERTEBRATE ICHNOLOGY OF THE EARLY TRIASSIC RED PEAK FORMATION (CHUGWATER GROUP), CENTRAL WYOMING**

LOVELACE, David, UW-Madison, Madison, WI, USA

The Early Triassic Red Peak Formation of the Chugwater Group has historically been considered to be nearly devoid of life. Recent field trips to outcrops in central Wyoming have yielded a new medium-high diversity vertebrate ichnossemblage (≥5 ichnogenera) that represents dinosauromorphs, archosaurs, lepidosaurs, and testudinates. The tracks are rare, and *Rhynchosauroides* tracks greatly outnumber all other taxa, with chirotheroid tracks representing the second most common clade. Rotoctylus and *Cheloniopus* tracks are rare, although *Cheloniopus* is well represented at one locality. Chirotheroid traces are the only taxa present in the uppermost sandstone, which is typically within 1-2 m of the overlying Alcove Limestone; these traces exhibit features consistent with a fully saturated substrate. Traces are preserved in convex hyporelief on the soles of very fine-grained sandstones interpreted to be crevasse splays and small-scale lenticular channel deposits, they are also preserved as concave epirelief on splay and bar tops. Interpretations of sedimentology suggest fluvial and floodplain deposits dominate the upper Red Peak Fm of central WY; the invertebrate and vertebrate ichnology support this interpretation. This is contrary to previous interpretations that considered the entirety of the Red Peak to represent marine and intertidal depositional environments. This ichnossemblage provides the first opportunity to observe vertebrate diversity and associated paleoenvironments in the Red Peak Fm.

**Posters Session III (Friday, November 4)**

**A NEW GOMBIPTERYGID BIRD FROM THE LATE CRETACEOUS CENTRAL CHINA AND ITS BIOGEOGRAPHIC IMPLICATIONS**

Li Junchang, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; Xu, Li, Henan Geological Museum, Zhengzhou, China; ZHANG, Xingliang, Henan Geological Museum, Zhengzhou, China; JIA, Songhui, Henan Geological Museum, Zhengzhou, China; CHANG, Huali, Henan Geological Museum, Zhengzhou, China

*Gobiapteryx minuta* was the first described enantiornithine bird from the Late Cretaceous of Asia. It was discovered from the Barun Goyot Formation in the Gobi Desert Mongolia. Herein reported is a new gobipterygid bird from the Late Cretaceous Qiupa Formation of Tantou Basin, Luanchuan County of Henan Province. The specimen is an almost complete skull and lower jaws with much of the postcrania skeleton preserved. The 60.6 mm long skull is three-dimensionally preserved. It is larger than specimens of *Gobiapteryx*. Important osteological characters include: nasals are long and narrow, fused anteriorly, but not fused posteriorly, occupying 47% of the skull length; the subtriangular nasal opening is typically smaller than the antorbital fenestra; length of the frontal equals its width; frontal shorter than nasals; vaulted parabasals are not fused, and are much shorter than the frontals; a distinct transverse nuchal crest is present on the parietal; distinct fossa present on the dorsolateral surface of the parietal; the quadrate is about 1/4 the length of the skull, similar to that of *Archaeopteryx* and *Gobiapteryx*. The proximal end of the quadrate is mobile but covered by the squamosal. The articulation with the lower jaw is as the level of the posterior margin of the orbit. In lateral view, the ventral margin of the dentary slopes ventrocaudally at an angle of roughly 35°. The long mandibular symphysis is well fused, but the suture is visible. The dentary bifurcates into dorsolateral and ventrolateral processes with the longitudinal groove (a lateral depression) in between, as in *Gobiapteryx*. The scapula is straight, with a well-developed acromion. The acromion is separated from the humeral articular facet by a thick neck. The deltopectoral crest of the humerus is large and flat, lacking any cranial curvature. The length ratio of the deltopectoral crest to humerus is about 0.4. The capitulum is distinct between the humeral head and the ventral tubercle. The ventral tubercle is well projected. The ulna is longer than the humerus. The radius is much more slender than the ulna.

**Posters Session II (Thursday, November 3)**

**THE TRACKMAKER OF THE LATE TRIASSIC TETRAPOD FOOTPRINT ICHNOSYSTEM BRACHYCHIROTHIERIUM WAS AN AEOSTAUR**

LUCAS, Spencer, New Mexico Museum of Natural History, Albuquerque, NM, USA; JIECKERT, Andrew, Appalachian State University, Boone, NC, USA; LOCKLEY, Martin, University of Colorado, Denver, Denver, CO, USA

*Brachychoirotherium* is a common ichnogenus of Late Triassic ichthofootsprints well known from western Europe, North America, Argentina and South Africa. Historically most workers have agreed that the trackmaker of *Brachychoirotherium* was derived crayotarsan archosaur, but the trackmaker has been identified as either a “rausuchian” or an aeosaur, though some workers attribute it to a primitive crocodylomorph (sphenosuchian). New knowledge of the osteology of the manus and pes of a large aeosaur, *Tytophoras coccinarum*, indicates a close correspondence between the manus and pes structure of aeosaurs and the morphology of *Brachychoirotherium*. Furthermore, functional analysis of complete skeletons indicates aeosaurs were capable of placing their feet in the narrow gauge, nearly over-stepped walk characteristic of *Brachychoirotherium*. *Brachychoirotherium* and aeosaurs have matched geographic and stratigraphic distributions in that both were Pangea-wide during the Late Triassic but restricted to Upper Triassic strata as well. The manus and pes morphology of rausuchians and early crocodylomorphs (sphenosuchians) deviate from *Brachychoirotherium* footprint morphology in key features, thus excluding their identification as trackmakers. Thus, morphological, functional morphological, geographic, and stratigraphic distributional data support identifying aeosaurs as the trackmaker of the footprints of the common Late Triassic ichnogenus *Brachychoirotherium*. Other suggested trackmakers—rausuchians and sphenosuchians—can be excluded because their manus and pes morphology, as well as their inferred gait, does not match that of *Brachychoirotherium*.

Preparers’ Session (Thursday, November 3, 9:30 am)

**BEST PRACTICES IN CLEANING, DRYING, AND STABILIZATION WET PLEISTOCENE MEGAFUNA MATERIAL FROM SNOWMOUNTAINS, COLORADO**

LOUCKING, Carol, Denver Museum of Nature and Science, Denver, CO, USA; FINLAXSON, Heather, Denver Museum of Nature and Science, Denver, CO, USA; SMALL, Bryan, Denver Museum of Nature and Science, Denver, CO, USA; MCFLARLANE, Megan, Denver Museum of Nature and Science, Denver, CO, USA; FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA

In 2010, the Denver Museum of Nature and Science collected ca. 600 Pleistocene bones from Ziegler Reservoir in Snowmass Village, Colorado. The first fossils were discovered by construction workers enlarging the reservoir. Working with a combination of heavy equipment and manual excavation techniques, museum staff and volunteers recovered the remains of multiple Columbian mammoths, American mastodons, giant bison, deer, and a Jefferson’s ground sloth. Bones, teeth, and tusks were extremely well preserved with much of the original organic material intact and no permineralization.

Freshly excavated bones were sediment-covered and saturated with water, presenting conservators and preparators with challenges in cleaning, drying and stabilizing specimens. Minimally invasive techniques (e.g., only water or ethanol as cleaning agents) were used to permit subsequent sampling for testing of DNA, histology, isotopes, and other aspects of composition. Different protocols were developed for bones, teeth, and tusks, but most involved retardation of drying by enclosing specimens in plastic bags, plastic containers, or plastic tents. With careful monitoring, specimens dried slowly enough to reduce warping and cracking but had enough air circulation to prevent mold growth. Minimizing moisture gradi-
ents was critical for maintaining integrity as specimens equilibrated to Denver’s low ambient humidity. To minimize differential drying of bones in plaster field jackets, small holes were cut in the bottom of the jackets.

Stabilizing the task material is vital to preserving the record of the lives of proboscideans. Age, sex, and season of death can be determined by studying the growth layers and composition of tusks. Zip ties were used to help prevent warping and expansion of cracks during the drying process, and in some cases, to close cracks. Once specimens were dry, methyl methacrylate was used as a consolidant and adhesive. For heavier items, epoxy was the preferred adhesive. Ultimately, almost every specimen required unique consideration to determine the best practices for its care and conservation.

Poster Session III (Friday, November 4)

CRANIAL REMAINS OF CHEIROGASTER (TESTUDINIDAE: TESTUDINIDAE) FROM THE LATE MIOCENE OF ECOPARC DE CAN MATA (VALLEYS-PENEDÈS BASIN, NE IBERIAN PENINSULA): TAXONOMIC AND PHYLOGENETIC IMPLICATIONS
LÜJAN, Ángel, Institut Català de Paleontologia, UAB, Barcelona, Spain; ALBA, David, Institut Català de Paleontologia, UAB, Barcelona, Spain; DELLFINO, Massimo, Dipartimento di Scienze della Terra, Università di Torino, Torino, Italy; FORTUNY, Josep, Institut Català de Paleontologia, UAB, Barcelona, Spain; CARMONA, Raül, FOSSILIA Serveis Paleontològics i Geològics, S.L., Sant Celoni, Spain

Cheirogaster includes medium to large-sized extinct terrestrial tortoises from Europe. Here we report two skulls from the Vallesian (Miñ, Late Miocene) of Ecopearc de Can Mata (ECCM; els Hestetals de Pierola, Catalonia, Spain), attributed to Cheirogaster richardi, whose cranial anatomy was previously unknown. This taxon was considered a subjective junior synonym of Cheirogaster boliviari on the basis of a previous neotype designation for C. richardi. Such designation, although justified because the holotype of C. richardi had been destroyed, must be considered invalid because it was based on material from a different basin—even though remains from the area of the original type locality were available. A new neotype designation based on material from the same area (though the destroyed holotype) would be desirable in the future, in order to provide an emended diagnosis of C. richardi (incorporating cranial features), and further clarifying its taxonomic status as a distinct species from C. boliviari.

In order to infer the phylogenetic relationships of Cheirogaster, we incorporated the cranial features revealed by the two ECM skulls, together with previously-published data on other Miocene Cheirogaster species, into a pre-existing matrix of cranial characters for extant testudinid genera. A cladistic analysis based on maximum parsimony yielded two most-par-simonious trees that support a sister-taxon relationship between testudinid genera. A cladistic analysis based on bootstrap analysis, with the Centrocelys-Cheirogaster clade being defined by several synapomorphies. Our results therefore contrast with those of a previous cladistic analysis, based on molecular and morphologic data (different matrix), indicating a much more basal position of Cheirogaster amongst testudinids. Furthermore, the nesting of Cheirogaster within a clade otherwise composed by African, Madagascar and Indo-oceanic taxa suggests that, from a paleobiogeographic viewpoint, Cheirogaster might be of Asian origin, although a taxonomic revision of Paleogene Cheirogaster from Europe would be required to test this hypothesis.

Technical Session XV (Saturday, November 5, 10:30 am)

NEGATIVE ALLOMETRY IN ONTOGENY AND EVOLUTION OF MAMMALIAN MIDDLE EAR IN MESOZOIC MAMMALS
Luo, Zhe-Xi, Carnegie Museum of Natural History, Pittsburgh, PA, USA

The definitive mammalian middle ear (DMME) is defined by the disconnection of the middle ear from the mandible, and also characterized by the smaller size of the ear, relative to the skull, than those of premammalian synapsids, especially cynodonts. In living therians and monotremes, the ectotympanic and the malleus of the middle ear, which are connected to the mandible in embryos and fetuses, become separated from the mandible in adults. This is accompanied by prominent negative allometry of the middle ear bones that are relatively large in early ontogeny, but precipitously decrease in size in late ontogeny, relative to the growth of cranium and mandible. This negative allometry is crucial for the normal development of the middle ear. Newly discovered Mesozoic mammals show homoplasmatic evolution of the middle ear of eutyrannodont and spalacotheriid mammals that are nested in crown Mammalia. The ear bones of eutyrannodonts are massive, large relative to the skull, and connected to the mandible via an equally massive Meckel’s element, suggesting that the negative al-lometry required for full development of the middle ear in living mammals did not occur in eutyrannodonts. The absence of negative allometry in eutyrannodonts is attributable to develop-mental paedomorphosis. Alternatively, the middle ear bones are so much smaller relative to the skull size in monotremes and extant therians that their ontogenies can be hypothesized as to show a much greater degree (or peramorphosis) in allometry, relative to the ancestral mammalianform condition, and to eutyrannodonts. Allometry is a fundamental pattern of changes in timing and rate during development, which is now known to be patterned by genes and signaling pathways in embryogenesis. The homoplasmatic evolution of the middle ear in the early history of mammals is profoundly influenced by labile development.

Poster Session II (Thursday, November 3)

IN THE TREES OR ON THE GROUND?: READDRESSING THE LCOMOTOR CLASSIFICATION OF EXTINCT AND EXTANT MUSTELODUS USING PRINCIPLE COMPONENTS ANALYSIS
Lynch, Eric, East Tennessee State University, Johnson City, TN, USA; Wallace, Steven, East Tennessee State University, Johnson City, TN, USA

Previous work indicates the reliability of principle components and discriminant function analyses to infer the behavior of extinct animals. Such analyses use skeletal morphology, quantified by size-independent variables, to statistically differentiate between locomotor groups (e.g., arboreal, aquatic). By entering a fossil species as an unknown, its morphologi-cal similarity to extant species with known, observable behaviors can be determined. While this method has been employed with apparent success using datasets at higher taxonomic levels (e.g., multiple orders within Mammalia), these studies are inherently dependent on the accuracy of the locomotor assignment for each species. To date, this has been dictated by the morphology of the hind limbs, tree branches, or species-specific features that escape predators. However, if focused on the lower taxonomic group, Musteloida, in which the majority of species are capable of some degree of arboreal, terrestrial, fossorial, and aquatic locomotion, specific locomotor assignment becomes dangerously arbitrary. We ad-dress this problem in the context of the Mi-Oligocene alurine (red pandas), Pristinailurus bristolii, from the Gray Fossil Site, Washington County, Tennessee, USA. Despite its close phylogenetic affinity to the extant, highly arboreal red panda, Ailurus fulgens, the skeletal morphology of P. bristolii bears some similarity to the scansional raccoon, Procyon lotor. Thus, its exact locomotor behavior and associated feeding ecology remain poorly understood. We use multivariate statistics to address the locomotor behavior of P. bristolii using angular measurements and linear ratios that characterize the shape of the major fore- and hindlimb bones. Rather than basing locomotor assignment on earlier literature, we use principle components analysis to classify each species. Thus, our locomotor groups are defined entirely by forelimb-hindlimb skeletal shape similarity. Ultimately, we infer the locomotion of the extinct red panda and its implications on feeding ecology and present a reduced set of variables that can statistically differentiate between locomotor groups within the Musteloida.

Poster Session IV (Friday, November 4)

DINOSAUR EXTINCTION: CLOSING THE "THREE METER GAP"
LYSON, Tyler, Yale University, New Haven, CT, USA; Bercovici, Antoine, China University of Geosciences, Wuhan, China; Chester, Stephen, Yale University, New Haven, CT, USA; Sargis, Eric, Yale University, New Haven, CT, USA; Pearson, Dean, Pioneer Trails Regional Museum, Bowman, ND, USA

The debate surrounding the extinction of non-avian dinosaurs ignited by publication of the Cretaceous-Tertiary (K-T) meteorite impact theory has seen 30 years of dispute over the position of the stratigraphically highest in situ dinosaur. A zone roughly three meters below the K-T boundary devoid of dinosaur fossils, coined the “three meter gap,” has helped drive controversy regarding the extinction of dinosaurs. Here we report the discovery of the stratigraphically youngest in situ dinosaur specimen: a centosaurus horn found in a poorly rooted, silty mudstone floodplain deposit located no more than 13 centimeters below the palynologically defined boundary. The K-T event is identified using three criteria: 1) the point of a major decrease in Cretaceous palynomorphs without subsequent recovery, 2) the existence of a “fern spike” event also present in several K-T boundary sections worldwide, and 3) correlation to a nearby stratigraphic section where primary extrarrestrial impact materials are present (e.g. iridium, shocked spherules, shocked quartz, etc.). The in situ specimen demonstrates that the gap devoid of non-avian dinosaur fossils does not exist and is inconsistent with the hypothesis that non-avian dinosaurs were extinct prior to the K-T boundary meteorite impact event.

Poster Session IV (Saturday, November 5)

A NEW PARAREPTILE FROM THE LOWER PERMIAN RICHARDS SPUR FORMATION, NEW HAVEN, CONNECTICUT
MacDougall, Mark, University of Toronto, Mississauga, ON, Canada; Reisz, Robert, University of Toronto, Mississauga, ON, Canada

The fissure fill deposits at the Richards Spur locality (popularly known as Fort Sill) of Oklahoma are unique in that they have yielded one of the most diverse and well preserved Paleozoic tetrapod faunas in the world. This rich fauna of over 30 Early Permian amniotes includes several parareptile species, which is unusual for a Permian locality. Previously described parareptiles from the locality include Bolosaurus grandis, Delorhynchus priscus, Colobomycerott phololter, and Microterolycus mckinzieorum. We describe here a new parareptile recovered from Richards Spur. The specimen consists of a small, exquisitely preserved skull (total skull length ca. 25mm), which preserves almost all cranial elements. This new parareptile is characterized by its small triangular shaped skull, large postorbitals, but small squamosals. The specimen also possesses very large teeth on the anterior end of its maxillarla. The two anterior-most teeth appear to be at least twice as large as any of the succeeding teeth. The teeth are recurved with a single cusp, indicating that this tiny parareptile was likely a predator. A phylogenetic analysis of 31 taxa and 136 characters was conducted to investigate the relationships of the new parareptile within Parareptilia. A heuristic search produced 55 optimal trees, and the strict consensus of these trees has a topology in which the new Richards Spur parareptile was found to cluster...
It is widely accepted among Quaternary paleontologists that there were two distinct species of mammoth in North America during the Late Pleistocene: *Mammuthus primigenius*, or the woolly mammoth, and *M. columbi*, the Columbian mammoth. These species are normally envisioned as having (1) distinctive morphologies, especially in regard to taxon-specific features of the molars; (2) different apparent precursors (*M. trogontherii*, *M. americanus*, respectively); (3) different habitats and distributions; and (4) non- or only slightly-overlapping instantaneous ranges, with *M. primigenius* being adapted to colder conditions than *M. columbi*. The obvious expectation from these considerations is that these elephants would also have been distinct genetically. To evaluate this hypothesis, as part of our ongoing studies of mammoth evolution, we sequenced the complete mitochondrial genomes of both a Columbian mammoth and a North American woolly mammoth, and compared them to each other and to several previously published genomes of Eurasian woolly mammoths. Surprisingly, the *M. columbi* mitogenome we obtained falls unequivocally within a previously-characterized subclade of endemic North American *M. primigenius*. The conclusion that these two nominal species interbred at some point in their evolutionary histories seems inescapable. One potential explanation is that woolly mammoth haplotypes entered Columbian mammoth populations via introgression along subglacial ecotones, a scenario involving parallel introgression of ancient elephants and consistent with certain other indications (such as the morph “*M. jeffersonii*”, sometimes regarded as an actual hybrid between *columbi* and *primigenius*). Globally, these and other recently published results demonstrate that next-generation sequencing technologies hold much promise for utilizing specimens from contexts (non-cold zone, non-cave) previously regarded as marginal for aDNA investigations, as well as for rigorously testing phylogenetic hypotheses at heretofore unachievable levels of genomic resolution.
rotator in theropods, but is a lateral rotator and extensor in birds and Lesothosaurus, because of pubic retroversion. Despite the convergent hip morphology of Lesothosaurus and birds, muscle moments were rather different, with Lesothosaurus exhibiting the condition probably present in basal dinosaurs. Computational modelling of 3D moment arms quantifies muscle leverage, allowing comparisons between muscles and across taxa, and provides a framework for understanding locomotion in extinct animals.

Poster Session I (Wednesday, November 2)

NEW THEROPOD MATERIAL FROM THE CRETACEOUS (CENOMANIAN) WOODBINE FORMATION OF NORTH CENTRAL TEXAS: PALEOBIOGEOGRAPHIC AND PALEOECOLOGICAL IMPLICATIONS

MAIN, Derek, University of Texas, Arlington, TX, USA; NOTO, Christopher, University of Wisconsin, Kenosha, WI, USA; SCOTESE, Christopher, PaleoMap Project, Arlington, TX, USA

Vertebrate fossil material from the mid-Cretaceous is rare. When available, it provides a critical glimpse of a transitional period that resulted in major faunal changes in many areas. The timing and nature of these faunal changes is poorly understood, but have important biogeographic and evolutionary implications. In north Texas there is a unique, urban fossil locality called the Arlington Archosaur Site (AAS), which preserves a diverse coastal delta plain ecosystem. The AAS lies within the Lewisville Member of the Woodbine Formation, dating to the Cenomanian (95 Mya). Until now, theropod material from the Woodbine was rare. Here we describe the first significant theropod material from the AAS, consisting of teeth, limb fragments, a pedal ungual, and manual ungual. The material suggests a relatively diverse theropod community of large, medium, and small taxa. This new material helps demonstrate the transitional nature of Cenomanian terrestrial ecosystems, which shows a mixture of Early and Late Cretaceous groups (basal tetanurans and dromaeosaurs, respectively). The theropod community represented at the AAS therefore shows important biogeographic connections with earlier Gondwanan faunas and suggests that large basal tetanurans continued to play an important ecological role through the mid-Cretaceous.

Paleogeographic and paleoclimatic models demonstrate a semi-arid climate belt extending from Texas to Morocco and Niger during the Cenomanian, linking the ecosystems of these regions within a single climate envelope. It appears that during the Cretaceous large basal tetanurans had an ecological and climatic preference for semi-arid equatorial biomes, which may also help explain their persistence through this time of transition. Equally of interest, this new material implies that Early Cretaceous dinosaur faunas could have dispersed across the Berensian land bridge and established an Appalachian presence sooner than previously thought. Further research of the fauna of the AAS is expected to shed more light upon the ecology and biogeography of Cenomanian dinoosaur communities.

Technical Session X (Friday, November 4, 9:45 am)

SEMI-ARTICULATED FOOT OF EOCENE NOTHARCTUS: NEW EVIDENCE FOR A GROOMING CLAW IN AN ADAPIFORM PRIMATE FROM NORTH AMERICA

MALOINE, Stephanie, Stony Brook University, Stony Brook, NY, USA; BOYER, Doug, Brooklyn College City University of New York, New York, NY, USA; LEMELIN, Pierre, University of Alberta, Edmonton, AB, Canada; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; GROENKE, Joseph, Stony Brook University, Stony Brook, NY, USA

Extant strepsirrhines and the non-anthropoid haplorhine, natural history and biogeography of Cenomanian dinosaur communities.

We compared the distributions of the megaherbivorous dinosaurs to those of several palaeoenvironmental proxies explained megaherbivorous dinosaur turnover better than a simple palaeoenvironmental change, we subjected the data to a canonical correspondence analysis. In order to test whether the turnover of the DPF megaherbivorous dinosaurs corresponds to palaeoenvironmental proxies, we subjected the data to a canonical correspondence analysis. We compared the distributions of the megaherbivorous dinosaurs to those of several palaeoenvironmental proxies, including palynomorphs, mollusks, pedotypes, and lithotypes. Megaherbivorous dinosaur turnover most closely mirrored that of the palynomorphs, followed sequentially by lithotypes, mollusks, and pedotypes. However, none of these palaeoenvironmental proxies explained megaherbivorous dinosaur turnover better than a simple time proxy. This suggests that the evolution of the DPF megaherbivorous dinosaurs was not strongly linked to environmental change.

Symposium 4 (Friday, November 4, 11:00 am)

A TEMPERATE PALEODIVERSITY PEAK IN MESOZOIC DINOSAURS AND EVIDENCE FOR LATE CRETACEOUS GEOGRAPHICAL PARTITIONING

MANNION, Philip, University College London, London, United Kingdom; BENSON, Roger, University of Cambridge, Cambridge, United Kingdom; UPCHURCH, Paul, University College London, London, United Kingdom; BUTLER, Richard, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; CARRANO, Matthew, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

Modern biodiversity peaks in the tropics and declines poleward, a pattern that is potentially driven by climate. Although this latitudinal biodiversity gradient (LBG) also characterises the marine invertebrate fossil record, distributions of ancient terrestrial faunas are poorly understood. Using a comprehensive dinosaur dataset (738 genera and over 3000 occurrence records, including birds), standardised for the uneven spatiotemporal sampling of the fossil record, we demonstrate that the dominant group of Mesozoic terrestrial vertebrates did not

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conform to the modern LBG. Instead, dinosaur diversity was highest at temperate paleo-latitude through the 160 million year span of dinosaurian evolutionary history, and may have been driven by the amount of available land area among latitudinal belts. Thus, the ubiquity of the paleotemperature peak indicates that there is no evidence that fluctuations in climate exerted a strong influence on diversity, or that the dinosaurs were most diverse at any point in their evolutionary history: the earliest known representatives of most clades are from temperate paleolatitudes. Late Cretaceous sauropods and ornithischians exhibit disparate LBGs, providing clear evidence of geographical partitioning among major clades of herbivorous dinosaurs. This partitioning may result from the advanced stages of continent fragmentation and/or differing responses to increasing latitudinal climatic zonation. The apparent conformity of post-Eocene birds to the "standard" LBG contrasts dramatically with Mesozoic dinosaurs. Our results suggest that the modern day LBG on land was only established 30 million years ago, following a significant post-Eocene recalibration, potentially related to a reduction in extratropical speculation rates as a consequence of increased seasonality across the Eocene/Oligocene boundary.

Technical Session X (Friday, November 4, 8:30 am)

EVIDENCE FOR SCANOSORIALITY IN THE FORELIMB OF NORTH AMERICAN PALEOCENE INSECTIVORES (MAMMALIA, EULIPOTYPHA)

MANZ, Carly, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA

Eulipothyphl is a monophyletic clade of insectivorous mammals (shrews, moles, hedgehogs, scleodonts) that generally exhibit terrestrial or fossorial behaviors, but little is known about positional behaviors of early eulipthyphids. While their teeth are known back to the early Paleocene, postcranial are only rarely found. Here we describe the forelimbs of two taxa with considerable forelimb mobility inherited from a boreoeutherian ancestor. The elbow joint appears to have been habitually flexed, based on the shallow olecranon and deep radial fossa on the distal humerus, and on the short, cranially curving olecranon process of the ulna. Considerable supination was possible at the elbow joint between the nearly spherical fossae on the distal humerus, and on the short, cranially curving olecranon process of the ulna. These characteristics of the forelimb indicate arboreal capabilities and suggest that early members of Soricomorpha and Erinaceomorpha were scansorial, unlike the terrestrial Macroscelididae, Erinaceus, erinaceomorphs for which whole skeletons are known. The distal humeri have a rounded head,低位的ans (and muscle attachment) sites for rotors of the shoulder that suggest considerable mobility at the glenohumeral joint. The elbow joint appears to have been habitually flexed, based on the shallow olecranon and deep fossa on the distal humerus, and on the short, cranially curving olecranon process of the ulna. Considerable supination was possible at the elbow joint between the nearly spherical humeral capitulum, the deeply concave, rounded central fossa of the proximal radius, and the ulna. This mobility is suggested by the trapezoidal shape of the first supraglenoid. Within this clade, a supraglenoid with straight edges and proximal participation in the central fossa of the proximal radius is autapomorphic for the genus. A large central fossa with hyo and hypoplastron polygonal medial margins (i.e., segments with well-defined angles, rather than being gently curved), reduced contact between xiphiplastron and reduced size of the two last neural plates is shared between T. hugi and the Oker specimen. DFMMF/FV 296 differs from this species due to the presence of plastral projections. The different shape of the plastron (no polygonal-like margins or hyo- and hypoplastron projections) suggests that T. moeris might be reclassified into a different genus. Therefore, we can assign this specimen to Thalassemy sp.

Poster Session II (Thursday, November 3)

ONTOGENIC CHANGES IN THE SKULL ELEMENTS OF THE LATE JURASSIC DWARF SAUROPOD EUROPASAURUS HOLGERI

MARPMANN, Jean Sebastian, Steinmann Institute for Geology, Mineralogy, and Paleontology, Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany; SANDER, P., Martin, Steinmann Institute for Geology, Mineralogy, and Paleontology, Division of Paleontology, Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany; BERTOLucci, C., Martina, Steinmann Institute for Geology, Mineralogy, and Paleontology, Division of Paleontology, Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany; MARQUARDT, Clor, University of Cambridge, Cambridge, United Kingdom

Sauropods are very rare in the fossil record. No extensive ontogenetic growth series exists for sauropod skulls, and consequently, the morphological changes in ontogeny are not well understood. This study explores such changes in the most complete collection of disarticulated skull bones of a single sauropod taxon, the dwarf basal macronarian Europasaurus holgeri from the Kimmeridgian of northern Germany. The skull material includes different individuals of various ontogenetic stages. Because size alone is not a good indicator to determine ontogenetic stage, we used size-independent characters to stage the bone elements. Since the original description of Europasaurus, new skull material has been found and allows the creation of an updated reconstruction of an adult individual. The updated reconstruction features smaller external nares and a larger orbit as compared to the original reconstruction. Important ontogenetic changes are the decreasing ventral exposure of the jugal, which is extensive in the juvenile, and the increasing supraorbital arch, which is present in the adult. The skull of Europasaurus represents the transition of pleiomorphic characters seen in Macrobaeothosauria (e.g. Plateosaurus and Stagonolepis) to sauropod dinosaurs (e.g. Saltasaurus). Apart from three partial braincases, isolated skull bones have been found. The pattern, the lack of fusion of the skull bones, is regarded as another example of the unique features that characterize Sauropoda.
proliferation of singular apomorphies or unique character-combinations used to define new taxa, which raises the possibility that these new taxa will become obsolete following the discovery of more complete material. As a result, our understanding of ‘apomorphic’ and ‘plesiomorphic’ character-states has been blurred and confused.

A clearer understanding of the ranges and styles of anatomical variation within populations of diagnosable Operational Taxonomic Units (OTUs) is becoming increasingly important, because it will inform the selection of features that are likely to be taxonomically informative. To explore this general concern, a comprehensive review of non-hadrosaurid ankylopoxelian material, collected from Europe and the United States, has been examined at first hand. Particular emphasis has been placed upon localities that have yielded multiple specimens. Results demonstrate that many anatomical features are far more malleable: between taxa and within populations, than previously supposed. Variation between morphs within populations may also be a source of confusion. Although certain anatomical characters may be used to define ‘grades’ of iguanodontians, their usefulness can be altered dramatically by the discovery of new ‘intermediate’ taxa; this results from attempting to code evolutionarily continuous features as discrete characters for the purposes of defining OTUs and promotes variability to taxonomic status. It also appears to be the case that particular anatomical characters, such as the structure of teeth, have continued to be used because they maintain historical associations or reflect an (unstated) expression of anthropogenic preference for specific areas of the skeleton, particularly with regards to cranial material.

Technical Session VIII (Thursday, November 3, 2:45 pm)

THE EARLY HISTORY OF TETRAPODS IN THE SOUTHERN HEMISPHERE: THE SPATIAL AND TEMPORAL DISTRIBUTION OF PALEOZOIC BASAL TETRAPODS IN WESTERN GONDWANA

MARSICANO, Claudia, Universidad de Buenos Aires, Buenos Aires, Argentina; ABDALA, Fernando, University of the Witwatersrand, Johannesburg, South Africa; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa; RUBIDGE, Bruce, University of the Witwatersrand, Johannesburg, South Africa

The history of early tetrapod diversification in Gondwanaland has remained elusive, particularly in the southern part of the supercontinent. The earliest record of non-amniotes include Pennsylvanian temnospondyl footprints from northern Chile followed by a gap of more than 40 My that separates it from the diversified Middle Pennsylvanian faunas known from both southern Africa and South America. The only exception is the Early Pennsylvanian temnospondyl remains reported from western Namibia (Gai-as Formation). Recent work in the area evidenced they are fairly abundant in nearly the whole succession and just above the Mesosaurus bearing levels. They represent the only evidence of non-amniotes in Western Gondwana during the early-middle Permian and the earliest body-fossil remains of the group. Comparatively, the Gondwanan early amniote record is better represented. The oldest record of amniotes in Gondwana are the mesosaurids, a group of endemic aquatic parareptiles known only from Artinskian (Early Permian) levels of Namibia, South Africa, Uruguay, and Brazil. It was not until the Guadalupian (Middle Permian) that more diverse amniote faunas comprising only synapsids are represented in southern Africa and Brazil. Nevertheless, several tetrapod footprints and trackways from Permian levels of western Argentina have recently been re-evaluated and the list of known tetrapods has been increased. Some of the most important of these are: (1) the occurrence of these tetrapods in a paleosol, indicating how the bones affected tracemaker behavior. The paleoenvironmental history of the site indicates the burrows were likely made long after the sauropod was buried, when pedogenesis was occurring over the previous water hole. The tracemakers then tunneled into the underlying strata containing the sauropod. The occurrence of these burrows in a paleosol, as well as their complex geometry, point toward mammals as the most likely tracemakers, as opposed to other similarly sized vertebrates or large decapods. These burrows confirm the notation at least some Mammaliaformes used a burrowing lifestyle. Furthermore, the estimated mass of the tracemaker would make this the largest mammal known from the Morison Formation thus far, suggesting a remaining undiscovered mammalian diversity.

Technical Session XIX (Saturday, November 5, 2:45 pm)

INTERPRETING THE FOSSIL RECORD OF MYSTICETI (CETACEA) USING NEW METHODOLOGIES IN DIVERGENCE DATING

MARTIN, Anthony, Emory University, Atlanta, GA, USA; NOTO, Christopher, University of Wisconsin-Parkside, Kenosha, WI, USA; CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA, USA

Despite a relatively diverse mammalian fauna in the Morrison Formation, little of their paleobiology is understood. A fossorial lifestyle has been suggested for many Morrison mammal taxa, but examples of preserved burrows are exceedingly rare. Here we describe a large and extensive burrow system in association with a camarasaurs sauropod skeleton, discovered during field operations by the Natural History Museum of Los Angeles County in the summer of 2010. The locality is near Bluff, Utah in the lower Morrison Formation, most likely the Salt Wash Member. The primary bone bed contains most of a single disarticulated skeleton in a fine-grained, gray-green mudstone. This sediment layer tapers laterally and is surrounded by motiled red mudstone, suggesting it was once a water body. The bone bed layer is covered by a motiled red mudstone and capped by a meter or more of well-cemented channel sandstone. The largest burrows are 8-10 cm in diameter, but extend to 12-15 cm wide at burrow junctions. Burrow allometry, which in many burrowing animals correlates with body mass, indicates relatively large tracemakers (400-500 g). Burrows are filled with a very fine sandy mud and cemented with chert. Some internal sedimentary structure is visible, possibly the result of active back-filling. Several branching burrow systems have been found throughout the quarry and include main tunnels, side tunnels, and variously size branches. Some of the smallest burrows had tunnels that were wide enough for sauropod bones, indicating how the bones affected tracemaker behavior. The paleoenvironmental history of the site indicates the burrows were likely made long after the sauropod was buried, when pedogenesis was occurring over the previous water hole. The tracemakers then tunneled into the underlying strata containing the sauropod. The occurrence of these burrows in a paleosol, as well as their complex geometry, point toward mammals as the most likely tracemakers, as opposed to other similarly sized vertebrates or large decapods. These burrows confirm the notation at least some Mammaliaformes used a burrowing lifestyle. Furthermore, the estimated mass of the tracemaker would make this the largest mammal known from the Morison Formation thus far, suggesting a remaining undiscovered mammalian diversity.
of fossil calibrations. The phylogenetic position of Caperea and Eschrichtius were different between the two analyses and this alone could be the reason for different dates, as phylo-
genetic position has a well-recognized influence on divergence dating.

Technical Session XV (Saturday, November 5, 11:00 am)
MIDDLE JURASSIC MAMMALS FROM THE ITAT FORMATION AT BEREZOVSK QUARRY IN WESTERN SIBERIA (RUSSIA)

MARTIN, Thomas, Universitat Bonn, Bonn, Germany; AVERIANOV, Alexander, Russian Academy of Sciences, St. Petersburg, Russia; LOPATIN, Alexey, Russian Academy of Sciences, Moscow, Russia

The Berezovsk coal mine in the Nazarovsk Basin in southern Krasnoyarsk territory of west-
ern Siberia has yielded the first Middle Jurassic (Bathonian) mammals of Russia. Limnic
clays and marls of the Itat Formation have produced teeth and mandibular fragments of the eleutherodontid haramiyid Sineleutherus isxodonicus, diverse docodonts (Isotodon tatarinovi, Simpnonodon sibiricus, and Heterotherium yaxngii), an amphisteid-grade eutrechodon-
tan, as well as the cladorhampitheriid Amphibetitalus kramolatziék. Amphibetitalus is an unidentifed amphideriid from the Balabanasi Formation of Kyrgyzstan represent the first records of Amphideriidae outside Britain.

Recent discoveries comprise an edentulous dentary of a haramiyid (probably Sineleutherus), the distal part of a docodont humerus, ’PM5 and P4 of a new multituberculate, and an edent-

luous mandible and lower molars of a basal dryolestid. The eleutherodontid dentary holds two

antei for each single-rooted incisors of which the anterior is oriented almost horizontally and the posterior at an angle of about 45°. After a wide diastema follow six alveoli which possibly belong to a single-rooted premolariform (pre-)molariforms; behind the sixth alveolus the jaw is broken. As is evident from µCT study, the alveoli are connected by a large mandibular canal, that labially opens into two mental foramina.

The lower dryolestid molars represent, besides the specimens from Kirtlington in Britain, the geologically oldest evidence for that group and prove that Dryolestidae were present in the middle Jurassic of Asia. Sistergroup Paurodontidae recently has been reported from the late Middle Jurassic (Callovian) of Kyrgyzstan. Whereas Dryolestidae and Paurodontidae were very successful in Western Europe and North America in the Late Jurassic and Early Cretaceous, they have not been found after the Middle Jurassic in Asia so far.

Currently, the Berezovsk mammal assemblage is similar in diversity to that from the Bal-

banasi Formation in Kyrgyzstan, but has a much greater potential for further discoveries. It will play a major role for the understanding of Jurassic mammalian evolution in Asia.

Poster Session I (Wednesday, November 2)
A NEW HALECOMORPH FISH FROM THE EARLY CRETACEOUS WETLAND OF LAS HOYAS

MARTIN-ABAD, Hugo, Universidad Autónoma de Madrid, Madrid, Spain; POYATO-

ARIZA, Francisco, Universidad Autónoma de Madrid, Madrid, Spain

At least three different taxa can be recognized among the some 250 specimens preliminarily

assessed to the Ambiformes (Actinopterygii, Halecomorpha) from the continental beds of Las Hoyas (upper Barremian, Cuenca, Spain). One of them, only four specimens so far, lacks

ossified autocentra in the axial skeleton, unlike the others. On the basis of meristic characters (i.e., number of fin rays, number of ribs and haemal spines) these four specimens probably

belong to a single taxon. Ambiformes are divided into Amiidae and Caturidae. The absence of ossified autotranca is a typical feature of caturoids. However, these four specimens do not

show any diagnostic character of Caturoidae (i.e., presence of paired, block-like neural arch ossifications; or four or more ossified neural arches) or Caturoidae (e.g., haemal

spines broadly spallate in the transverse plane; 22 or more pairs of branchiostegal rays).

Incomplete specimens from Las Hoyas were reported as Catusus sp. as they present amioid scales and unossified vertebral autocentra. These four complete, articulated specimens have,

incomplete specimens from Las Hoyas were reported as Catusus sp. as they present amioid

scales and unossified vertebral autocentra. These specimens do not present diagnostic characters of the Ambiformes (absence of episomatic and pterotic bones); yet, they seem to show the other

diagnostic character of amioid fishes, two or less ossified neural arches. Therefore, with the present evidence, the new genus can be considered as Halecomorphi B indet.

Oreopithicus bambolii is a Late Miocene hominoid with an extensive fossil record in the Baccinello Basin (Tuscany, Italy), and was the only European hominoid to survive a major

extinction event ca. 9.6 Ma ago. Oreopithicus lived in the insular Tusco-Sardinian paleo-

bio-province, where it evolved many unique anatomical specializations that make it important for

understanding the mechanisms and history of Late Miocene hominoid evolution. The eventual extinction of Oreopithicus and its associated fauna has generally been attributed to interaction with species that arrived from continental Europe following tectonic collision of the Tusco-Sardinian province with mainland Italy, but palynological, palaeontological, and sedimentological records indicate an environmental shift toward more arid and variable climates across the extinction event.

To explore the possibility of environmental change as a contributing factor in the extinction of Oreopithicus, we developed a stable carbon isotope (δ13C) record from organic matter and authogenic carbonate in paleosols from the Baccinello Basin. These data show very low temporal and spatial variability (indicating plant ecosystem stability through time and space) and a broadly significant change during the late Middle Miocene spanning the extinction event, at least as recorded by δ13C values. These results are consistent with the importance of species interaction as an underlying cause for the extinction of Oreopa-

thisus and its associated fauna. The carbon isotope values fall entirely within the range of isotopic variability for modern plants following the C3 photosynthetic pathway (trees, shrubs, cool-season grasses), indicating that C4 vegetation (warm-season grasses) was not an important component of biomass. When corrected for temporal variation in the carbon isotopic composition of atmospheric carbon dioxide, the paleosol carbon isotope values are consistent with predicted values based on modern plants and the Baccinello palynoflora, confirming the reliability of paleosol isotopic records as paleoecological proxies.

Preparers’ Session (Thursday, November 3, 8:30 am)
CLOSE-RANGE PHOTOGRAMMETRY OF PARTIAL RE-EXCAVATION OF THE KITONJO MAMMILL HILOMIN FOOTPRINTS, IN NORTHWEST TANZANIA

MATTHEWS, Neffra, Bureau of Land Management, National Operations Center, Denver, CO, USA; NOBLE, Tommy, Bureau of Land Management, National Operations Center, Denver, CO, USA; MUSIBA, Charles, University of Colorado Denver, Denver, CO, USA; WASHA, Jackson, National Museum of Tanzania, Dar es Salaam, Tanzania; BREITHAUP, Brent, Bureau of Land Management, WYSO, Cheyenne, WY, USA

In 1978 members of Mary Leakey’s team working near Olduvai Gorge, Tanzania, discov-

ered fossil hominin footprints in a 3.6 million year old volcanic tuff layer. These

footprints provide the earliest known evidence of an upright stance in our human ancestors marking a significant milestone in the vertebrate fossil record. At the time of the discovery, a trail containing approximately 40 steps was excavated and documented by Leakey’s team, who reburied the excavation to protect the footprints. In 1995, prompted by concerns of veg-

ation overgrowing the site, members of the Getty Conservation group removed the vegeta-

tion, re-exposed, conserved, and documented the previously excavated surface, and re-buried it using a multilayer strategy. In February of 2011, an international team of scientists under

the request of the Ministry of Natural Resources and Tourism in Tanzania re-excavated a 3.5

meter long section of the trackway to evaluate and document the condition of the footprints.

This project provided an opportunity to conduct new, close-range photogrammetric documentation of the footprints, as well as a first generation cast residing in the National Museum of Tan-

zania and House of Culture in Dar es Salaam. Stereoscopic imaging was conducted using a remotely triggered digital SLR camera mounted on a monopod to obtain overhead images of the re-exavation stages culminating with the footprints having been average for approximately 25 minutes per layer and was of minimal impact to the excavation process.

Multi-stage imagery was placed in a common coordinate space and used to generate 3D point clouds, surfaces, and associated “aerial” orthophotographs. These data sets allow for a virtual re-excavation, as over 13 layers of materials can be digitally removed to expose the final footprint surface. Close-range photogrammetry provided an excellent method for
documenting field subjects in remote regions of East Africa, as well as museum specimens in display situations. Rapidly developing innovations and reduction in costs of software make this technique available to a much larger spectrum of users and vital to proper documentation and conservation efforts.

Technical Session XVII (Saturday, November 5, 4:00 pm)

**INCLUSION OF FOSSIL SPECIES RANGE DATA IN DISPERAL-EXTINCTION-CLADOGENESIS (DEC) ANALYSES CORRECTS LOW ESTIMATES OF EXTINCTION RATE AND IMPROVES ESTIMATES OF HISTORICAL BIOGEOGRAPHY**

MATZEK, Nicholas, University of California, Berkeley, Berkeley, CA, USA; MAGUIRE, Kaitlin, University of California, Berkeley, Berkeley, CA, USA

A new phylogenetic method of inference in historical biogeography, dispersal-extinction-cladogenesis (DEC), currently implemented in Lagrange, is being employed to be investigating effects of taxon extent. This maximum-likelihood method reconstructs the ancestral range of lineages and estimates rates of dispersal and extinction along time-scaled branches. However, the method was primarily designed for molecular-derived ultrametric trees in which all taxa are extant, and it typically underestimates extinction rate and can overestimate vicariance and ancestral range size. Here we test the utility of DEC in analyses that include fossils. Specifically, we use databases such as MIMOP to include the geographic range of fossil mammals in the DEC analysis, through a modification of DEC that adds each fossil species extant in each North American Land Mammal Age onto the phylogeny with a short branch. Furthermore, following preliminary studies which showed that DEC does not treat branch endings as extinctions, we modified DEC to recognize branch tips as extinction events. We find that the inclusion of fossils in a DEC analysis improves the biogeographic reconstruction through more realistic estimates of extinction rate, and more precise estimates of biogeographic history. These analyses were conducted on a variety of clades with available high-resolution phylogenies of fossil and extant species. These included an extinct clade of equids, extinct and extant clades of canids, and a clade of marmots including extinct and extant species.

Symposium 1 (Wednesday, November 2, 10:30 am)

**INTRASPECIFIC VARIATION IN THE LIMB STRUCTURE OF THE LOWER JURASSIC ICHTHYOSAUR *STENOPTERYGIS***

MAXWELL, Erin, Staatliches Museum für Naturkunde, Stuttgart, Germany

*Stenopterygis*, a derived ichthyosaur from the Early Jurassic of Germany, had highly modified limbs, an adaptation for a secondarily aquatic way of life. These modifications included morphological changes such as hyperphalangy and reduced proximodistal differentiation of elements. In addition to these changes, high levels of variability have been reported in the limbs of *Stenopterygis*, including variation in phalangeal counts, digital bifurcation, interdigital ossicles and fusion of phalanges. The objective of this study was to examine the roles of proximal-distal differentiation and hyperphalangy on intraspecific variation. The paddle variants present in a single species, *S. quadriscissus*, were catalogued based on 65 articulated specimens, and these data were compared to a sample of congers (*S. tristes* and *S. uniter* in) order to assess whether patterns were conserved at the generic level. Data from the Triassic ichthyosaur *Missoraurus* was used to evaluate conservation of variants over longer time scales. *Missoraurus* differs from *Stenopterygis* in retaining a higher degree of proximal-distal differentiation of elements, but is also characterized by hyperphalangy. Across all ichthyosauran taxa surveyed, intraspecific differences in phalangeal count were observed. The digits with the highest phalangeal counts were most likely to vary between the right and left sides of an individual, but the longest functional digits were least variable within a species, implying a degree of functional constraint on digit length. The longest digits also suggest that loss of proximal-distal differentiation, not hyperphalangy, provided increased opportunities for the generation of morphological diversity in ichthyosaur paddles.

**TORTOISES AS TEMPERATURE PROXIES: A PHYLOGENETIC REAPPRAISAL**

MCCORD, Robert, Arizona Museum of Natural History, Mesa, AZ, USA

The use of tortoises as indicators of minimum temperature proxies has a long tradition in vertebrate paleontology notably since work published in the late 1950s and early 1960s. Generations of paleoecologists have cited these works in analysis of temperate faunas with tortoise remains. Subsequent work has clarified and quantified the relationship of tortoises to temperature. There has been an increased understanding of the limiting factors of reptiles in general and tortoises in particular. Cold month mean temperature (CMM) has become recognized as the aspect of temperature that tortoises best reflect, although likely not the true limiting factor. Size and the ability to burrow have been recognized as modifying the limiting conditions in tortoises.

More recently there have been many attempts at the phylogenetic reconstruction of physiological ancestral traits. These methods infer probable ancestral states using means or maximum likelihood methods from known values for extant taxa. This method is here applied to tortoises. Oxygen isotope ratios of biogenetic phosphate can, in some select cases, give CMM data as well. These are here employed as additional data on extinct taxa in a phylogenetic framework. Phylogenetically inferred CMM minima for extinct tortoises give us a more realistic appraisal of these tortoises as temperature proxies. Tortoises may have some utility as temperature proxies, but are not as sensitive or reliable as other taxa, like crocodilians. The North American tortoises appear to represent a more temperate clade than extant giant tortoises.

Poster Session IV (Saturday, November 5)

**A SUBADULT SPECIMEN OF RUBEOSAURUS OVATUS (DINOSAURIA: CERATOPSIDAE) AND ITS IMPLICATIONS FOR CENTROSAURINE PHYLOGENY**

MCDONALD, Andrew, University of Pennsylvania, Philadelphia, PA, USA

The Upper Two Medicine Formation (middle Campanian) of northwestern Montana boasts an excellent record of centrosaurine ceratopsids. Four taxa have been named: *Brachyceratops tonomansis*, *Rubeosaurus ovatus*, *Einosaurus procurvicornis*, and *Achelousaurus horneri*. *Rubeosaurus* has been historically the most sparsely known and least understood of those taxa, although the recent referral of a second skull elucidated important aspects of its anatomy. A third specimen, USNM 14765, may now be referred to *Rubeosaurus ovatus* based upon features shared with the holotype of that taxon.

USNM 14765 is the partial skull and postcranium of a subadult centrosaurine from the Upper Two Medicine. It was discovered by an expedition of the National Museum of Natural History and described as an adult individual of *Brachyceratops*. However, the holotype and other specimens from the type quarry of *Brachyceratops* are juvenile individuals and do not bear any features by which to diagnose the taxon. *Brachyceratops* is thus a nomen dubium. Furthermore, USNM 14765 does not share any characters exclusively with specimens of *Brachyceratops*. A revised interpretation of the parietal processes of USNM 14765 suggests that it possesses a nascent P5 spike in addition to incipient P4 and P3 spikes. P5 spikes are otherwise known only in *Styracosaurus albertensis* from the Dinosaur Park Formation of Alberta and in *Rubeosaurus ovatus*. USNM 14765 differs from *Styracosaurus* by its lack of at P1 process, but agrees with the holotype of *Rubeosaurus* in this character. USNM 14765 may therefore be referred to *Rubeosaurus ovatus* as the third known specimen and first recognized subadult of the species. USNM 14765 provides additional anatomical information on *Rubeosaurus ovatus*, allowing the taxon to be coded for more characters in a phylogenetic analysis. The analysis places *Rubeosaurus ovatus* as the sister taxon to a clade composed of *Einosaurus procurvicornis*, *Achelousaurus horneri*, *Pachyrhinosaurus lakustai*, and *Pachyrhinosaurus canadensis*.
The hadrosaurine MCGARRITY, Christopher, University of Toronto, Toronto, ON, Canada

WITH IMPLICATIONS FOR HADROSAURID DIVERSITY AND EVOLUTION

cannot be verified or rejected as the taxa lack comparable material. Until such compari
tetanuran. The previously proposed synonymy of
series. Other potential apomorphies sensitive to positional interpretation and homologies,
but it is unknown whether this characterizes all or only part of the cervical
skeletal series. Anterior articular facet; (2) interzygapophyseal laminae absent on cervicals and anteriormost
theropods known from comparable material include: (1) prominent median tuberosity on the
interjugal laminae extend from the anterior margin of the neural spine to the posterior edge of the supraneural;
ventrally open trench continuous with the posterior margin of the neural spine and the pos-
posterior margin of the last cervical vertebra. The position of the foramen magnum is an important characteristic of hadrosaurid


CRANIAL MORPHOLOGY AND VARIATION IN PROSAUROLOPHUS MAXIMUS WITH IMPLICATIONS FOR HADROSaurID DIVERSITY AND EVOLUTION

MCGARRY, Christopher, University of Toronto, Toronto, ON, Canada

The hadrosaurine Prosaurolophus maximus is known from numerous articulated specimens
in Late Campanian deposits of the Dinosaur Park Formation of southern Alberta. Therefore,
it is an ideal taxon to reconstruct patterns of growth and variation in hadrosaurids, and
improve our understanding of their evolutionary relationships. Though well represented in the
fossil record, P. maximus has been poorly documented. This study describes the cranial anatomy in P. maximus, quantitatively examines its range of variation, and provides the first ontogenetic series for this taxon, with implications for dinosaur diversity and evolution.

Prosaurolophus maximus is characterized by a solid nasal crest located above the rostrodr-
sal margin of the orbit that is excavated laterally by the circumnasal depression. Regression analyses indicate that growth of the crest is positively allometric, consistent with hypotheses of a sexually selected structure. A second species, P. blackfeetensis from the Two Medicine Formation of Montana, was named based on morphological differences in the nasal crest; however, morphometric results in this study fail to quantitatively differentiate P. blackfeetensis from P. maximus.

A species-level phylogenetic analysis of hadrosaurids, the first to include both species of
Prosaurolophus, recovers a single most parsimonious tree with P. maximus and P. blackfeet-
tensis as sister taxa. The analysis supports a monophyletic relationship between Saurolophus and Prosaurolophus with an Edmontosaurus-Kerberosaurus clade as their sister taxon.

Inclusion of Hadrosaurus into the current data matrix supports a monophyletic Hadrosauri-
neae. Based on both the morphometric and phylogenetic data, this study supports the previous hypothesis that P. blackfeetensis is a junior synonym of P. maximus thereby increasing its
temporal range to 1.6 Ma, and suggests a long period of morphological stasis in this taxon.

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Poster Session I (Wednesday, November 2)

REDIAGNOSIS AND PHYLOGENETIC RELATIONSHIPS OF SIGILMASSASAURUS, A PROBLEMATIC THEROPOD FROM THE MID-
CRETACEOUS OF MOROCCO

MCFEETERS, Bradley, Carleton University, Ottawa, ON, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; SCHRODER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada; HINIC-FLOG, Sanja, Carleton University, Ottawa, ON, Canada

The holotype of the problematic mid-Cretaceous Moroccan theropod Sigilmassasaurus brevicollis is an isolated posterior cervical vertebra. Originally described as a highly aberr-
nerous theropod representing a previously unknown lineage (Sigilmassasauridae), subsequent studies have been unable to clarify its systematic position or have questioned its validity as a unique taxon. Unambiguously referred material is restricted to cervical and anteriormost dor-
sal vertebrae sharing apomorphies with the holotype. Of the five characters originally used to
diagnose the taxon, only one, intercentral articulations much wider than high, exceeding
length of centrum in width, is confirmed to be present and unique to Sigilmassasaurus.

Additional new characters that diagnose and differentiate Sigilmassasaurus from all other theropods known from comparable material include: (1) prominent median tuberosity on the anterior articular facet; (2) interzygapophyseal laminae absent on cervicals and anteriormost dorsals, such that the anterior margin of the neural spine contacts the anterodorsal margin of the neural canal; and (3) the spinopostzygapophyseal fossa takes the form of a posteriorly-oriented, ventrally open trench continuous with the posterior margin of the neural spine and the pos-
terodorsal margin of the neural canal. The absence of epipophyses may also be diagnostic of Sigilmassasaurus, but it is unknown whether this characterizes all or only part of the cervical series. Other potential apomorphies sensitive to positional interpretation and homologies of the material include the first appearance of true centrodiapophyseal laminae close to the
cervico-dorsal transition, and the appearance of the largest hypapophyses in the posterior cervicals. A phylogenetic analysis supports previous hypotheses that Sigilmassasaurus is a
tetanuran. The previously proposed synonymy of Sigilmassasaurus and Carcharodontosau-
rus cannot be verified or rejected as the taxa lack comparable material. Until such compari-
sions can be made Sigilmassasaurus is provisionally retained as a valid taxon.
Poster Session I (Wednesday, November 2)

ASSESSING RATE AND SCALE IN TEMNOSPONDYL EVOLUTION

MCHUGH, Julia, University of Iowa, Iowa City, IA, USA

Rate and magnitude of speciations and extinctions can only be properly addressed in a phylogenetic context with respect to either community background levels or within a clade of interest. Here, stage-level rates of speciation and extinction are calculated for the extinct amphibian clade Temnospondyli, spanning the Early Carboniferous (Bashkirian) to the Late Triassic (Norian). Rates are based on specimen occurrence data and minimum divergence of ghost lineages derived from a large-scale species-level phylogenetic analysis, which is based upon a matrix of 87 taxa and 328 morphological characters. Results show two discrete periods of elevated levels of lineage extinctions per million-years: 1) Wuchiapingian-Ladinian, peaking in the Induan; and 2) a bimodal event with peaks in the Sakmarian and Kungurian. Origination levels of lineages per million-years show five discrete events: 1) Changhsingian-Anisian, peaking in the Induan; 2) Gzhelian-Sakmarian, peaking in the Asselian; 3) Serpukhovian, Kasimovian, peaking in the Bashkirian; 4) Serpukhovian, peaking in the Capitanian; and 5) Carnian. When ghost lineage data are removed from estimations of lineage origination only events 1, 2, and 5 remain, illustrating the importance of utilizing ghost lineages derived from phylogeny in the estimation of speciation levels. The largest individual origination and extinction events are concurrent with the Permian-Triassic boundary. The speciation peak at the beginning of the Induan greatly exceeds the extinction event at the end of the stage, indicating that despite a dramatic increase in extinction levels, the speciation initiated in the late Changhsingian began a large amphibian radiation that continued through the Permian-Triassic boundary and into the Triassic.

Technical Session XII (Friday, November 4, 3:30 pm)

THE LIANG BUA AVIFAUNA: FAUNAL COMPOSITION, DIVERSITY, AND EXTINCTION

MEIJER, Hammee, Smithsonian Institution National Museum of Natural History, Washington, DC, USA; JAMES, Helen, Smithsonian Institution National Museum of Natural History, Washington, DC, USA; SUTIKNA, Thomas, The National Research and Development Centre for Archaeology, Jakarta, Indonesia; DUE, Rhuko, The National Research and Development Centre for Archaeology, Jakarta, Indonesia; TOCHERI, Matthew, Smithsonian Institution National Museum of Natural History, Washington, DC, USA

Liang Bua, a cave on the Indonesian island of Flores, preserves a rich fossil sequence spanning the past 95,000 years. Recent excavations have recovered a faunal assemblage that comprises well-preserved mammal, bird, reptile, fish and mollusc remains. Bird fossils are abundant throughout the Liang Bua stratigraphic sequence, providing important new insights into the evolutionary and ecological history of a Wallacean bird community. Here, we present the results of the first study of a large sample of avian bone and bone fragments (N = 577) retrieved from the excavation of 9.5 m of sediments from Sector XI, a 2 m by 2 m square along the east wall of the cave. We identified 242 non-passerine bird bones to genus, and where possible, species level. These represent at least 29 taxa in 14 families. Twenty-four taxa were recorded in the Pleistocene sediments, and nine in those of the Holocene. Four taxa are present in both time periods. The Pleistocene assemblage represents a diverse avifauna including several birds of prey (Accipitridae), kingfishers (Halcyonidae), snapping turtles (Chelydridae), and a large barn owl Tyto sp. are thought to have gone extinct at the end of the Pleistocene. The Holocene documents the arrival of Imperial pigeons Ducula sp., Gurney's Eagle Aquila gurneyi and Junglefowl Gallus sp. However, species diversity is significantly lower in the Holocene sediments, and together with the probable loss of at least four Pleistocene species, this is interpreted as evidence for an avifaunal turnover toward the end of the Pleistocene. The observed changes in avifaunal composition and species diversity may reflect climatic change at the end of the Pleistocene, possibly amplified by the arrival of modern humans in the Holocene.
Poster Session I (Wednesday, November 2)

A DIPNOAN PTERYGOID FROM BERGISCH GLADBACH, GERMANY
MELLBIN, Barbro, Uppsala University, Uppsala, Sweden

The Late Devonian Bergisch Gladbach locality in western Germany has yielded numerous fossil lungfish over the years, including Rhinodipnurus, Grippognathus, and Diperus. Lungfishes are very important to our understanding of Devonian vertebrate evolution, but despite a rich fossil record key parts of their early history are still poorly understood. It is therefore important to try to resolve outstanding issues in Devonian lungfish morphology, phylogeny, ecology and evolution. The locality is no longer accessible, but still provides unique specimens such as an unusually large dipnoan pterygoid that was discovered in the collections of the Swedish Museum of Natural History. Initially, this fossil was interpreted to be a dipnoan pterygoid, as it seems to share several characteristics with Dipnorhynchus, including having dentine-plated pterygoids. However, upon closer inspection, this particular pterygoid may represent a new lungfish taxon. Like Dipnorhynchus this pterygoid has no clearly defined teeth, but it does present three distinct oval elevations along its lateral edge and two elevations along the medial side. The anterior medial elevation is similar in size to the lateral elevations whereas the posterior one is significantly larger, round, and placed slightly posterior to the centre of the specimen. None of these features are characteristic for a Dipnorhynchus pterygoid. There appears to be no fusion between the left and right pterygoid, which also differentiates this specimen from Dipnorhynchus where the entire palate is fused. The anteromedial edge would have been in contact with the corresponding surface of the left pterygoid and a long, narrow parapharynx would have been present between the pterygoids. Its unusual size and features, completely unlike that of other Bergisch Gladbach lungfishes, may provide important data from both a phylogenetic and ecological perspective.

ACROCANTHOSAURUS ATOKENIS (DINOSAURIA: THEROPODA) FROM THE CLOVERLY FORMATION OF WYOMING: IMPLICATIONS FOR EARLY CRETACEOUS NORTH AMERICAN ECOSYSTEMS
MELSTROM, Keegan, University of Michigan, Ann Arbor, MI, USA; DEMIC, Michael, University of Michigan, Ann Arbor, MI, USA

We present the first remains of the allosauroid theropod Acrocanthosaurus atokensis from the Albion Cloverly Formation of Wyoming. This partial skeleton contains a skull andappendicular material and is referable to Acrocanthosaurus based on the presence of a pointed femoral head in proximal view. The absence of neurocentral fusion and bone histology of the femur indicate that the specimen is a juvenile. We use the circumferences of femoral lines perpendicular material and is referable to Acrocanthosaurus would have reached adult body mass (ca. 6,000 kg) within 20-30 years. Gigantism in Acrocanthosaurus evolved via acceleration of basal allosauroid growth rates, similar to the situation in some other clades of giant theropods (e.g., Tyrannosauridae). All large-bodied theropod remains from the Early Cretaceous of North America are consistent with identification as Acrocanthosaurus atokensis, but most are too fragmentary to confidently assign to the taxon. Like some other Early Cretaceous North American dinosaur genera, Acrocanthosaurus' geographic range spanned over 1500 km of paleolatitude. In North America, end- Early Cretaceous ecosystems were more similar to those of the end-Late Cretaceous than previously thought; both featured a single very large-bodied, fast growing, geographically widespread theropod dinosaur.

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PALEOECOLOGY OF TWO PLIOCENE VERTEBRATE FOSSIL ASSEMBLAGES IN WESTERN NORTH AMERICA: THE PANACA FAUNA OF LINCOLN COUNTY, NEVADA AND THE HAGERMAN FAUNA OF TWIN FALLS COUNTY, IDAHO
MEYERS, Vicki, University of Nevada Las Vegas, Las Vegas, NV, USA; ROWLAND, Stephen, University of Nevada Las Vegas, Las Vegas, NV, USA

To characterize the responses of terrestrial vertebrates to Plio-Pleistocene climate change in western North America, it is important to establish baseline characteristics of terrestrial communities and ecosystems early in this interval. To that end, we have conducted a comparative study of two Pliocene (Blancan Land Mammal Age) faunal assemblages—one from the Panaca Formation of Lincoln County, Nevada, and other from the fossil-rich beds of the Glenns Ferry Formation exposed near Hagerman, Idaho. Both the Panaca and Hagerman ecosystems represent mid-latitude, inland basins that were dominated by fluvial, floodplain, and lacustrine habitats in a seasonal climate with wet and dry periods. The Panaca vertebrate faunal assemblage contains forty-three genera in twenty-five families. This diverse fauna reflects a mixture of habitats, including lacustrine, marsh-woodland, riparian, upland, and steppe. Especially revealing is the Panaca avifauna, which includes Cygnus, Anas, and Rallus. More xerophilic inhabitants include Basaricas, Repomys, Prodipodomys and Lepidos. Lagomorphs are especially abundant and diverse. The Panaca fauna includes at least two early Blancan immigrant taxa from Asia: the vole Mimosmys panaceanus and the caprine Sinocapra wildowensis. The Hagerman fauna, with ninety-one vertebrate genera in thirty-five families, has a much greater diversity than the Panaca fauna. We attribute the greater diversity of the Hagerman fauna primarily to the fact that the Hagerman basin was much larger than the Panaca basin, and it was also connected by riparian corridors to other stream systems and to the Pacific Ocean. The Panaca Basin, by contrast, was a much smaller, internally drained basin with an ephemeral pluvial lake. Also, the Hagerman fauna has been studied more intensively than has the Panaca fauna, so it is more completely known. We compared trophic level diversity values within these two faunas to that of the modern Amboseli Basin of East Africa. Relative to the other two faunas, the Panaca fauna seems to be slightly over-rich in small mammal taxa and depauperate in carnivore taxa, however it is too early to determine the significance of these values.

EFFECTS OF VARIABLE MAGNIFICATION AND IMAGING RESOLUTION ON PALEODIETARY INTERPRETATIONS DERIVED FROM DENTAL MICROWEAR ANALYSIS
MILBACHLER, Matthew, New York College of Osteopathic Medicine, Old Westbury, NY, USA; BEATTY, Brian, New York College of Osteopathic Medicine, Old Westbury, NY, USA

Light microscope dental microwear analysis (LMDMA) has been increasingly utilized for paleodiet studies. LMDMA involves viewing dental surfaces, either through the objective lenses of a microscope, or on micrographs taken through a microscope. Published LMDMA studies report a highly varied range of magnifications (30x-100x). The magnifications used in most LMDMA studies appear to have been arbitrarily chosen and no studies have been undertaken to examine the effects of differential resolution. To test the effects of resolution, the two authors independently examined 30 randomly ordered digital micrographs (taken when viewed at 100x magnification through the microscope), consisting of equal numbers of dental wear surfaces from a browser (moose), a grazer (zebra) and hard object feeder (pecary). Both observers labeled microwear features in predefined 400μm x 400μm areas with an initial image resolution of 1.33 pixels/μm. The images were reanalyzed with decreasing resolutions: 80%, 40%, 20%, 10%, and 5% of initial resolution. Significant interobserver differences were found at all resolutions; however, correlation coefficients were consistently very high, indicating that both observers recovered similar data at all resolutions, albeit with differing degrees of feature recognition. Both observers recognized significantly fewer features as resolution decreased, but similar proportional differences in the numbers of pits and scratches between the browser and grazer were always recovered. However, at the lowest resolutions (5% and 10%) each observer positioned the hard object feeder very differently with respect to the browser and grazer, suggesting that different dietary categories or particulate surface textures may be more sensitive to resolution variation. Paleodietary predictions based on LMDMA seemed insensitive to resolution, as long as a resolution is consistent and equivalent to 20% (0.27 pixels/μm) or higher. Because LMDMA at this lower resolution is rapid, researchers may be able to conduct larger microwear studies than current methods allow, potentially involving thousands of specimens used to analyze paleodiet trends through long intervals of time.

EFFECTS OF GEOGRAPHIC AREA AND SAMPLE SIZE ON TAPHONOMIC OVERPRINTING
MILDECO, Lauren, Penn State University Department of Geosciences, University Park, PA, USA; GRAHAM, Russell, Penn State University Department of Geosciences, University Park, PA, USA; FALK, Carl, PaleoCultural Research Group, Fairfield, PA, USA; SEMKEN, JR., Holmes, University of Iowa, Dept. Geoscience, Iowa City, IA, USA

We analyzed late Holocene (4-0 Ka) paleoecologically and archaeologically-derived mammal samples along a multistate geographic transect for environmental signals. Previous work suggests that both natural and, in the case of archaeological sites, human-induced (cultural filter) taphonomic factors had a substantial influence on the faunal compositions of sites within an area of an individual state. Based on these taphonomic factors included food gathering strategies that depend on culture, season, and resource availability, site types (cave-deposited versus floodplain open areas) and site accessibility (e.g., size of cave opening). Finally, excavation and screening procedures, including screen size, may alter the assemblage. Therefore, in order to analyze this sample for an environmental signal, sites of like taphonomic pathways had to be compared, which was difficult because of the limited sample size. Thus, in order to assess the effects of sample size and geographic area on taphonomic overprinting, we performed Nonmetric Multidimensional Scaling (NMDS) analyses of sites within individual states (North Dakota, South Dakota, Iowa and Illinois, USA) which today lie along a strong environmental gradient, the prairie-forest ecotone. In addition, a subsequent NMDS analysis for a sample that included all sites along the transect was performed. NMDS analysis of the sites from each state revealed no specific pattern or gradient, even when such a gradient was known to exist. However, the known ecological gradient does emerge through NMDS analysis of the full dataset and we conclude that the taphonomic bias may be overcome. The signal that can be extracted is a product of the relative strengths of the environmental gradient versus taphonomic factors. With a large enough dataset and extensive geographic area, the true underlying structure (an ecological gradient here) will shine through in ordinations of even taphonomically diverse datasets.
NEW ANTHROCATHERES (ARTIODACTYLA) FROM WADI MOGHRA, EGYPT, AND THEIR BEARING ON HIPPOPOTAMUS PHYLOGENY
MILLER, Ellen, Wright State University, Dayton, OH, USA; MILLER, Wade, Brigham Young University, Provo, UT, USA; DELGADO DE JESUS, Rene, Secretaria de Educacion y Cultura, Saltillo, Mexico; GOMEZ NUNEZ, Rosario, Secretaria de Educacion y Cultura, Saltillo, Mexico; VALLEJO GONZALEZ, Jose, Secretaria de Educacion y Cultura, Saltillo, Mexico; LOPEZ ESPINOSA, Jose, Secretaria de Educacion y Cultura, Saltillo, Mexico

Exceptionally sparse information has been published on Pleistocene vertebrates from the northern Mexican state of Coahuila. This is despite the fact that Coahuila ranks as the third largest Mexican state, has numerous intermontane basins with Pleistocene sediments, and lies adjacent to Texas with its abundant Pleistocene fossil sites. In most instances Pleistocene beds of Coahuila lie unconformably on fossiliferous late Cretaceous strata.

The newly reported fossil site here was discovered in October, 2006. It was named Hedionda del Lobo (HDL), and lies about 34 km west of the capital city of Saltillo. The highly dissected floodplain deposits at this locality trend east-west, and vary in width between 2 and 4 km. The exposed sediment depth is roughly 5 m. Sediments, consisting mostly of poorly consolidated muds and fine-grained sands, do include lenses of coarser sands and gravels. Fossils have been collected throughout a 300 m stretch within this intermontane basin. Vertebrate fossils thus far recovered are mainly disarticulated, but show minimal erosional wear.

Fossils identified from HDL include several taxa not previously reported from Coahuila. These are: cf. Rana, cf.Chrysemys, Serpentes indet., cf. Spheno suchus, cf. Chrysemys, Neotoma cf. albigula, Cynomys cf. mexicanus, Canis cf. lupus, Tapirus cf. haysii, and Bison antiquus. Also included in this local fauna are Pappogeomys cf. castanos, Mammut americanum, Mammut columbi, Equus cf. eocerus, cf. Camelops, and Capromeryx cf. Mexicana. Horse and mammoth fossils represent the most abundant animals present. The faunal mix at HDL indicates primarily grassland conditions coupled with nearby moist woodlands. This differs significantly from the current Chihuahuan Desert habitat.

A NEW LATE PLEISTOCENE VERTEBRATE SITE FROM COAHUILA, MEXICO
MILLER, Wade, Brigham Young University, Provo, UT, USA; DELGADO DE JESUS, Rene, Secretaria de Educacion y Cultura, Saltillo, Mexico; GOMEZ NUNEZ, Rosario, Secretaria de Educacion y Cultura, Saltillo, Mexico; VALLEJO GONZALEZ, Jose, Secretaria de Educacion y Cultura, Saltillo, Mexico; LOPEZ ESPINOSA, Jose, Secretaria de Educacion y Cultura, Saltillo, Mexico

Poster Session III (Friday, November 4)
REVISION OF TECHNICAL SESSION VII (Thursday, November 3, 3:15 pm)

FROM THE EARLY EOCENE OF THE IBERIAN PENINSULA

BY MARIÁNGEL MINVER-BARAKAT, Rafael, Institut Català de Paleontologia, Cerdanyola Del Vallès, Barcelona, Spain; MARIÓG, Judit, Institut Català De Paleontologia, Cerdanyola Del Vallès, Barcelona, Spain; BADIOLA, Ainara, Universidad Del País Vasco, Bilbao, Spain; MOYÁ-SOLÁ, Salvador, Icrea, Institut Català De Paleontologia, Cerdanyola Del Vallès, Barcelona, Spain

Ommomys are one of the earliest groups of Primates, which were abundant and diverse in the Northern Hemisphere during the Eocene with some genera lasting into the Oligocene. Their main scientific interest focuses on their unresolved phylogenetic relationships with other members of the order, particularly anthropoids. The family Ommomycidae is currently divided into three subfamilies, the Ommomyinae, Aproptomorphinae, and Microchoerininae, this latter known exclusively from Europe. Fossil remains of microchoerines are scarce, so the knowledge of this group is still far from being complete. New fossil findings of primates from the Eocene of the Iberian Peninsula have contributed to increase the fossil record of microchoerines across Europe, allowing a better understanding of their biodiversity. Some of them are already published, such as the species Pseudoloris pyrenacus from the Middle Eocene (Robiácin, MP14-15) of Sant Jaume de Frontanyà (Ripollès-Bergadà Basin, southern Pyrenees), whereas others are still not described. This is the case of another new species of Pseudoloris found in the Middle Eocene (late Robiácin, MP15-16) site of Mazaterón (Almazín Basin), and the recent findings from the Late Eocene (Headonian, MP18) site of Zambrana (Miranda-Trebio Basin). The material from the latter locality consists of two well-preserved right mandible fragments with relatively complete dental series, including p3-m3 and p4-m3. The overall tooth morphology and the presence of enamel wrinkling are similar to those observed in the genera Necrolemur and Microceirus. New discoveries from Mazaterón and Zambrana constitute the first record of microchoerines in the whole Western Iberian Bioprovince, which includes several western and central Iberian basins that have yielded endemic mammalian fossils (mainly rodents and perissodactyls), unknown in the Southern Pyrenean Basins and elsewhere in Europe. The endemic nature of the primates in this bioprovince is mainly supported by the presence of the adapiform MazatAddon edemiacus. The study of microchoerine fossils found in Mazatérón and Zambrana will extend what is known in this matter.

CRANIAL MORPHOLOGY OF THE BASAL TYRANNAUSAUROID.ITEMIRUS MEDULLARIS AND EVOLUTION OF THE BRAINCASE PNEUMATIZATION IN NON-AVIAN COELOUSOARS

BY MIYASHITA, Tetsuto, University of Alberta, Edmonton, AB, Canada

A redescription of Itemirus medullaris from the Turonian of Uzbekistan supports the hypothesis that this taxon represents a relatively derived non-tyrannosaurus tyrannosaur. The exquisitely preserved braincase of Itemirus has a number of characters previously unique to tyrannosaurs among non-avian theropods, such as the separation of the branches of the trigeminal nerve within the endocranial cavity. The redescription also recovered a mosaic of coelurosaur plesiomorphies and tyrannosaur apomorphies in Itemirus. For instance, tyrannosaurs had prominent pneumatic sinuses within the supraoccipital, otocipital, and prootic, but these sinuses were either absent or less extensive in Itemirus. A wide taxonomic comparison led to mapping braincase pneumaticity onto a cladogram of the Coelurosauria. The anterior and posterior tympanic, basipterygoid, and basioccipital recesses tend to be conserved across coelurosaurian lineages, whereas other air sacs are highly homoplastic. The development of the cranial pneumatization in modern birds suggests that the relatively conservative air sacs in Coelurosauria developed following the onset of ossification of the pneumatized element. The highly homoplasy air sacs are likely to represent secondary pneumatization after the completion of prenatal ossification.

Evolutionary rates by using the sequestered character set. By performing this “jack-knife”- analogous technique multiple times, average rates of character evolution can be elucidated without concerns of preoptimization from the tree assembly procedure. Although the instability of the tree time consuming, I also present the necessary function to perform the analysis in R using only a nexus-format character matrix and a vector of ages (with phylogenetic reconstruction performed by TNT), and present simulation results showing that the altered procedure is highly susceptible to falsely detecting declining rates. Further, I reanalyze several published datasets that have already had their rates calculated using the original methodology, and show how this simple, and necessary, alteration impacts the results. Despite this methodological advance, more work is needed and caution in interpreting phylogenetic data in non-phylogenetic contexts is urged, due to a plethora of potential pitfalls and biases.

Poster Session III (Friday, November 4)

USING PHYLLOGENETIC CHARACTERS TO INTER EVOLUTIONARY RATES

BY MITCHELL, Jonathan, University of Chicago, Chicago, IL, USA

Phylogenetic character matrices represent a rich trove of morphological information, which evolutionary biologists could potentially mine to understand the tempo and mode of major transitions in the fossil record. However, the characters chosen are neither random, nor necessarily equally informative for evolutionary rates. Further, the standard protocol for computing evolutionary rate, pathic dissimilarity divided by length for each branch, uses the character states that made the tree to also compute the rates of change along that tree. Using the most parsimonious tree generated from the same data automatically results in the lowest possible overall rates. More importantly, though, the repeated use of the same data biases changes towards internal branches which, in turn, leads to higher rates of change early in a clad’s history not (necessarily) as a function of evolutionary dynamic, but as an artifact of analysis. I present a slight alteration to the standard procedure by advocating iterative partitioning. Each rate calculation is done by removing a small subset of characters and finding the most parsimonious trees for the remaining characters, and then calculating evolutionary rates by using the sequestered character set. By performing this “jack-knife”- analogous technique multiple times, average rates of character evolution can be elucidated without concerns of preoptimization from the tree assembly procedure. Although this is time consuming, I also present the necessary function to perform the analysis in R using only a nexus-format character matrix and a vector of ages (with phylogenetic reconstruction performed by TNT), and present simulation results showing that the altered procedure is highly susceptible to falsely detecting declining rates. Further, I reanalyze several published datasets that have already had their rates calculated using the original methodology, and show how this simple, and necessary, alteration impacts the results. Despite this methodological advance, more work is needed and caution in interpreting phylogenetic data in non-phylogenetic contexts is urged, due to a plethora of potential pitfalls and biases.

Technical Session XIV (Saturday, November 5, 10:15 am)

CRANIAL MORPHOLOGY OF THE BASEL TYRANNOUSAUROID.ITEMIRUS MEDULLARIS AND EVOLUTION OF THE BRAINCASE PNEUMATIZATION IN NON-AVIAN COELOUSOARS

BY MIYASHITA, Tetsuto, University of Alberta, Edmonton, AB, Canada

A redescription of Itemirus medullaris from the Turonian of Uzbekistan supports the hypothesis that this taxon represents a relatively derived non-tyrannosaurus tyrannosaur. The exquisitely preserved braincase of Itemirus has a number of characters previously unique to tyrannosaurs among non-avian theropods, such as the separation of the branches of the trigeminal nerve within the endocranial cavity. The redescription also recovered a mosaic of coelurosaur plesiomorphies and tyrannosaur apomorphies in Itemirus. For instance, tyrannosaurs had prominent pneumatic sinuses within the supraoccipital, otocipital, and prootic, but these sinuses were either absent or less extensive in Itemirus. A wide taxonomic comparison led to mapping braincase pneumaticity onto a cladogram of the Coelurosauria. The anterior and posterior tympanic, basipterygoid, and basioccipital recesses tend to be conserved across coelurosaurian lineages, whereas other air sacs are highly homoplastic. The development of the cranial pneumatization in modern birds suggests that the relatively conservative air sacs in Coelurosauria developed following the onset of ossification of the pneumatized element. The highly homoplasy air sacs are likely to represent secondary pneumatization after the completion of prenatal ossification.

The parsimony analysis of Coelurosauria highlighted a few stem taxa with conflicting character information, which made plesiomorphic states ambiguous along the main stem of the tree. This ambiguity increased the number of alternative ingroup relationships and collapsed distant nodes under strict consensus. Removal of these problematic taxa substantially improved the resolution of the analysis. The second analysis recovered a phylogenetic signal for ingroup relationships that are historically challenging to resolve under strict consensus, including alvarezsaurids, compsognathids, and troodontids. The analysis also supported two tyrannosaurid radiations, Proceratosauridae and the rest of the Tyrannosauroidea, both of which dispersed across Laurasia by the Middle Jurassic times.

Phylogenetic character matrices represent a rich trove of morphological information, which evolutionary biologists could potentially mine to understand the tempo and mode of major transitions in the fossil record. However, the characters chosen are neither random, nor necessarily equally informative for evolutionary rates. Further, the standard protocol for computing evolutionary rate, pathic dissimilarity divided by length for each branch, uses the character states that made the tree to also compute the rates of change along that tree. Using the most parsimonious tree generated from the same data automatically results in the lowest possible overall rates. More importantly, though, the repeated use of the same data biases changes towards internal branches which, in turn, leads to higher rates of change early in a clad’s history not (necessarily) as a function of evolutionary dynamic, but as an artifact of analysis. I present a slight alteration to the standard procedure by advocating iterative partitioning. Each rate calculation is done by removing a small subset of characters and finding the most parsimonious trees for the remaining characters, and then calculating evolutionary rates by using the sequestered character set. By performing this “jack-knife”- analogous technique multiple times, average rates of character evolution can be elucidated without concerns of preoptimization from the tree assembly procedure. Although this is time consuming, I also present the necessary function to perform the analysis in R using only a nexus-format character matrix and a vector of ages (with phylogenetic reconstruction performed by TNT), and present simulation results showing that the altered procedure is highly susceptible to falsely detecting declining rates. Further, I reanalyze several published datasets that have already had their rates calculated using the original methodology, and show how this simple, and necessary, alteration impacts the results. Despite this methodological advance, more work is needed and caution in interpreting phylogenetic data in non-phylogenetic contexts is urged, due to a plethora of potential pitfalls and biases.

Technical Session XVII (Saturday, November 5, 3:30 pm)

STEPHANOBIURUS CF. HUNDHESHEMISNIS FROM KURTAN, A NEW EARLY PLEISTOCENE SITE IN THE LORI PLATEAU, ARMENIA: IMPLICATIONS FOR THE BIOGEOGRAPHY OF RHINOCRÖTIDAE SEED AWARD

BY MKRITCHYAN, Ruzan, Yerevan State University, Yerven, Araba; BELMAKER, Miriam, The Collage of William and Mary, Williamsburg, VA, USA; HYNKE, Scott, University of Utah, Salt Lake City, UT, USA; BELAYEVA, Elena, University of St. Petersburg, St. Petersburg, Russia; ASLANIAN, Stepan, Center of Political and Strategic Research, St. Petersburg, Russia

The genus Stephanobirus is a rhinocerotid known from the Pleistocene of Eurasia and has been used as a biochronological marker. Compared to its relative abundance in Western Europe, specimens from the Caucasus are relatively rare. Here we present preliminary results from a new locality, Kurtan, with evidence for an early presence of Stephanobirus cf. hundheshemisn. Situated in the Lori Plateau of Armenia is the new stratified site, Kurtan. The fossil bearing sediments contain pedogenic carbonates and overlie a pumiceous volcanic ash bed, which has been dated at 1.49 + 0.01 Ma by 40Ar/39Ar laser fusion of single sandstone crystals. At
its base, this ash bed is in erosional contact with vesicular basalt. The western wall of the Kurtan quarry is directly overlain by a fine-grained volcanic ash bed for which a zircon U-Pb date of 1.371 ± 0.022 Ma has been obtained. The site yielded a small lithic assemblage attributed to the Early-Middle Acheulean tradition dated to ca. 1.0-0.8 Ma.

Fossils from Kurtan include lower dentition referable to Stephanorhinus cf. hundsheimensis. The taxon differs from *S. etruscus*, dated to 1.6-1.2 Ma, as well as from younger specimens attributed to *S. hundsheimensis* (=*S. brachycephalus*), that post-date 0.8 Ma. Instead, specimens resemble those from Pietravairata, Italy, dated to the Farenta fauna unit ca. 1.6-1.2 Ma, and which combines features of both taxa assigned to Stephanorhinus cf. hundsheimenis-s. This study sheds light on the biogeography of the taxon and suggests a wider distribution than previously assumed.

Poster Session II (Thursday, November 3)

**A QUANTITATIVE APPROACH TO SAUROPOD NECK MORPHOLOGY**

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Sauropod cervical vertebrae show considerable variation in number and proportion. Ventral profiles, which plot centroid length for each position in the column, can be used to simultaneously capture variation in vertebral length and count. These profiles also allow comparisons amongst disparate groups and reveal several general neck morphotypes. These include necks with vertebrae of homogenous size, as well as those with the most elongate vertebrae positioned anteriorly, posteriorly, or in the middle of the series. Comparison of ventral profiles among sauropods reveals several basic patterns. Basal sauropods typically have similarly-sized cervical vertebrae, whereas more derived sauropods have several elongate cervical vertebrae that are positioned near the middle of the neck. Within-clade similarity in vertebral profiles was observed in both Macronaria and Diplodocoidea. Parallel analyses performed on other vertebrae with elongate necks indicate that sauropod necks are distinct in morphology from those of mammals and birds. Necks of modern long-necked mammals have the longest vertebrae positioned anteriorly, whereas long-necked birds have the vertebrae positioned posteriorly. The prolatenterform *Tyrannosaurus* was found to have a cervical profile comparable to that of sauropods. A standardized method of analyzing sauropod necks will facilitate their description in future work and provide a better understanding of neck elongation, mechanics, and structure in tetrapods.

Poster Session II (Thursday, November 3)

**"EUHELOPODIDAE" (SAUROPODA) TEETH FROM THE UPPER JURASSIC OF PORTUGAL**

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Although previous studies of Portuguese Upper Jurassic sauropods assumed a close relationship with Morrison Formation taxa (USA), reassessment and new findings have established the presence of endemic taxa in the Iberian Peninsula. Contrary to the patterns in other dinosaur groups (e.g., theropods), the Iberian Upper Jurassic sauropods support a vicariance model to explain their diversity in this territory.

Two sauropod teeth from the Tithonian of Peralta (ALTSHN.122) and Cambelas (ALTSHN.121) (Lourinhã Formation, Portugal) are discussed. The most complete tooth (ALTSHN.122) consists of a premolar or maxillary tooth, based on lingual wear. It is a spoon-shaped tooth with a wrinkled crown surface and D-shaped cross section. The labial face is strongly convex, forming an apicobasal bulge, and the lingual face is slightly concave and preserves an apicobasal crest visible only on the apex. The mesial and distal edges of the first two-thirds of the crown are straight and parallel and exhibit leaf-shaped lingual crown buttresses. Apically, the edges converge, forming a nearly symmetric apex with a slight distal deflection. Crown-to-crown occlusion has produced V-shaped wear facets. The slenderness index is ~1.7. The general morphology of these teeth corresponds to those of the Camarasau-ridae and "Euhelopodidae", if it is accepted that a lingual crown buttress is an autapomorphy of Euhelopus.

At present, Euhelopus is considered a Somphospondylidae, and isolated Asiatic and Euro-ean teeth from the Early Cretaceous have been assigned to "Euhelopodidae". If the relationship of these teeth with "Euhelopodidae" can be confirmed with more complete material, then they are the oldest record of this group, suggesting a more ancient presence (Tithonian) in the Iberian Peninsula than previously thought. However, an alternative hypothesis implies the presence of currently unsassigned sauropods with Camarasaurus-like teeth and lingual crown buttresses in the Iberian Peninsula during the Upper Jurassic. If confirmed, this second hypothesis could explain the presence of "euhelopid" teeth in the Iberian Early Cretaceous, extinguishing the "Euhelopodidae" distribution to Asia.

Technical Session II (Wednesday, November 2, 2:15 pm)

**A NEODIAPSID REPTILE FROM THE LOWER PERMIAN OF OKLAHOMA**

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The evolutionary history of Neodiapsida (recently redefined by the authors as the sister taxon of Afroaesofelida) during the Paleozoic Era is remarkably poor. Following the reclassification of the Early Permian *Apisaurus witteri* as a synapsid last year, recognition of the Middle Permian species *Lanthanolania ivakhnenkoi* as the oldest known neodiapsid species resulted in a 38-million-year-long ghost lineage for Neodiapsida. That outcome was short-lived, however, with our description of *Orovenerator mayorum*, a new, early neodiapsid based on two partial skulls from the Lower Permian of Oklahoma. Both specimens share a uniquely curved, anteriorly narrow lacrimal that distinguishes *O. mayorum* from other early reptiles. A phylogenetic analysis (188 characters, 30 diapsid taxa, and 4 outgroups) positions *O. mayorum* as the basal-most representative of Neodiapsida. Updating the character codings for L. ivakhnenkoi, using a recently collected skeleton, strengthens Neodiapsida with respect to our previous results (Bremer support index increased to 3 [from 2], and bootstrap support increased to 89% [from 63%]). Support for certain major clades, such as Sauria and Archo-sauromorpha (both of which collapsed with a single extra step in the prior analysis), was also increased slightly. Interrelationships among basal neodiapsids (*O. mayorum*, L. ivakhnenkoi, tangasaurids, younginids, and Cladosaurus germani) remain weak and collapse with the addition of a single extra step. An unexpected result of our analysis is the recovery of a clade of marine reptiles comprising ichthyopterygians, sauropterygians, and thalattosaurs, which falls within Archosauromorpha and requires three extra steps to collapse. Interestingly, our results suggest that the lower temporal bar was lost by the ancestral neodiapsid, and thus relatively soon after the evolution of the diapsid temporal morphology and, conversely, that the diapsid temporal configuration of the Late Permian neodiapsid *Yongquina capensis* is a secondary condition.

Technical Session VIII (Thursday, November 3, 2:00 pm)

**NEW FEATURES AND FUNCTIONAL MORPHOLOGY OF THE AXIAL SKELETON IN THE EARLY TETRAPOD PEDERPEDES FINNEVÆ**

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The axial skeleton of the basal tetrapod *Pederpes finnevæ* is reconstructed in three dimensions from micro-CT scans. Previously unknown features are described, and the biomechanical implications of the vertebral morphology are examined. *Pederpes* is a rare fossil tetrapod from Romer’s Gap, a period in the Early Carboniferous during which tetrapods emerged onto land and diversified greatly. It is one of only a few specimens that represent a vital link, both phylogenetically and biomechanically, between primitively aquatic stem-tetrapods such as *Acantostega* and Ichthyostega and terrestrial stem-amphibians and -amniotes such as *Eryops* and *Seymouria*. The vertebral column of *Pederpes* is rhachitomous, with a central notochord and separately ossified neural arch, intercentrum, and pleurocentra. This arrangement is ancestral for tetrapods but is not found in any extant vertebrate. Digital separation of bone from matrix reveals for the first time the 3D surface of the zygapophyses and an almost complete series of intercentra and pleurocentra. Based upon the new reconstruction, characters linked to axial flexibility and locomotor style are used to build a vertebral functional profile, from which information can be gathered about the axial mobility of *Pederpes* in comparison to extant tetrapods. These characters and their functional correlates include: zygaphysal angle (primary planes of movement and motion coupling), vertebral body dimensions, transverse process width, and distance between zygaphyses (stiffness in flexion and torsion), and transverse process width and deflection angle (muscle leverage). The results reveal that *Pederpes* had a locomotion profile most similar to those of the giant salamander and the salt water crocodile, which swim and walk using lateral undulations of the body. The zygaphyses of *Pederpes* are deflected more than 45° from the sagittal plane throughout the column, indicating greater resistance to dorsoventral movements in comparison to mediolateral movements. None of the measured parameters exhibit marked regional variation. Thus, we infer that *Pederpes* largely retained plesiomorphic intervertebral joint motions dominated by mediolateral flexion. This study of an important taxon lays the groundwork for future biomechanical comparisons between *Pederpes* and other early tetrapods.

Poster Session IV (Saturday, November 5)

**DIETARY INFERENCES OF PROTOCERATOPSID DINOSAURS FROM THE LATE CRETACEOUS OF MONGOLIA BASED ON STABLE ISOTOPE GEOCHEMISTRY**

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The dietary affinities of dinosaurs have remained elusive in the absence of preserved gut contents or coprolites. Proceratopsid dinosaurs were ubiquitous in the Late Cretaceous ecosystems of Mongolia’s Gobi Desert. Some, including teeth, are frequently recovered in the extremely fossiliferous red sandstones of the Djadochta formation. Their dietary preferences can therefore be determined through geochemical analysis of tooth enamel, as is commonly done for extinct mammals. We analyze dinosaur tooth enamel, made of bioapatite, from the Djadochta Formation for carbon and oxygen isotope compositions. Specifi-
cally, we analyze the teeth of the herbivorous dinosaur *Protoceratops andrewsi*. Statistical comparisons of the isotope ratios between different types of material, such as tooth dentine, tooth enamel, soil carbonate, and eggshell, along with SEM analysis are used to illustrate that diagenesis has not overwhelmed all primary isotopic signals. Carbon isotope values from teeth indicate the dinosaurs were subsisting on C3 plants adapted to arid climates, such as conifers, and drinking pools of water subject to evaporation. The stable isotope values of dinosaur eggshells from the same localities are also compared and contrasted to illustrate the different environmental signals present in each type of fossilized material.

Technical Session XVIII (Saturday, November 5, 3:15 pm)

**EVOLUTION OF THE OTIC REGION OF FOSSIL CROCODYLIFORMES**

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Transitions between terrestrial, semi-aquatic, and aquatic habitats had huge implications in numerous aspects of morphology, physiology, and sense organs in all vertebrates that experienced these shifts. These habitat shifts impose large constraints to hearing. The fossil record is rich in information, with well developed scars in the lateral surface of the quadrate for the attachment of the tympanic membrane. A large tympanic membrane would have encompassed the many quadrate fenestrae present in basal crocodyliforms and derived notosuchians (e.g. *Notosuchus richardsoni*, *Pissarrachampa sero* and *Marlissuchus amarali*) suggesting these structures also played a role in hearing. We present a discussion of variation of relative hearing abilities within Crocodyliformes inferred from the entire external and internal temporal complex that correlates well with the terrestrial to aquatic habitatcline. Overall, the external morphology of the otic region and its peripheral structures are strongly linked to clade-specific habitat occupation across Crocodyliformes and emphasize auditory acuity as a major factor in the evolution of the group. These results suggest great potential for future work on anatomical and physiological comparisons of fossil and extant crocodyliforms.

**DEVELOPING ADULT EDUCATIONAL PROGRAMS: BEER & BONES, A COCKTAIL PARTY APPROACH TO PUBLIC OUTREACH**

MOOTS, Hannah, Museum of Nature and Science, Dallas, TX, USA; BUCKLIN, Stacey, Museum of Nature and Science, Dallas, TX, USA; CAUGHRON, Sarah, Museum of Nature and Science, Dallas, TX, USA

In 2011, the Museum of Nature & Science in Dallas, Texas, initiated a new adult-only educational series, called Beer & Bones. The purpose of this series is to attract and present scientific information at the appropriate level for an adult constituency, with an effort to include young adults, age 18-30. This age range is often overlooked by science museums and has historically focused marketing and programming efforts on school children and families. Raising awareness of current research, traveling exhibits, and museum educational programming (camps, lectures, etc.) are key objectives of this public outreach series. This poster highlights the inaugural program held on March 24, 2011, a cocktail night which featured special access to Dinosaurs Unearthed, a traveling exhibition of animatronic dinosaurs. Visitors mingled with the MNS’s Paleontology and Education staff and enjoyed the first public viewing of a *Pachyrhinosaurus* specimen that is the focus of ongoing research.

The event afforded the MNS’s Paleontology Department the opportunity to share their ongoing research, fieldwork and lab work with attendees and afforded the Education Department the opportunity to conduct hands-on activities and share information about programs and outreach events for adults, for families, and for schools. This poster details the creation and execution of this inaugural event, provides an evaluation and presents statistics based on organizer observations and attendee surveys, and discusses changes implemented in subsequent events in the series based on these evaluations.

Poster Session IV (Saturday, November 5)

**ROLAND SPRINGS RANCH LOCALITY 1, AN EARLY PLEISTOCENE FAUNA FROM THE SOUTHERN PLAINS OF TEXAS**

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Roland Springs Ranch (RSR) Locality 1 is situated on Turtle Creek, an ephemeral contributor to the Clear Fork of the Brazos River, on the Southern Plains within the western Rolling Plains of Texas. Faunal material is encased within gleyed sand in an ancient channel. The surface of this ancient drainage and the plotted positions of specimens provide an opportunity to study the deposition patterns of a small early Pleistocene stream.

Over 50 taxa have been identified at least to the family level, demonstrating a strong record of biodiversity. Multiple species of *Hesperotherium* and *Petrostomus* (primarily *Chrysomys picta*), are the dominant forms in the assemblage. Remains of the three-toed horse, *Nannipus peninsulatus*, are common, while those of a representative of the modern genus, *Equus simplicidens*, are rare. Carnivores are represented by *Taxidea taxus*, *Biusinctus brevarimus*, and *Canis leopogaphus*, as well as a small *Mircosynus*, referred to *M. trunani*. Avian material is abundant, including primarily Passeriformes but also members of Ardeidae, Corvidae, and Accipitriformes, and an extinct species of *Meleagris*. Microfaunal remains are abundant and diverse.

An approximate age is provided by faunal comparison. *Ogmodonatomyx pauphagus*, *Prepodomatomyx centrals*, *Geomys (Nierрогeomys) minor*, *Scelopus (Hesperoscopus) cf. recrvoadi*, and a small *Sigmodon minor/medius* indicate a middle to late Blancan age. The referred identifications of *Mircosynus trunani* and *Lapos* would indicate a latest Blancan age, while *Nannipus peninsulatus* is confined to the late Blancan. Viewed together, these animals represent a late Blancan fauna of earliest Pleistocene age (2.6 – 1.8 million years ago).

The fauna indicates a riparian setting within a grassland environment, lacking seasonal extremes and perhaps with an increased moisture regime relative to today’s continental climate. Fish (*Ictaluridae*), aquatic turtles, *frogs (Rana)* and the *Ardeid* bird indicate that the drainage was a regular, if not permanent, source of water. Hackberry (* Celtis*) bordered the drainage and perhaps existed throughout the bottomlands, providing habitat and roosts for wild turkey and raptors.

**MIOCENE MICROVERTEBRATES FROM PANAMA**

MORGAN, Gary, New Mexico Museum of Natural History, Albuquerque, NM, USA; RINCON, Aldo, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; MORSE, Paul, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; DENETCLAW, Utahna, New Mexico Museum of Natural History, Albuquerque, NM, USA; VALLEJO, Maria, Smithsonian Tropical Research Institute, Ancon, Panama

A screenwashing program initiated in 2010 has resulted in recovery of a moderately diverse fauna of early to medial Miocene terrestrial and freshwater microvertebrates from two geo-logic units along the Panama Canal in central Panama at about 9° North latitude. The older Las Cascadas Formation has produced a large mammal fauna of early Miocene age (late Arikareean NALMA, ~21-19 Ma). Small vertebrates identified from the Las Cascadas Formation include the dentary of an iguanid(?) lizard, a partial mandible of a bat, and an isolated tooth of a neotropical rodent. The bat is similar to a newly described genus from the Oligocene of Florida that is near the base of the radiation of Neotropical noctilionoid bats (e.g., *Phyllostomidae*, Mormoopidae). A more varied assemblage of microvertebrates is known from the Centenaria Fauna derived from the younger Cucaracha Formation. Geochronological data indicate an age of ~17 Ma (late Hemingfordian NALMA) for the Cucaracha Formation, whereas the biostatigraphy of the large mammals from the Centenaria Fauna suggests a possible age range from early Miocene to early medial Miocene (latest Arikareean to early Barstovian NALMA, ~19-15 Ma). Small vertebrates from the Centenaria Fauna include teeth of several species of bony fish, vertebrate of boid snakes, a tooth of the large petauristine flying squirrel *Petauristodon*, a tooth and proximal humerus of a smaller sciurid, teeth of the small geomyoid rodent *Tezomyx stewarti*, and teeth of a new species of larger rodent similar to *Tezomyx*. Although crocodilians are not generally considered microvertebrates, the most abundant small vertebrate fossils from the Centenaria Fauna are isolated teeth of diminutive, presumably juvenile, crocodilians representing several taxa. The occurrence of *Petauristodon* and *Tezomyx* is reminiscent of several late Hemingfordian and early Barstovian faunas from the Texas Gulf Coastal Plain. A presumably tropical Mesoamerican Miocene vertebrate fauna that occurred from Panama north to Texas, and perhaps east to Florida, is supported by the presence of the small protoceratid artiodactyl *Paratoceras* in early to medial Miocene faunas in Panama, Mexico, and Texas.
NEW STUDIES OF BRAIN AND INNER EAR STRUCTURE IN STEGOSAURUS (DINOSAURIA: ORNITHISCHIA) BASED ON CT SCANNING AND 3D VISUALIZATION

MORRIS, Zachary, UC Berkeley, Museum of Paleontology, Berkeley, CA, USA; FERRER, Elizabeth, UC Berkeley, Museum of Paleontology, Berkeley, CA, USA; WALLACE, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA

The Jurassic dinosaur Stegosaurs has been emblematic of the small-brained dinosaur since it was recognized that its brain was the size of walnut. Virtual endocasts of four Stegosaurs specimens were examined using CT scanning and 3D visualization software (Avizo 6.3). This technique differs from those involving physical endocasts in that it allows the virtual endocast to be viewed in isolation as well as in situ with the surrounding semitransparent braincase. This unique perspective permits the tracing of cranial nerves and vessels through their corresponding canals and foramina within the anatomical context of the cranial bones, allowing unambiguous identification of external foramina. In contrast to physical endocast production, the construction of virtual endocasts can be accomplished even with damaged specimens and/or those obscured by matrix infilling. Having four specimens provides a rare opportunity to assess variation in endocast structure, and remarkably little variation is observed. The olfactory bulbs and tracts are small and flattened. The optic nerves exited through a combined opening. All other cranial nerves and endocardial vessels are visible and follow the typical rostral-to-caudal location pattern. The endocasts indicate a relatively small complement of cranial nerves and vessels with differences in size and location, which may not be reliable. We performed a 2D geometric morphometric analysis of epiplastron shape and sensory capabilities. Unlike advanced maniraptorans, the brain of Stegosaurs clearly did not fill the endocranial cavity entirely. Stegosaurs endocasts are thus poor proxies for the brain itself. To estimate more realistically the brain morphology of Stegosaurs, future work will focus on the application and refinement of a technique known as Gross Anatomical Brain Reconstructions (GABRA), which establishes recognizable structures from the surface of endocasts as delimiting indicators for demarcation of the location and size of major brain regions (e.g., olfactory bulbs, optic lobes, cerebral hemispheres, cerebellum).

Poster Session III (Friday, November 4)

ONTOGENETIC VARIATION IN EPIPLASTRAL SHAPE AMONG EOCENE TESTUDINOID TURTLES (ECHMATEMYS) OF WESTERN NORTH AMERICA

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Testudinoids are common in terrestrial North American Cenozoic and modern faunas, but there has been limited study of their geographic, sexual, and ontogenetic variability. If the morphological features used to distinguish among taxa are ontogenetically or geographically variable, our estimations of species diversity may be too high, especially for fossil taxa. Recent studies have shown age- and sex-related differences in skull morphology in kinosternid and testudinoid turtles, but little work on shell variability has been completed. This is problematic for fossil turtle taxa, which rarely preserve shells and shells in association, and are usually represented by partial shells or isolated shell elements. In order to address this imbalance, studies of ontogenetic change in shell elements are needed. Epiplastron shape has previously been used to diagnose fossil testudinoids to the species level, but in the absence of statistical analyses of ontogenetic, sexual, or geographic variation, these characters may not be reliable. We performed a 2D geometric morphometric analysis of epiplastron shape (Procrustes principal components analysis) in the extant testudinoid Actinemys (= Emys) maritima (to document age- and sex-related variation) and three Echmatemys testudinoids: Echmatemys testudinea, E. euthenaea, and E. wyomingensis. To counter geographic and temporal variation, only Echmatemys samples from three stratigraphically distinct and geographically limited localities in southwestern Wyoming were used. The mean shape of E. euthenaea epiplastrs differed statistically from those of the other two taxa, corroborating visual assessments of shape differences, but E. wyomingensis and E. testudinea could not be distinguished with a limited, 5-landmark analysis. A general ontogenetic trend in the angle of the epiplastral horn and the expansion of the lateral side of the element were observed in all taxa, but there were distinct taxonomic differences in the ontogenetic trajectories.

Technical Session IV (Wednesday, November 2, 3:00 pm)

MIOCENE BEAVERS (CASTORIDAE, RODENTIA) FROM JAPAN

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The fossil record of Miocene terrestrial small mammals in Japan is very scarce, with some orders represented by only a single or two specimens. Castoridae are best documented in terms of taxon and specimen numbers, including the giant castoroidine beaver Youngofiber sinensis, which is also known from Sihong in East China. New findings from the Early Miocene Mizunami Group in central Japan reveal additional, and endemic taxa. A large-sized species from the Dota locality in the Kani Basin represents an archiindarchiomyine beaver. It is much smaller than the North American Anchilostoma flumenis and even smaller than the Eurasian Anchilostoma. The dentition is characterized by large upper and lower premolars and subhypopodont molars with a regular, transversally oriented fosssetid pattern. The convex incisors with no or very weak striations are less hypsodont than in larger archiindarchiomyines. Incisor enamel microstructure shows a mixture of derived and less derived features, e.g., weakly inclined Hunter-Schreger bands, but fewer confluences than in larger archiindarchiomyines. The Dotu beaver represents the smallest archiindarchiomyine castorid outside North America. A medium-sized species from Matsugase in the adjacent Mizunami Basin documents a palaecostearine beaver which is highly adapted to fossoriality, like or even more than North American species. Derived cranial features are a flattened skull, complete fusion of the naasals, and an extremely broadened and shortened occipital region due to the posterior expansion of the zygomatic arches. The non-procumbent incisors are flat with a shallow sulcus. The Matugu beaver is the first fossorial castorid outside North America. With an age of 17.5 Ma it represents the latest record of the group, about 2.5 Ma after the demise of fossorial beavers in North America. The two new castorids from the Mizunami Group indicate pyleogeographic relations to North America. Together with the other small mammals from the Mizunami and Nojima Groups, the beavers share the pattern of paleobiogeographic links and endemisms, probably as a result of the separation of the Japanese island arc from the Asian continent during the Early Miocene.

Poster Session III (Friday, November 4)

PARTIAL HYAENODONTID (MAMMALIA, CREODONTA) SKELETON FROM THE PALEOCEANE-EOCENE THERMAL MAXIMUM OF NORTH AMERICA

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The creodont Prototomus deimos is one of several species of carnivorous mammals that first appear in North America at the base of the Eocene. Hyaenodontoids, along with euprimates, perissodactyls, and artiodactyls, likely immigrated from Asia across a high-latitude land connection associated with global warming of 5-10°C during the Paleocene-Eocene Thermal Maximum (PETM,.55.8 Ma). The PETM hyaenodontid fossil record is represented mostly by isolated teeth and dentary fragments, limiting our understanding of relationships and positional behaviors. Here we describe a partial skeleton of P. deimos from the PETM, Wilwood Formation, southern Bighorn Basin, Wyoming, that includes a left dentary with P3-M3, a right maxilla with P4-M3, a left maxilla with M1-3, and left and right mandibular condyles, a zygomatic arch, and a petrosal. Associated postcrania include a scapula, proximal humerus, acetabulum, proximal and distal femora, and vertebrae. The new specimen shows for the first time that P. deimos differs from other species of Prototomus in having a relatively reduced M3, an anteroposteriorly compressed M3, and anterior displacement of the protocone relating to the paracone. A reduced M3 is reconstructed as a generalization of the Asian Paleocene hynocyniform Prolimncocyon chowi, and the North American proivertebrate Galecyon, also from the PETM. However, the position of the protocone is similar to that of the more derived Gazzinocyon from the early Eocene of North America, suggesting a possible relationship. Features of the hynocynine that are consistent with scapular or arboreal locomotion include a greater tiberosity no taller than the head and a rugose insertion for the teres major muscle. In contrast, a long femoral neck and a femoral head projecting above the greater trochanter suggest the hindlimb was more generalized for cursoriality or scansoriality. This generalized or potentially arboreal locomotion, similar to that inferred for other later occurring species of Prototomus, appears to be primitive for the group and likely characterizes the positional behavior of the hynocynoid immigrant from Asia that gave rise to P. deimos.

Poster Session IV (Saturday, November 5)

ANALYSIS OF VARIATION IN SNAKE VERTEBRAE USING GEOMETRIC MORPHOMETRICS

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Snakes comprise a vital component of the Cenozoic reptilian fossil record. Due to their relatively delicate skulls and lack of limbs, snake fossils are most frequently represented by vertebrae. Despite their relatively high abundance however, isolated snake vertebrae remain notoriously difficult to identify. This difficulty stems mainly from the inherent variability of snake vertebrae, specifically the wide range of morphological variation that exists not only between individuals of the same species, but also among the vertebrae of a single individual. Understanding and characterizing this variation is a critical step in improving our ability to identify fossil snakes. Here we present an analysis of the variation in snake vertebrae using geometric morphometrics, a method which has been utilized in similar studies, but rarely with snakes. We applied landmark data to selected vertebrae along the vertebral column of an individual snake specimen, and using thin-plate splines (TPS), we were able to characterize patterns of morphological variation along the column. Repeating this method for numerous individuals representing several extant species allowed for comparison of these patterns of variation between multiple taxa. Applying relative warp analysis (RWA) and discriminant analysis (DA) to these data allowed for identification of those morphological characters which are most variable between taxa, as well as those most variable between different segments of the vertebral column; these characters thus hold the most potential for use in the identification of isolated snake vertebrae. The application of this method to a wider data set of taxa in future studies will vastly improve our techniques for identification of snake fossils, and thus improve our understanding of snake evolution and diversity.
EXPERIMENTAL BONE DIAGNOSIS: DIFFUSION PROFILES AND TIMING OF RARE EARTH AND TRACE ELEMENT UPTAKE

MOSES, Randolph, Museum of Geology, South Dakota School of Mines and Technology, Rapid City, SD, USA; KOHN, Matthew, Department of Geosciences, Boise State University, Boise, ID, USA

An increasing number of studies have attempted to characterize the uptake of rare earth elements (REE) and trace elements (TE) into bioparticulate. Many studies measured elemental profiles in fossil bone analyses and attempted to draw conclusions regarding the mechanisms and timing of REE and TE uptake during the fossilization process. Very little controlled experimentation has been conducted to investigate the processes and mechanisms of the early fossilization process.

To investigate early stages of bone fossilization, sections of Bos taurus femora were sealed in plastic sample reactors for 18 months in aqueous solutions spiked with REE (Ce, Nd, Sm, Eu, Gd, and Yb) and TE (Sr, U). Addition of kaolin, plus slight impurities permitted investigation of several other trace elements, (Al, Y, the other REE, Pb, and Th). Three different sample preparation methodologies varied pH buffers and used fresh bone vs. bone from which collagen had been extracted. Elemental profiles were measured in reacted and unreacted bone using laser ablation ICP-MS as 100 µm depth profiles and as several mm-long profiles, both parallel and perpendicular to the long-axis of the bone. Profile shape differences in reacted bone reflect differences in trace element diffusivities and rates of uptake.

REE and TE have relatively high diffusivities, typically 1x10-13 cm2/sec for bone with collagen perpendicular to the long bone axis; diffusion parallel to the bone axis is 1/2 to 2 times faster. U, Pb, and Al diffuse about 2 times faster than REE. In contrast to published data, no differences in diffusivities or partitioning were observed among the REE, possibly indicating different uptake mechanisms: diffusion plus adsorption in the experiments vs. diffusion plus recrystallization in nature. Prior removal of collagen decreases partition coefficients by a factor of ~2 for most elements, but ~50 for U, and increases diffusivities by a factor of ~2. These results confirm some expectations, including faster uptake in bone than in enamel (~1x10-14 cm2/sec), and parallel to bone axes than perpendicular. Unexpected similarities in partition coefficients among REE recommend further synthesis experiments.

Technical Session XIX (Saturday, November 5, 4:00 pm)

PAST GLOBAL WARMING AND EMERGENCE OF MARINE MAMMALS AND REPTILES

MOTANI, Ryosuke, University of California, Davis, Davis, CA, USA; MONTÁNEZ, Isabel, University of California, Davis, Davis, CA, USA

At least 24 lineages of mammals and reptiles invaded the sea during the last 250 million years (i.e., started to feed almost exclusively in the sea). These marine invasions occurred episodically, only during 11 specific time intervals. We previously suggested that marine reptile invasions had corresponded with periods of high sea levels recorded in rock sequences. However, the lack of paleotemperature reconstruction with sufficiently high resolution prevented a direct comparison between the historical records of temperature and marine invasion by tetrapods.

We reconstructed seawater paleotemperature curves over the Phanerozoic with the highest resolution permitted by the data. We incorporated updated 818O data, georeferenced timescales, and pH correction based on atmospheric CO2 level. We also removed three previously unrecognized systematic biases, which sometimes result in errors greater than 10 °C in combination. The reconstructed curves suggest that at least 19 of the invasions occurred near the temperature peaks, although they were usually located on the shoulders rather than coincident with the thermal peak. For ecotemors, higher temperatures probably allowed early invaders to thermoregulate in the water without physiological modifications. A similar physiological bias was exhibited by the thermal peak. For ectotherms, higher temperatures probably allowed early invaders to withstand higher temperatures although they were usually located on the shoulders rather than coincident with the thermal peak. For ectotherms, higher temperatures probably allowed early invaders to withstand higher temperatures although they were usually located on the shoulders rather than coincident with the thermal peak.

Technical Session XIV (Saturday, November 5, 12:00 pm)

NEW DISCOVERIES AND INVESTIGATIONS ON THE LATE CRETACEOUS VERTEBRATE FAUNA OF NORTHERN SUDAN

MÜLLER, Johannes, Museum f. Naturkunde/Humboldt-Universität, Berlin, Germany; BUSSEERT, Rob, Technische Universität, Berlin, Germany; WILLS, Matthew, University Museum/University of Toronto, Toronto, ON, Canada; KLEIN, Nicole, Universität Bonn, Bonn, Germany; SALIH, Khalaf, Al Neelain University, Khartoum, Sudan, USA

The Late Cretaceous (Cenomanian) Wadi Milk Formation in northern Sudan is known to yield a wide spectrum of aquatic and terrestrial vertebrates, yet the fauna remained poorly studied. Vertebrate fossils have also been reported from the Shendi Formation, putatively a lateral equivalent of the Wadi Milk Formation, but material from these formations is rarely collected. Our targeted investigations have uncovered a rich vertebrate fauna from the Late Cretaceous (Cenomanian) Shendi Formation in northern Sudan.

Romer Prize/Technical Session 5 (Thursday, November 3, 10:45 am)

THE SOUTH AMERICAN LOWLAND GOMPHOTHERE (MAMMALIA, PROBOSCIDEA, GOMPHOTHERIDAE): TAXONOMY, PHYLOGENY AND BIOGEOGRAPHY

MOTTHE, Dominia, Laboratório de Mastozoologia, Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; AVILLA, Leonardo, Laboratório de Mastozoologia, Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; COZZUOL, Mario, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

The South American gomphotheres are classified into three genera and three species. Two biogeographic corridors are recognized for their dispersion in South America: Carvieronius hyodon was found mainly by the highlands and west to the Andes, and Stegomastodon platensis and Haplomastodon chimborensis, in the lowlands. The aim of the present study is to reconstruct the taxonomy, systematics and biogeography of the South American lowland gomphotheres. We analyzed a large sample of specimens, which included cranium, teeth and postcrania from several localities in Brazil, Ecuador, Colombia, Venezuela, Argentina and Uruguay. We reviewed the diagnostic characters proposed and found that they are variable in both species when large samples are considered. In this way, there is no support for more than one South American lowland gomphothere species, which shows a significant morphological variation in some characters. After a taxonomic review, a new combination name, Notiomastodon platensis, is validated. The cladistic analysis resulted in four most parsimonious trees. The family Gomphotheriidae is paraphtetic. The species N. platensis is positioned as the sister taxon to a clade composed of Stegomastodon spp. (represented here only by Central and North American taxa) and C. hyodon. These results disagree with several previous studies, in which the South American gomphotheres are a monophyletic clade. The South American gomphotheres are mainly recorded for the Pleistocene, although there are a few reported from the Miocene and Pliocene. These records together with our phylogenetic results suggest that the ancestor of the clade that includes the South American gomphotheres originated in North America until the Late Miocene. Moreover, the South American gomphotheres had two independent biogeographic histories. A first arrival may have occurred during the short land connection between Central and South America during the Miocene, and a second arrival during a longer period, in the Great American Biotic Interchange (Pliocene/Pleistocene). However, the lack of a gomphothere record before the late Miocene and late Pliocene in South America is still an unexplained issue.
At the time of their discovery, the footprints were systematically documented, photographed, and reburied by the Leakey team for conservation purposes. Maps published at the time documented trackways made by three individuals. It was suggested that the G 2/3 trackway was made by a large individual, followed by a smaller individual, walking in the steps of the larger. Another individual walked, in step, but on their side (G 1). Sex, relative age, and family relationships were immediately assumed and a family group was depicted traveling together in the Pliocene of East Africa. In February of 2011, at the direction of the Ministry of Natural Resources and Tourism in Tanzania, a 3.5-meter-long section of the footprint Tuff was re-excavated to evaluate and document the current condition of the footprints. This project pulled together scientists from around the world and provided a third opportunity to conduct close-range photogrammetric documentation of the footprints. Also documented at this time were casts which reside within the National Museum of Tanzania and Tanzania Culture.

Preliminary examination (foot-length, step, stride, pace angulations, and morphology) of the footprint surface, along with similar data from early generation casts, is now possible using close-range photogrammetric documentation. Evidence suggests that at least four individuals of similar foot length and size, with a consistent stride length created the trackways at Laetoli.

Technical Session I Wednesday, November 2, 11:15 am)

THYREPHORAN JAW MECHANICS AND THE FUNCTIONAL SIGNIFICANCE OF THE PEDENTARY BONE

NABAVIZADEH, Ali, Johns Hopkins University School of Medicine, Center for Functional Anatomy and Evolution, Baltimore, MD, USA

Thyreophoran jaw mechanics is poorly known. Stegosaurs have been described as orthal processors due to offset occlusion of maxillary and dentary teeth, absence of major tooth wear, and reduced buccal emargination. In addition, previous tooth wear analyses of ankylosaurs have shown them to be propalinal shearsers with medial pivoting of the tooth rows to provide occlusion. To test these hypotheses and explore other possible mechanisms, a morphological analysis of articular surfaces of the jaw, focusing on the predentary-dentary and quadrate-mandibular joints, was conducted. Various stegosaur and ankylosaur specimens as well as computed tomography (CT) data and three-dimensional digital models were used to visualize and measure morphologies of all articular surfaces of the predentary, dentary, and post-dentary bones as well as tooth row curvature along the maxilla and dentary. Morphology that promoted or restricted movement of the jaw elements during mastication was interpreted accordingly. Based on the flat, open predentary-dentary joint and the ball-socket quadrate-mandibular joint, medial rotation of both dentaries around their long axis is plausbile. The predentary would have acted to allow both dentaries to rotate independently of each other. This would have increased feeding efficiency as it allowed the animal to process vegetation on both sides of the mandible simultaneously. In stegosaurs, these features plus the pronounced and shallow tooth wear rows with an orthal feeding mechanism incorporating slight medial long-axis rotation of the dentaries to maneuver vegetation into the oral cavity. In ankylosaurs, the snout is broader and the tooth row has a more distinct curvature than stegosaurs. A dorsal lip on the lateral border of the articular bone restricts the previously suggested pivoting motion of the dentaries. Instead, rotation of the dentaries in association with the predentary while simultaneously shearing propalinally is more likely in ankylosaurs. Further analysis of more primitive thyreophorans will shed light on the evolution of this novel chewing, thus revealing the importance of retaining the predentary throughout Ornithischia.

Poster Session III (Friday, November 4)

ISOTOPIC INDICATORS OF SEASONALITY IN THE LATE PLEISTOCENE OF NORTHWEST ETHIOPIA

NACHMAN, Brett, The University of Texas at Austin, Austin, TX, USA; MILLESON, Mary, Southern Methodist University, Dallas, TX, USA; KAPPELMAN, John, The University of Texas at Austin, Austin, TX, USA; TABOR, Neil, Southern Methodist University, Dallas, TX, USA; TODD, Lawrence, The University of Texas at Austin, Austin, TX, USA

Recent excavations along the Shinha River in NW Ethiopia have uncovered a diverse vertebrate fauna dating to the late Pleistocene. The fauna includes members of several vertebrate classes including Marsupialia, Bats, Reptilia, and Aves. Much of this fauna is found in association with evidence of hominin occupation, including lithics and cut-marked bone. Both the temporal and spatial aspects of this locality are important not only in terms of expanding our understanding of vertebrate evolution in late Pleistocene Africa, but also for informing debates surrounding the route modern humans took when our species migrated out of Africa to colonize the Old World. Furthermore, evidence of seasonality in hominin occupations and its effect on foraging strategies can help elucidate the nature and extent of interactions between humans and the vertebrate community at large. The modern climate in this area is highly seasonal with the Shinha River showing high river flow during the wet season and low flow during the dry season. A central focus of this study is to determine whether the existing climate system is a reasonable representation of late Pleistocene environments as deduced from fossil herbivore tooth enamel, which acts as a proxy for bio-available H2O and plant type utilization by these animals across the paleolandscape. The selection of fossil tooth enamel reflects the fact that it is resistant to diagenesis and more likely than other fossil vertebrate material to preserve original isotopic values that are relevant to reconstructions of paleoenvironment, including habitat openness and aridity (carbon) and temperature and seasonality (oxygen).

We present data from carbon and oxygen isotope measurements taken from fossil bivores.
Our data show a wide variety of δ18O values, though all are greater than typical rainfall and groundwater levels, indicating evaporative enrichment consistent with a long dry season. δ13C values also vary, with some individuals indicating a mix of C3/C4 plant diets but the majority feeding on C4 plants exclusively. The isotopic data are consistent with a warm and dry environment, similar to what is found during portions of the modern area’s dry season.

Poster Session III (Friday, November 4)

A GIGANTIC BIRD FROM THE UPPER CRETACEOUS OF CENTRAL ASIA

NAISH, Darren, Darwin College of Portsmouth, Portsmouth, United Kingdom; DYKE, Gareth, University College Dublin, Dublin, Ireland; CAU, Andrea, Museo Geologico e Paleontologico “Giovanni Capellini, Bologna, Italy; ESCULLIÈRE, François, Élodie, Gannat, France; GODEFROIT, Pascal, Institut royal des Sciences naturelles de Belgique, Bruxelles, Belgium

We present a gigantic bird from the Late Cretaceous of Kazakhstan, represented by two edentulous mandibular rami from the same individual. As each ramus extends 275 mm, their owner was clearly enormous. The presence of two distinct mandibular cotyles, fusion of mandibular elements, atypical pneumatization and absence of mandibular fenestrae place the specimen in Avialae. It lacks the characters of other edentulous tetrapods (Testudines, Pterosaurus, Cretaceousaur, Ornithomimosaurus, Oviraptorosauria). Large size and an elongate mediiodorsal sulcus are autapomorphies of a new taxon. While the rami are edentulous, the dentary symphysis is unknown, so it remains possible that the animal possessed teeth in this position (or in its upper jaw).

 Incorporation of the specimen in a phylogenetic analysis of Theropoda leads to a hypothesis that the genus Ornithuara. This position shows that size and toothless mandibular rami evolved independently within Ornithuara. This new taxon is significant for several reasons. Firstly, it augments our poor knowledge of central Asian Cretaceous terrestrial faunas. Secondly, it demonstrates independent evolution of giant size in non-ornithuromorphian birds. This not only increasing our knowledge of size and trophic diversity in Mesozoic birds, it also indicates that the survival of ornithuromorphians across the K-Pg boundary (and the concomitant extinction of enantiornithine and ornithuromorph lineages) was not necessarily related to greater morphological and ecological adaptability. Thirdly, the existence of a gigantic Cretaceous bird provides additional support that the Mesozoic was not a ‘non-avialian-dinosaurs-only theme park’: large, terrestrial birds evolved alongside non-avialian dinosaurs, as did symphysids, lepidosaurs and crocodyliforms.

OSTEOCLEROSIS IN THE LIMB BONES OF TERRESTRIAL AND AQUATIC TURTLES

NAKAJIMA, Yasuhisa, the University of Tokyo, Tokyo, Japan; NAKATSUKASA, Masato, Kyoto University, Kyoto, Japan

The internal limb bone structure of tetrapods varies depending on their habitat and manner of locomotion: limb bones of terrestrial taxa tend to show tubular structure with open medullary cavity, while limb bones of aquatic taxa tend to be compact, the habitat preferences cover a wide range (terrestrial, semi-aquatic and aquatic), via microstructural response to functional requirements. Further, between species and genera, we have been able to maintain lines of action at 90° to one another, as in other morphotypes, including (Dermochelyidae), whose limbs are composed entirely of cancellous bone. This suggests an absence of evolutionary pressure to reduce the density of the limb bones in terrestrial turtles, possibly due to the restrictive nature of the carapace and plastron in terrestrial environment.

Poster Session I (Wednesday, November 2)


NAPLES, Virginia, Northern Illinois University, DeKalb, IL, USA

Until recently, three cat-like carnivore morphotypes, based on canine features and postcranial skeletal proportions were known. Xenosmilus hodsonae (Early Paleocene of Florida), a new saber-tooth genus and species, that contains bear-like postcranial elements with a more horizental line of action for this muscle than in previously studied saber-tooths such as species of the genus Homotherium, the dirk-tooth saber-tooth Smilodon fatalis and the conical-tooth cat Panthera atrox. Reorientation of the temporalis increased the muscle’s ability to elevate the mandible with greater force toward the end of closure by maximizing pull posteriorly in a more direct line as the mandible approached occlusion. The superficial masseter of X. hodsonae is also reoriented when compared to other saber-tooth and conical tooth morphs, improving the ability of this muscle to permit more effective force generation at initial mandibular closure. Therefore, both of the muscles responsible for effecting mandibular closure in X. hodsonae have been able to maintain lines of action at 90° to one another, as in other cats, while simultaneously maximizing their effectiveness in generating more consistently high pressures at all gaps, as well as being able to generate maximized initial closing pressures.

Early Late Miocene large ape (hominoid) fossils are rare in Sub-Saharan Africa. We reconstructed the paleoenvironments of early Late Miocene hominoid sites in the Namurungule Formation of the Samburu Hills and the Nakali Formation, Kenya, from rodent fauna and mesowear analysis of herbivore cheek teeth. The geologic ages of both formations are the same and their general faunal composition are similar. However, in contrast to the Nakali Formation whose only one hominoid fossil has yet been found, fossils of two hominoids and those of several other catarrhine taxa have been found from the Nakali Formation. Although only two rodent taxa (several specimens) are known from the Namurungule Formation, eight rodent taxa (more than 600 specimens) are known from the Nakali Formation. The paleoenvironment of Nakali inferred from the rodent fauna is a wet environment with upland forests, with wet climate and rainy-dry seasonality. An analysis of mesowear of Hyaenodon and bovid cheek teeth indicate that those from the Nakali Formation tended to be browsers. The paleoenvironment of the Nakali Formation may have been a wet woodland environment, while the Namurungule Formation may have been an arid open environment. This environmental difference between the Namurungule Formation and Nakali Formation probably indicates the environmental change through geological age and/or the topographic difference between highland and lowland at a similar age. This result is supported by stable isotope analysis of mammalian tooth enamel, pollen analysis and sedimentary analysis from both formations.

POSTER SESSION II (Thursday, November 3)

THE BRAINCASE OF PLACODUS GIGAS AGASSIZ, 1833 (SAUROPTERYGIA: PLACODONTIA) - A NEW RECONSTRUCTION BASED ON μCT SCANNING

NEENAN, James, Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland; SCHEYER, Torsten, Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland

Placodus gigas is a non-armored placodont marine reptile (Diapsida: Sauropterygia) known from the Middle Triassic of Europe, most commonly found in the shallow marine carbonates of the German Muschelkalk. The skull is generally very well understood, with the braincase that were previously obscured and allowing accurate osteological reconstruction.

The braincase has been revised, especially with regard to the proportions that the prootic and opisthotic contribute to the lateral wall. One of the specimens also displays a distinct fenestra anterocentral to the fenestra vestibule, which is tentatively identified as the fenestra rotunda. The parabasiphenoid, a large amount of which is obscured by the pterygoid and palatine bones, is revealed as being rather short, lacking a cultriform process, the ethmoid cartilage instead being supported by a n-shapped groove of the strongly raised palatines. However, an unusual, ring-like structure is visible at the anterior margin of the parabasiphenoid. Since
Placodonts are the sister group to all other sauroporignyas, including the fully marine pliosaurs, these new data are of great comparative and phylogenetic significance as it gives insight into some of the morphological and functional changes that took place at the base of the sauroporignyan clade, before the group became fully aquatic.

**Technical Session II (Wednesday, November 2, 3-45 pm)**

**AN ENIGMATIC ARCHOSAURIFORM FROM THE MANDA BODIES (MIDDLE TRIASSIC) OF SOUTHWESTERN TANZANIA: CHARACTER CONFLICT AT THE BASE OF PSEUDOSUCHIA**

NESBITT, Sterling, University of Washington, Seattle, WA, USA; SIDOR, Christian, University of Washington, Seattle, WA, USA; ANGIELCZYK, Kenneth, The Field Museum, Chicago, IL, USA; SMITH, Roger, South African Museum, Cape Town, South Africa; TSUJI, Linda, University of Washington, Seattle, WA, USA.

The presence of deriv pseudosuchians and ornithodirans in Anissian beds of South America and Africa shows that the archosaur radiation was well underway by the beginning of the Middle Triassic. The phylogenetic placement of many Middle Triassic archosauriforms (e.g., *Gavialis, Tarchonathus, Torvosaurus*) is poorly understood, with most assigned to the anapsid and likely paraphyletic “Rauisuchia.” Only a few are suggested to be basal members of younger clades, whereas nearly all Late Triassic taxa can be placed into clearly diagnosed clades (e.g., *Aetosaurus, Ornithosuchus, Dinosauriaorosaurus*). Here, we introduce a new archosauromorph with an unusual mix of character states found within Pseudosuchia, and just outside Archosaurus. The specimen consists of parts of the mandible, pterygoid, pectoral girdle, humerus, pubis, vertebrae from much of the axial column, osteoderms, and a nearly complete hindlimb including a complete ankle. The ankle is of cruriform type and the calcaneum and astragalus articulate similarly to members of Phytosauria. There are five leaf-shaped osteoderms per two vertebrae and neural spines feature lateral expansions at their dorsal ends. The length of the pubis is short (~35%) relative to that of the femur. The pterygoid bears the anteroposteriorly oriented rows of teeth and the surangular bears a large lateral shelf. Including the new specimen in an extensive analysis of basal archosaurs (412 characters, 80 taxa) results in its placement as a basal pseudosuchian more closely related to paracrocodylomorphs than to aetosaurans. Constraint trees and other sensitivity analyses resulted in little change in the relationships of other Triassic clades but drastically changed optimizations of certain character states or complexes (e.g., dual origin of a phytosaur-like ankle, osteoderm shape). Our analyses suggest that high rates of homoplasy and incomplete specimens are hindering understanding of the origin and early evolution of Pseudosuchia and, in turn, Archosaurus.

**Poster Session II (Thursday, November 3)**

**A GEOMETRIC MORPHOMETRIC ANALYSIS OF CROCODIlius NILICUS: OSTEOLogICAL EVIDENCE FOR A CRyPTIC SPECIES COMPLEX**

NESTLER, Jennifer, University of Iowa, Iowa City, IA, USA

The Nile crocodile *Crocodylus niloticus* currently has an extensive range throughout the African continent and Madagascar, though fossils reveal a larger historical range including parts of the Sahara Desert, Mediterranean coast, and Arabian Peninsula. Recent molecular studies have yielded genetically distinct populations of *C. niloticus*, suggesting that it is a cryptic species complex. However, morphological variation remains unassessed. Although long thought to be part of a lineage present in Africa since the Paleogene, recent work on the East African crocodylian fossil record indicates divergence of *C. niloticus* within the past two million years. A geometric morphometric analysis of cranial variation in *C. niloticus* demonstrates population variation broadly bound by river basins, with at least three distinct populations present. The morphometric analysis is coupled with a geographic analysis to determine if the species is morphologically variable by geographic region. These results agree with molecular analyses, supporting the methods employed herein as an effective way to distinguish cryptic species in the fossil record. At least two of these are more morphologically distinct from each other than they are to other members of the genus *Crocodylus*, thus supporting the recognition of a cryptic species complex. Because threats to *C. niloticus* vary by region, at least one of these species may be endangered. The greatest potential for the survival of these populations lies in a thorough understanding of the evolutionary history, interrelationships, and biogeography of these animals. These results demonstrate that paleontology has the ability to inform and improve our decisions about conservation, and allow us to assess the diversity of a species or species complex across time and space.

**Poster Session IV (Saturday, November 5)**

**Hypselosinus Fition: An Exemplar of Nomencelral Confusion and Standards of Taxonomic Practice in WaldeI GignodontiNs**

NORMAN, David, University of Cambridge, Cambridge, United Kingdom

The generic name *Iguanodon* bears an historic legacy linked to it having been a founder member of Richard Owen’s ‘sub-class’ Dinosauria. During the late decades of the 19th century a number of new *Iguanodon* species were proposed on the basis of incomplete skeletal remains recovered from a discrete area of south-east England known as The Weald; among these new taxa were *I. fitioni* and *I. hollingtoniensis*. These two species were described comparatively briefly in short notes and have, for most of the intervening time, resided relatively inconspicuously in taxonomic compilations of dinosaurs. During the past three years several researchers have reassessed these (and other, closely related) English taxa and proposed a number of nomenclatural remedies to what are perceived to be taxonomical problems or shortcomings originating in the original descriptions. The approaches that have been published by these researchers will be shown to be varied and inconsistent, leading to contradictory outcomes. This raises concerns about the standards that should be required in order to maintain reasonable levels of consistency of taxonomic practice. Given that reliable and accurate taxonomy underpins most aspects of synthetical palaeobiology it is self-evidently important that a reasonable degree of consistency of approach is maintained in the scientific literature.

**Stratigraphy of a Fossiliferous late Wasatchian (Lestocabinian) Fluvial Section in the Red Desert, North Eastern Green River Basin, Wyoming**

NEUMANN, Allison, University of Alberta, Edmonton, AB, Canada; ZONNEVELD, John-Paul, University of Alberta, Edmonton, AB, Canada; BARTELS, William, Albion College, Albion, MI, USA; GUNNELL, Gregg, University of Michigan, Ann Arbor, MI, USA;

Fossil vertebrates from the early Eocene Wasatchian Land Mammal Age (Lestocabinian Subage, Wa7) occur in the Pinnacles area in the Green River Basin. This series of localities represents one of the most fossiliferous latest Wasatchian successions in the world and has produced well over 1000 tetrapod fossils including 17 orders, 30 families and 57 species of mammals. The Pinnacles represent the uppermost 40-50 meters of the Main Body of the Wasatch Formation in the South Pass area. The exposures are dominated by overbank mudstones overprinted by weakly to well-developed palaeosols, thin cresvase spill sandstones, and repeating sequences of golden colored ribbon sandstone bodies representing high sinuosity meandering stream channels. The buttes are capped by stromatolitic limestones and shales of the lower 5-10m of the Tipton Shale Member (Green River Formation) providing an easily identified upper boundary to the Wasatch Formation (Main Body) and recording late environmental change, from meandering fluvial to dominantly lacustrine. Accumulation of fossil material in palaeosols represents in situ skeletal debris, whereas fossils from the lower part of channel sequences commonly exhibit signs of reworking from adjacent paleosol units. Although vertebrates have been recovered from the floodbasin deposits, the vast majority come from a few densely fossiliferous localities within the channel sandstone bodies exposed throughout the study area. Mammalian representatives of the Lestocabinian subage are abundant in the lower section of the Pinnacles, while fossil material from the upper section is currently absent. Measured sections indicate that several distinct ribbon sand bodies occur in the area and that productive horizons occur in at least two of these. The stratigraphic correlation between these localities and the lateral extent of fossiliferous beds at the Pinnacles has not previously been well constrained. Detailed stratigraphic and sedimentological analyses provide additional context to more accurately interpret the taphonomy of these accumulations, which facilitates faunal comparisons with the classic Lestocabinian assemblages.

**Avifaunas of the Middle Pleistocene Irvington and Fairmead Landfill Localities in California**

NGO, My, Department of Earth & Environmental Sciences, California State University, Pomona, CA, USA; CANCHOLA, Jose, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA; DUNDAS, Robert, Department of Earth & Environmental Sciences, California State University, Fresno, CA, USA.

Two avifaunas in the University of California Museum of Paleontology (UCMP) and Madera County Paleontology Collection (MCPC), namely Irvington and Fairmead Landfill, provide insight into the middle Pleistocene birds of the coastal and interior areas of central California. Located in the San Francisco Bay area in Fremont, California, the Irvington biota was recovered from fluvial deposits in a gravel quarry. The type locality of the Irvingtonian land mammal age, Irvington fossils were preserved in reversely magnetized strata interpreted to be within the upper part of the Matuyama magnetic polarity chron (>78 Ma). Irvington records 55 taxa (31 mammals, 8 birds, 4 amphibians, 3 reptiles, 5 mollusks). The eight bird taxa are represented by 15 bird specimens which include Ardeidae (UCMP 67817 distal ulna), Anserini (UCMP 80995 left humerus, UCM 67817 radius, UCMP 80997 distal ulna, UCMP 80996 proximal femur), Canada Goose *Branta canadensis* (UCMP 38336 left humerus), American Neophron *Neophron peruvianus* (UCMP 80998 left humerus), Phasianidae (UCMP 80994 partial coracoid), Meleagridae (UCMP 80993 distal femur), Scolopacidae (UCMP 80992 distal femur), and Passeriformes (UCMP 80896 carotenopus, UCMP 80898 left ulna, UCMP 80899 left humerus, UCMP 80990 coracoid, UCMP 80991 coracoid). In the San Joaquin Valley of California, 10 miles north of Madera, Fairmead Landfill has yielded thousands of specimens from a site 0.78 Ma to 0.55 Ma in age. The biota consists of 57 taxa (27 mammals, 5 birds, 3 reptiles, 2 amphibians, 1 fish, 1 bivalve, 1 gastropod, 1 plant macrofossil, 16 diatoms). Among the finds are 10 bird specimens, representing at least five taxa, including small goose cf. Branta sp. (MCPC A1102 synanum), Canada Goose *Branta canadensis* (MCPC A1103 left distal humerus), Common Shelduck *Tadorna tadorna* (UCMP 140414 right distal humerus, UCMP 141403 right humerus, UCMP 144432 right humerus), diving duck cf. Aythya sp. (UCMP 144432 right tarsometatarsus), Mourning Dove *Zenaida macroura* (MCPC A1560 left proximal tarsometatarsus), and burrowing owl *Athene cunicularia* (MCPC A1350 left distal tarsometatarsus).

**Landfill Localities in California**

**A VIFAUNAS OF THE MIDDLE PLEISTOCENE IRVINGTON AND FAIRMEAD**

**Poster Session I (Wednesday, November 2)**

**A VIFAUNAS OF THE MIDDLE PLEISTOCENE IRVINGTON AND FAIRMEAD LANDFILL LOCALITIES IN CALIFORNIA**

**Poster Session IV (Saturday, November 5)**
The full taxonomic history of *Hypselosaurus* and closely related Wealden iguanodontians exemplifies both good and bad practice, and serves as a timely reminder of the place and fundamental importance of objective taxonomic procedures.

**Poster Session I (Wednesday, November 2)**

**MORPHOLOGICAL VARIATION IN THE SKULL OF *AELOURGNATHUS* (THERAPSIDA, GORGONOPSIDA) AND ITS REPERCUSSION ON THE TAXONOMY OF THE GENUS**

NORTON, Luke, Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg, South Africa

Gorgonopsia represent a group of specialised carnivores that fulfilled the role of the dominant predator during the Late Permian in the terrestrial realm of what is now southern Africa, East Africa and Russia. Skull size in the Gorgonopsia ranges from that of a cat, to larger than any terrestrial mammalian predator. Despite this variation in size, morphological variation in the skull is very conservative. This study aimed to better understand the degree of variation among species attributed to the South African genus, *Aelurognathus*, and to possibly refine the taxonomy of the genus. *Aelurognathus* was chosen as it contains the most number of recognised species (six) and the largest number of specimens (16). All specimens were examined in order to identify morphological variation within species (intraspecific), as well as variation between species (interspecific). Differences observed at the ‘interspecific’ level allowed for the division of the six species into two taxa, predominantly on the presence or absence of a prearticular. Occurrence of supernumerary bones has been documented in the skull roof of extinct and extant taxa, with the presence or absence of a prearticular varying even within a breeding population of *Procavia*. Taking this into account, the hypothesis that all 16 specimens represent a single taxon, exhibiting a high degree of morphological variation, was tested using allometric techniques. Seventy linear measurements of the skull were selected, such that variation in skull shape and size could be accounted for in all dimensions. Results of the analyses showed that the specimens plotted on a growth curve, supporting the single taxon hypothesis. While *Aelurognathus* has previously been divided into six species using morphological characters, this study has shown that characters used can be variable within a population. As it is seldom that a population is preserved in the fossil record, using morphological characters too strictly to describe specimens has likely led to the number of recognised gorgonopsian taxa being larger than expected. As such it is proposed that all species attributed to *Aelurognathus* be synonymised with the type, *Aelurognathus tigriceps*.

**Poster Session II (Thursday, November 3)**

**LIFE AND DEATH IN A CRETACEOUS COASTAL SWAMP: EXAMPLE FROM THE WOODBINE FORMATION OF TEXAS**

NOTO, Christopher, University of Wisconsin-Parkside, Kenosha, WI, USA; DRUMHELLER, Stephanie, University of Iowa, Iowa City, IA, USA; MAIN, Derek, University of Texas at Arlington, Arlington, TX, USA; ALLEN, Eric, University of Iowa, Iowa City, IA, USA

During the Cenomanian, the Dallas-Fort Worth area was situated along a subtropical coastline. Part of this ecosystem is preserved at a fossil locality called the Arlington Archosaur Site (AAS). Sedimentary data suggests the climate was distinctly seasonal. The wet season experienced increased precipitation, sometimes with intense tropical storms that felled large trees. Periodic wildfires occurred in the dry season, as shown by numerous charcoal fragments and burned root systems. A diverse fauna of dinosaurs, crocodyliforms, turtles, sharks, rays, lungfish, and invertebrates have been recovered to date. Here we present a preliminary description of the paleoecology and taphonomy of the AAS fauna, focusing on trophic interactions represented at the site. Most fossils are concentrated in a time-averaged peat bed and are well preserved but disarticulated. Numerous specimens exhibit tooth marks diagnostic of feeding by a large crocodyliform, consistent with the size of skeletal remains from the site. Feeding traces consist of pits, scores, and a puncture that occur on multiple turtle fragments and two dinosaur limb bones. The pattern of marks and breakage on turtle shells suggests inertial feeding followed by crushing. Marks on the di-nosaur bones indicate possible disarticulation, which is consistent with marks produced by living crocodylians. The co-occurrence of bite marks and skeletal remains from adult and juvenile individuals suggests this area was inhabited by an active breeding population.

The ecology of AAS crocodyliforms appears most similar to that of generalist crocodylians inhabiting deltaic-plains ecosystems. Theropod dinosaur remains are rare and diagnostic tooth marks absent. Therefore, AAS crocodyliforms were the likely apex predators in this ecosystem, not unlike the situation reconstructed for similar environments dominated by gigantic crocodyliforms in the Late Cretaceous. AAS crocodyliforms also played an important taphonomic role in the assembly of vertebrate remains from the surrounding community, possibly through the creation of caches. The AAS provides a critical window into the workings of a middle Cretaceous coastal ecosystem.

**Poster Session III (Thursday, November 4)**

**THERAPSIDA, GORGONOPSIDA AND ITS REPERCUSSION ON THE**

**TAXONOMY OF THE GENUS**

NORTON, Luke, Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg, South Africa

NORTON, Luke, Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg, South Africa

The Cretaceous (Cenomanian to Turonian) deposits of the Kem Kem in SE Morocco have been studied since the 1950s and have yielded an extremely varied fossil assemblage of terrestrial and aquatic animals: fish, turtles, crocodiles, pterosaurs, non-avian dinosaurs, including very large theropods (*Spinosaurus*, *Carcharodontosaurus*) and birds.

Footprints of fossil reptiles are also common near the top of the Kem Kem beds. Though known for many years, the fossil traces present in these levels have never been analyzed despite claims about the unique nature of the Kem Kem ecosystem.

In May 2011 we collected vertebrate traces at several localities in the Kem Kem region, at Gara Es Shaa and in new localities. Trampled levels (carbonate-cemented fine-grained quarries) with ripple cross-lamination occur just a few meters below bivalve and gastropod-rich marly-limestones that cap the section in almost vertical cliffs. No large track surfaces were found due to the almost flat attitude of bedding and to the often scarce cementation of the layers which break into relatively small (max. 1.5-2 m2) slabs.

More than forty tracks were recorded at three different sites, alongside many others that were not collected or measured due to poor preservation. Still others occur on completely disintegrated surfaces where individual prints cannot be discerned. All tracks are isolated and preserved as natural casts: many were collected from scree, very close to the original level. Amongst our collection, most tracks were made by medium (8-25 cm) to large (8-40 cm) theropods, especially at Gara Es Shaa. Other vertebrates are also represented by swimming traces of turtles and crocodylians coeval with theropods. It is likely that while the theropods were large enough to walk in some of the large Kem Kem ponds and swamps of the coastal mudflat, whereas their smaller counterparts had to swim. One putative sauropod manus print was also recorded.

Though our work in the Kem Kem is preliminary and ongoing, the ichnocoenosis recognized here describes several ecological reconstructions for the area as theropod-dominated, even though no tracks comparable in size with the largest theropods were found.

**Poster Session IV (Saturday, November 5)**

**AGE, STRATIGRAPHY, DEPOSITIONAL ENVIRONMENT AND VERTEBRATE**

**ICHNOLOGY OF THE MIOCENE-PLIOCENE COPPER CANYON FORMATION, DEATH VALLEY, CALIFORNIA**

NYBORG, Torrey, Loma Linda University, Loma Linda, CA, USA; BUCHHEIM, Paul, Loma Linda University, Loma Linda, CA, USA; SANTUCCI, Vincent, NPS - Geologic Resources Division, Washington, DC, USA

Extremely well preserved fossil tracks and trackways of mammals and birds are preserved in playas mud flat deposits of the Copper Canyon Formation. Twenty-six ichnospecies of cat, camel, horse, mastodon and bird tracks have been identified from 60+ localities spanning over 1200 m of lacustrine deposits. The formation is composed of approximately 1800 m of conglomerates, basalt flows, and fluvial-lacustrine sediments exposed within Copper and Coffin Canyons on the west side of the Black Mountains in southern Death Valley National Park, California. It is exposed in a tectonic basin associated with right steps within a low angle reverse fault system that cut the Cretaceous–Paleogene boundary. The Black Mountain formation is composed of thick sequences of black volcanic tuff and andesitic breccia, as well as trachytic and quartz diorite, and is unconformably overlain by the Funeral Mountains. The formation is divided into three units: the Black Mountain tuff, the Funeral Mountains tuff, and the Copper Canyon tuff, with the latter unit being the youngest.

Although the depositional environment of the Copper Canyon Formation has been discussed in the past, few ichnological studies have focused on the trackways in the Copper Canyon or its surrounding area. In May 2011 we collected invertebrate tracks at several localities in the Copper Canyon Formation, specifically in the War Eagle Ranch, California. It is exposed in a tectonic basin associated with right steps within a low angle reverse fault system that cut the Cretaceous–Paleogene boundary. The Black Mountain formation is composed of thick sequences of black volcanic tuff and andesitic breccia, as well as trachytic and quartz diorite, and is unconformably overlain by the Funeral Mountains. The formation is divided into three units: the Black Mountain tuff, the Funeral Mountains tuff, and the Copper Canyon tuff, with the latter unit being the youngest.

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20 taxa/morphotypes), Aguja (Texas; 9 taxa/morphotypes), Judith River (Wyoming; 5 taxa/morphotypes), Fruitland (New Mexico; 3 taxa/morphotypes), and El Gallo (Baja California; 1 taxon)—numbers are approximate as some records are difficult to confirm. When comparing the squamate faunas from north to south there are recognizable trends: (1) iterative and balanced presence of anguids, platynotans, and snakes; (2) iterative presence of chamaepelotes with decreasing diversity from north to south; (2) presence of polyglyphonodontonts limited to southern regions; (3) presence of xenosaurus and cordylid/paramacellodoid-grade taxa limited to more northern regions; (4) iguanians present only in Alberta; and (5) the Utah fauna is taxonomically transitional between those of the north and south. Many of the taxonomic trends are recognizable only at or above the family level with regional endemism of many genera and/or species. The various north-to-south differences in the squamate faunas appear to be correlated with latitude (and the presumed associated broad-scale environmental diversity). However, differences in specific depositional environments (e.g., meandering river systems versus backwater lagoons) likely are also responsible, in part, for the variation in taxa from locality to locality. While the last 20 years has seen much improvement, the squamate record is still limited and requires continued recovery of additional specimens throughout Laramidia, particularly in the more southern latitudes.

Poster Session III (Friday, November 4)

ADVANTAGEOUS ARTIODACTYL ANATOMY: ASSESSING THE FUNCTION AND EVOLUTIONARY HISTORY OF THERMOREGULATORY CRANIAL VASCULATURE WITHIN THE RUMINANTIA
O’BRIEN, Haley, Ohio University, Athens, OH, USA

Artiodactyls are considered the most successful extant ungulates, in both geographic range and species-level diversity. This success has been attributed to derived anatomical structures, such as the ruminant digestive tract, hypothesized to have sheltered the clade from extinction through its ability to digest vegetation. Recently, the subdural carotid rete (CR) has been hypothesized to impart artiodactyls with a fitness advantage. The CR is a meshwork of small arteries that plays an important homeostatic role by selectively maintaining cooler cranial blood temperatures even as body temperature increases via metabolic activity or exposure to high environmental temperatures. The present study reviews and models the anatomy and functions of the CR, and uses osteological correlates to explore the distribution and evolutionary history of this potentially advantageous structure in extant and fossil ruminants.

The CR completely replaces the internal carotid artery (ICA) and vertebral arteries in supplying the brain with oxygenated blood, resulting in significant changes in cranial osteology. Unlike the ruminant digestive tract, osteological correlates are identified for the carotid rete—an important advantage for paleontological studies relying on hard part anatomy. Presence of the sphenoidal foramen orbitorum is indicative of the CR, whereas fora-}


tions of evidence for viviparity in the derived sauropterygian clade Plesiosauria despite an excellent fossil record and a collection history spanning almost two hundred years. Here we report the first definitive evidence of plesiosaurian viviparity. The fossil described here was discovered in Logan County, Kansas, at the base of the Sharon Springs Member of the Pierre Shale (Campanian). It consists of the largely articulated remains of two plesiosaurs, an adult and a juvenile displaying early autapomorphic features. The adult is a large plesiosaur referable to Polycotylus latippinus and is complete save for the head and anterior 21 cervical vertebrae. The juvenile consists of a largely disarticulated mass of poorly ossified bones spilled from the body cavity of the adult, and is also referable to Polycotylus latippinus. There are no gastroliths associated with the embryo, and no mummification or cartilaginous surfaces attributable to stomach acid. The taxonomic identity of adult and embryo, the location of the embryo within the adult body cavity, the early ontogenetic stage of the embryo, and the lack of evidence for a gastric mass all support the conclusion that the adult was a gravid female.

Utilizing morphometric data from the vertebral centra, we calculate a conservative embryo length of 150 cm at time of death (32% of the 470 cm maternal length). Length at full term would have been significantly longer; we calculate a rough estimate of 40% of maternal length or more. Polycotylus therefore gave birth to very large, probably single progeny, a reproductive strategy unique among marine reptiles. The mammal-like traits of viviparity, small brood size, and large embryo size are rare in modern lizards, but this combination does occur in the scincid Egeruna species group. This clade also exhibits mammal-like social behaviors, including stable, kin-related group structures and parental care. Because both ceteceans and Egeruna-group lizards are highly social and engage in significant maternal care, we hypothesize that pleosaurids may have behaved similarly.

Poster Session II (Thursday, November 3)

X-RAY VISION SEES THROUGH THE FEROCIOUS PONY HYPOTHESIS
O’SULLIVAN, Jay, University of Tampa, Tampa, FL, USA

Previous work indicates that the ethology of the small Miocene equid Archaeohippus blackbergi differed substantially from that of the contemporaneous equid Parahippus leonensis. Studies of mortality curves based on fossils collected from the Thomas Farm site and housed in the Natural History Museum of Florida at the University of Florida suggest two distinct mortality distributions. The population of A. blackbergi experienced a sharp increase in mortality in young adults compared to P. leonensis. Such a pronounced mortality spike is typical of mammals in which males fight for access to females. This interpretation for A. blackbergi is supported by the presence of strong sexual dimorphism in canine size. Further support comes from a recent study that shows that the mandibles of specimens with large canines (males) are relatively thicker at the back of the diastema, presumably to resist loading on the anterior mandible during bite attacks. The present study uses x-ray imaging to further test the hypothesis that male A. blackbergi used their mandibles for fighting behaviors that were not displayed by females of the species or by P. leonensis. Further support for the hypothesis comes from the observation that cortical bone thickness in the diastema of males is relatively thicker than in either female A. blackbergi or in P. leonensis.

Poster Session III (Friday, November 4)

A MULTI-TAXON THEROPOD DINOSAUR ACCUMULATION FROM THE LATE CRETAEOC OF MADAGASCAR: NEAR-INSTANTANEOUT ENTOMBMENT OF SMALL-BODIED AVIALANS
O’CONNOR, Patrick, Ohio University, Athens, OH, USA; ROGERS, Raymond, Macalaster College, St. Paul, MN, USA; GROENKE, Joseph, Stony Brook University, Stony Brook, NY, USA; BURCH, Sara, Stony Brook University, Stony Brook, NY, USA; TURNER, Alan, Stony Brook University, Stony Brook, NY, USA

Recent field efforts conducted as part of the Mahajanga Basin Project have resulted in a significantly improved sampling of theropod dinosaurs from the Maevarano Formation. Both avialan and nonavialan taxa have been recovered from MAD 05-42, a locality exhibiting a mixed taphonomic signature that includes a range of preservational styles. Small (< 4 cm), isolated avialan specimens are routinely found in close proximity to large (> 15 cm) disarticulated nonavialan elements. Perhaps most striking is the co-occurrence of multiple semi-articulated to articulated partial avialan skeletons within the quarry. The most exquisite degree of preservation is exemplified by articulated phalangeal series consisting of individual elements < 2 mm in length. In this study we profile the co-occurrence of small-bodied, semi-articulated to articulated avialans among large-boded disarticulated specimens within a single quarry. High-resolution x-ray computed tomography was used to generate detailed sub-millimeter spatial characterizations and preliminary anatomical assessments of unprepared specimens. High-resolution spatio-anatomical data are combined with detailed quarry mapping, field collection data (e.g., orientation), and both field- and laboratory photography to evaluate hypotheses related to previously proposed burial models. Selected small, multi-element specimens (MOS) reveal remarkable preservation in the form of articulated vertebral, costal, and gastralial series and multiple limb segments, with many retaining the original three-dimensional organization. Other MOS exhibit slight (~ 2 cm) dissociation across joints, with yet others consisting of fragmentary, partial elements displaying loading of the anterior rib/costal during bite attacks. We calculated ages applied during burial and in the post-burial environment. The small size of avialan specimens, combined with their lightly-built skeleton and degree of articulation, strongly indicate that minimal transport occurred during burial. Data are consistent with interpretations of viscous mass flows as entombing agents, with microCT analysis providing novel perspectives on depositional kinematics.

Technical Session IX (Friday, November 4, 9:00 am)

VIVIPARITY AND CETACEAN-LIKE LIFE HISTORY IN A MESOZOIC MARINE PLESIOSAUR (REPTILIA: SAUROPTERYGIA)
O’KEEFE, F., Robin, Marshall University, Huntington, WV, USA; CHAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA, USA

Although live birth has been documented in several clades of Mesozoic aquatic reptiles, no evidence exists for viviparity in the derived sauropterygian clade Plesiosauria despite an
NEW INFORMATION ON THE PLOTOPTERIDAE SKULLS FROM THE OLIGOCENE KISHIMA GROUP AND ASHIYA GROUP OF NORTHERN KYUSHU, JAPAN

OHASHI, Tomoyuki, Kitakyushu Museum of Natural History & Human History, Kitakyushu, Fukuoka, Japan; HASEGAWA, Yoshikazu, Gunma Museum of Natural History, Tomioka, Gunma, Japan; KAWABE, Soichiro, The University of Tokyo, Tokyo, Japan; OKAZAKI, Yoshihiko, Kitakyushu Museum of Natural & Human History, Kitakyushu, Fukuoka, Japan

Plotopteridae is an extinct family of seabirds found from the Middle Eocene to Middle Miocene of the North Pacific region. Five species have been described previously, but many of them comprised fragmentary and postcranial materials. Therefore, their phylogenetic position in avian phylogeny is debatable. A recent phylogenetic study pointed out their relationship with Sphenisciformes, in contrast to most other studies that suggest their relationship with Pelecaniformes. We studied three skull specimens of plotopterid birds obtained from the Oligocene Kishima Group and Asiya Group of northern Kyushu, Japan. Two of the specimens essentially are preserved frontal-parietal parts and neurocranium. The other specimen is almost completely preserved. These specimens provided new information on the skull of plotopterid birds.

Two plotopterid species Copetopteryx heceris and C. titan are known from the Asiya Group. The skull elements of these specimens were not preserved. The holotype of C. titan is one left femur, which is larger than that of C. heceris. The orbital marginal length of each skull studied by us is different. The relationship between these skulls and Copetopteryx is not obvious, but judging from their skull size, these skull specimens are possibly of a different kind from each other.

Poster Session I (Wednesday, November 2)

CRANIAL GROWTH AND DEVELOPMENT IN PANTYLUS CORDATUS (LEPOSPORIDYL: TETRAPODA)

OLORI, Jennifer, The University of Texas at Austin, Austin, TX, USA

Incorporation of ontogenetic data into analyses of tetrapod relationships and the ancestry of extant amphibians is becoming increasingly common. However, the utility of those data is limited by lack of developmental information for many Paleozoic taxa. Although ontogenetic data for lepospondyls is increasing, nearly all of those data are for primarily aquatic taxa that required water for at least part of the life cycle. Almost nothing is known about skeletal growth in terrestrial taxa, such as Pantylus cordatus, that required water for at least part of the life cycle. Almost nothing is known about skeletal growth in terrestrial taxa, such as Pantylus cordatus, that required water for at least part of the life cycle. Almost nothing is known about skeletal growth in terrestrial taxa, such as Pantylus cordatus, that required water for at least part of the life cycle. Almost nothing is known about skeletal growth in terrestrial taxa, such as Pantylus cordatus, that required water for at least part of the life cycle.

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Poster Session I (Wednesday, November 2)

EGGSHELL ABRASION: AN EXPERIMENT TO CHARACTERIZE THE RESULT OF SEDIMENT INTERACTION ON FRAGMENTARY FOSSIL AND MODERN EGGSHELL

OSER, Sara, Montana State University, Bozeman, MT, USA; JACKSON, Frankie, Montana State University, Bozeman, MT, USA

Fossil egg horizons in the Cretaceous Wayan and Two Medicine formations of Idaho and Montana occur in fine-grained alluvial deposits and contain hundreds of eggshell fragments whose origin remains enigmatic. Possible explanations include 1) in-situ eggshells from hatched clutches or 2) fluvial transported material (pre- or post-fossilization). To investigate these possibilities, I conducted actualistic experiments using modern and fossil eggshell fragments. Eggshell presents a unique opportunity in that modern eggshell has a significant transport-induced abraion occurring pre-fossilization should leave marks distinct from abrasion after fossilization.

Thirty chicken (Gallus gallus domesticus) and three ostrich (Struthio camelus) eggshell fragments were used to determine the effects of abrasion pre-fossilization, while ten (presumably untransported) hadrosaur (Maiasaura peeblesorum) eggshell fragments from the Two Medicine Formation were used to determine the effects of abrasion after fossilization. These were divided into 3 groups and placed in a rock tumbler with water and quartz sand (0.5-1.0 mm) for one to three weeks (groups removed after 168, 336, and 504 hours). The fragments were then imaged using a JEOL JSM-6100 scanning electron microscope at 20 kV.

The organic components of the eggshell had a drastic effect as to how it responded to abrasion. The chicken eggshell lost the cuticle after 1 week and then experienced edge rounding and a loss of surface detail, similar to the fossilized eggshell. The ostrich eggshell (with a substantially thicker cuticle) developed small grooves on the cuticle surface and experienced crack propagation at the edges. The chicken eggshell displayed a higher degree of abrasion around the pore openings, which were protected by infill in the fossilized material and by the cuticle in the ostrich eggshell. The organic component of the cuticle may cause damage due to abrasion to be more minor and localized. Further research will extend the tumbler time with an expanded sample size and sediment variety.

Poster Session I (Wednesday, November 2)

REGIONAL VERSUS TAXONOMIC VARIATION IN VERTEBRAE OF ALBULOID (TELEOSTEI, ELOPOMORPHA) FISHES

OSTROWSKI, Summer, Michigan State University, East Lansing, MI, USA

Teleost vertebrae are common in many vertebrate paleontology collections, but quite often remain unidentified beyond “Teleost indet.” which is not useful to researchers. Fossil albolid (bonefish) vertebrae are relatively common and the group as a whole has a global distribution and is represented at many localities, yet their vertebrae have not been studied in detail. Albolid vertebrae are distinctive from most teleosts due to their “simple” shark-like appearance, and relatively short and compact proportions. The Late Cretaceous deposits of northwestern Madagascar have produced an intensely studied and highly diverse vertebrate
fauna, which includes multiple albuloid taxa (based on dental morphology). There is considerable variation among the vertebrae of albuloids collected from the sites in Madagascar, and these have yet to be assessed in the context of whether or not they are diagnostic in distinguishing between taxa or represent regional variation within a taxon. The Madagascar vertebrae range from small (<0.5 cm in diameter) and simple round-edged structures to large (>2.5 cm in diameter), robust vertebrae with a sigmoidal outline. This study assesses whether these variations are likely to occur within an individual (or individual genus), or whether it is more likely that these vertebral morphotypes correspond to the albuloid diversity seen in the Late Cretaceous deposits. Geometric morphometrics is applied to quantitatively compare the Madagascar albuloid vertebrae with one another, and with vertebrae of identified recent albuloids from comparative collections. It appears that the vertebral differences do reflect taxonomic distinctions, a conclusion that is supported by the morphological differences in toothplates found at the same sites.

E&D Poster Session

FOSSIL HORSES, ORTHOGENESIS, AND PUBLIC UNDERSTANDING OF EVOLUTION
OVIĘDO, Luz, Florida Museum of Natural History, Gainesville, FL, USA; SEYMOUR, Grace, Cornell University, Ithaca, NY, USA; MCAFADDEN, Bruce, Florida Museum of Natural History, Gainesville, FL, USA

Since the late 19th century, the fossil record of horses (Family Equidae) has been widely considered to be a classic example of macroevolution. As a result of Marsh and Huxley’s influence in the 1870s, fossil horses in North America were originally depicted as an orthogenetic (straight-line) sequence starting with “eohippus” in the Eocene and ending with modern day Equus. In the early 20th century, however, paleontologists studying fossil horses, such as Gidley (and then Simpson, for example), depicted fossil horse evolution as a branching phylogenetic tree, and not an orthogenetic pattern. Nevertheless, up to the present day, horse evolution is still communicated to other scientists, K16 students, and the general public as being orthogenetic in a wide variety of media. In addition, an orthogenetic pattern is also used to depict the evolution of other groups with a fossil record, including of great societal relevance, humans.

In this study we describe and evaluate how horse evolution is portrayed in different types of media and how its depiction influences the public understanding of evolution. Much of the public (mis)understanding of as it pertains to the fossil record stems from scientists’ failure, or inability, to communicate up-to-date and correct evidence for the pattern of evolution in diverse media including museum exhibits, textbooks, and web-based content. The explanation for this miscommunication may stem from the fact that orthogenesis is perhaps easier to grasp as a simple concept than a complexly branching phylogenetic tree, despite the fact that, depending upon one’s point of view, orthogenesis is either an oversimplification, or wrong. The challenge for researchers is to communicate complex concepts in a way that make these more accessible to a broad audience of scientists and the general public.

Technical Session X (Friday, November 4, 8:15 am)

PHYLOGENETIC DISTRIBUTION OF ECOLOGICAL TRAITS IN THE ORIGIN AND EARLY EVOLUTION OF BATS
PADIAN, Kevin, University of California, Berkeley, CA, USA; DIAL, Kenneth, University of Montana, Missoula, MT, USA

Living bats differ from other flying vertebrates (birds and pterosaurs) in having poor sight, echolocating, stressing slow, maneuverable flight, and seldom gliding. It has generally been assumed that gliding is a necessary precursor to flight, but phylogenetic analyses show that no gliding forms are found among the closest relatives of flying forms, and many gliding lineages have evolved with no apparent tendencies to powered flight. The most basal known bats could fly, but the most basal Orychonycteris lacked bony specializations for echolocation, which has suggested that flight evolved first. However, other mammals such as the tenrec do not fly but can echolocate in a more rudimentary way, and they lack chiropteran bony specializations for this. Nocturnal animals generally evolve enhanced vision, but animals that live in almost total darkness may no longer need the functional ability to see. Hence, visual capabilities of the earliest bats are ambiguous, but nearly all living bats are crepuscular, roosting in dark places.

We mapped traits related to echolocation, locomotion, vision, diet, and habitat in crown and stem bats. Results suggest that echolocation may be an “evolvable,” modular trait that has been hard-wired to various degrees in mammals. Basal bats are inferred to have been insectivorous, but they may have hunted differently than living bats do. Phylogenetic mapping shows that neither the ability to fly well nor to echolocate well may have been basal to bats; living in caves and feeding on poorly mobile insects may have been basal habits at least for crown-group bats. No outgroups to bats are or apparently were bipedal; thus the forelimbs of bats may have been freed to evolve powered flight if they were no longer necessary for standard quadrupedal locomotion. All bats can climb quadrupedally and this seems basal for crown-group bats. Caves have fewer predators than trees, and the ability to suspend the body from the roofs of caves appears to have been possible for all known Chiroptera, living and extinct. The features of cave habitats, although poorly fossilized, may explain much about the origin of bats.

Poster Session III (Friday, November 4)

CONCORDANCE OF DIETARY SIGNALS BETWEEN TOOTH CREST LENGTHS AND ENAMEL MICROWEAR OF EOCENE AND OLIGOCENE UNGULATES
PAZAPAZIAN, Jacqueline, Suffolk University, Boston, MA, USA; DEWAR, Eric, Suffolk University, Boston, MA, USA

The shapes and wear of the teeth of fossil mammals preserves information about their likely diets. While dental morphology reflects evolutionary adaptations toward particular dietary modes, tooth wear is evidence of how those dental tools were actually used during a short interval of the animal’s life prior to death. We compared the lengths of tooth crests vs. the low-magnification enameled microwear of four Eocene and Oligocene genera: the artiodactyls Poebrotherium (Camelidae), Merycoidodon (Oreodontidae), and Leptomeryx (Leptometri- dae), as well as the perissodactyl Mesohippus (Equidae).

We measured the crown features of these genera from digital micrographs of epoxy casts using a stereomicroscope. Differences in body size were accounted for by creating an index of the length of the lingual crests divided by the crown’s occlusal area. The likely adaptations of these genera come together using ecological observations and morphometric information about modern analogues and knowledge of food fracture mechanics. Longer tooth crests are known from modern grazers, such adaptations are efficient in grinding fibrous foods. We predicted that longer crests would also indicate adaptations toward grass chewing in these fossil species. We also expected that more grass in the diet would be reflected in the enamel microwear, especially in the number of scratches: living grazers incur more scratch-bearing bawing ungulates.

We found that the smaller “crest length/crown area” indices of Poebrotherium and Leptomeryx differed significantly from the larger indices of Merycoidodon and Mesohippus (F3,49 = 29.20, p < 0.0001). In terms of microwear, we found the significant differences between Leptomeryx and Poebrotherium vs. Mesohippus again at the ends of our range, but similar counts of scratches and pits between Poebrotherium and Merycoidodon. None of these species lived in almost total darkness. We found similar signals of browsing in Leptomeryx and Poebrotherium, trending toward more grass-eating in Merycoidodon and Mesohippus, but even these species were probably mixed feeders rather than committed grazers.

Technical Session VIII (Thursday, November 3, 2:45 pm)

THE MORPHOLOGY AND RELATIONSHIPS OF THE CARBONIFEROUS-PERMIAN NECITREAN DIPLOCRASIAE (RANGE)
PADDO, Jason, Carnegie Museum of Natural History, Pittsburgh, PA, USA

The Necitrea are a clade of aquatic tetrapods from the Carboniferous and Permian of North America, Europe, and North Africa known for extremely elongate caudal regions, conspicuous holospinous vertebrae and, in some taxa, bizarre hornlike extensions of the lateral skull. Despite including some of the most abundant and iconic components of the Carboniferous-Permian tetrapod fauna, the morphology of the Necitrea is poorly known. Here I present new data on the skull and postcranium of Diplocrasia burkei from the Upper Carboniferous and Lower Permian of Pennsylvania, Ohio, and West Virginia. The
skull of *Diploceraspis* differs from previous descriptions in the identity several bones of the skull roof, occiput, and palate. The nasals and supratemporals are not lost, contrary previous descriptions. The epitypoid, dorsal process, and otic capsule situated between the parietal and pterygoid and co-ossified with those elements. The 'pharyngobranchial pouch' of the horn complex is enclosed anterolaterally by the lamina ascendens, posteriorly by paroccipital and pterygoid and co-ossified with those elements. The 'pharyngobranchial pouch' of the skull roof, occiput, and palate. The nasals and supratemporals are not lost, contra previous skull of *Diploceraspis*. The 'pharyngobranchial pouch' of the skull roof, occiput, and palate. The nasals and supratemporals are not lost, contrary previous descriptions.

**Poster Session I (Wednesday, November 2)**

**EARLY CRETACEOUS ICHTHYOSAURS FROM THE TYNDALL GLACIER IN TORRES DEL PAINE NATIONAL PARK, SOUTHERNMOST CHILE**

PARDO PÉREZ, Judith Mariana, Ruprecht- Karls Universität Heidelberg, Heidelberg, Germany; FREY, Eberhard, Staatliches Museum für Naturkunde Karlsruhe, Karlsruhe, Germany; STINNESBECK, Wolfgang, Ruprecht- Karls Universität Heidelberg, Heidelberg, Germany; RIVAS, Luis, Universidad de Concepción, Concepción, Chile

The Tyndall Glacier is located within Torres del Paine National Park in Chilean Patagonia and represents an exceptional Early Cretaceous ichthyosaur fossil area. In 2003, researchers from Stanford University found a fragmentary ichthyosaur skeleton in the banks of a river close to the Tyndall Glacier. After this discovery, several expeditions to this locality were made. During field campaigns in 2009 and 2010, 46 articulated and partially articulated ichthyosaur skeletons were discovered, comprising adults, juveniles, neonates and even female marsupium, the majority of the ichthyosaur specimens preserve diagnostic features permitting their systematic identification. So far, a complete specimen of *Platypterygius haastihali* and *?Coryphodonaurus bonapartri* have been identified. Moreover, an isolated forefin that could represent a new species and another hitherto unknown specimen with anatomical characteristics from ichthyosaurs of Jurassic age, have been found.

The ichthyosaurs are associated with ganoid and telescop fishes, as well as abundant bennites. Ammonites and inoceramids are also frequent. Tree trunks partially encrusted and remains of land plants indicate a close shoreline, probably combined with a river that formed a submarine canyon. The enormous abundance of life is documented in Neptunian dykes full of bennites and ichthyosaur bone fragments.

The abundance of ichthyosaur skeletons in the Tyndall area suggests mass mortalities caused by mudflows running at high speeds through submarine canyons. The ichthyosaurs were captured by this mud flow or were sucked by it into the abyss. The bodies were deposited in an anoxic environment, where they were rapidly covered by sediment, which explains their excellent preservation.

The discovery of this site as well as the quality and quantity of specimens is unique to South America and may represent one of the best sites of Early Cretaceous ichthyosaurs.

**Poster Session II (Thursday, November 3)**

**A NEARLY RECOGNIZED SPECIMEN OF THE PHYTOSAUR *REDONDASaurus* FROM THE UPPER TRIASSIC OWL ROCK MEMBER (CHINLE FORMATION) AND ITS BIOSTRATIGRAPHIC IMPLICATIONS**

PARKER, William, Petrified Forest National Park, Petrified Forest, AZ, USA; MARTZ, Jeffrey, House of Bones, Poncha Springs, CO, USA; DUBIEL, Russell, U.S. Geological Survey, Denver, CO, USA

Historically, relative dating and biostratigraphic correlation of Triassic terrestrial strata in the western United States was accomplished through vertebrate biostratigraphy. Currently, four biozones are recognized and defined by the first appearances of phytosaurian taxa, from oldest to youngest Paleoharis (Otischalkian), Leptosuchus/Smilodoncetus (Adamianian), *Pseudopalatus* (Reuvelianian) and *Redonasaurus* (Apachean). Several localized erosion surfaces in the Upper Triassic Chinle Formation have been proposed as regional unconformities (Tr-4, Tr-5) based primarily on the purported association of major faunal reorganizations and thus equivalence to biozone boundaries: the Tr-4 as the Adamianian/Reuvelian boundary and the Tr-5 as the Reuvelianian/Adamian boundary. These unconformities have been argued to represent major sequence boundaries and tie points for correlations to marine units for the purposes of dating the terrestrial sequences. Recent detailed lithostratigraphic and biostratigraphic work in the Chinle Formation of Arizona and the Dockum Group of Texas has demonstrated that there is no basin-wide Tr-4 unconformity, and the associated faunal change actually occurs above the proposed level of the Tr-4. Re-preparation of a phytosaur skull from the hypothesized Reuvelian Owl Rock Member (Chinle) in Arizona reveals that it represents *Redonasaurus* and not *Pseudopalatus* as previously supposed. Therefore most of the Owl Rock falls within the Apachean Biozone and is biostratigraphically equivalent to the purportedly younger siltstone member (Chinle) and the Redonda Formation (Dockum) of New Mexico and the base of the Wingate Sandstone in Utah. This drastically changes existing biostratigraphic correlations of the upper parts of the Chinle and Dockum. More-

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RECONSTRUCTING THE DIVERSITY OF THE EARLIEST TERRESTRIAL HERBIVOROUS TETRAPODS

PEARSON, Marianne, University College London, London, United Kingdom; BENSON, Roger, University of Cambridge, Cambridge, United Kingdom; UPCHURCH, Paul, University College London, London, United Kingdom; FRÖBISCH, Jörg, Museum fur Naturkunde, Berlin, Germany; KAMMERER, Christian, American Museum of Natural History, New York, USA

Terrestrial herbivorous tetrapods first appear in the fossil record during the Late Carboniferous and while there is little consensus on how this adaptation originated, it is known that a change to an exclusively plant-eating diet evolved independently many times throughout the Phanerozoic. The abundance of herbivores makes them important because of their suitability as index fossils. However the diversity history of the earliest terrestrial herbivores is poorly understood except for a few studies that focus on specific clades. It is known that herbivore diversity reached significant levels until the Late Permian when the terrestrial vertebrate fauna in modern ecosystems were established. A new data set of 226 species of herbivorous tetrapods including, Anomodontia, Dimorphodonta, Pareiasauria, Diadectomorpha, Theropoda, Crocodilia, Captorhinidae, Cynodontia and Pelycosauria, their age and location has been assembled and analysed for diversity patterns for the Late Carboniferous to the Mid-Triassic, taking into account the effects of potential sampling biases. The results show the diversity of the herbivorous clades in relation to the number of total tetrapod-bearing formations, as a proxy for the rock record. Modelling of observed diversity as a function of sampling enabled the estimation of residual diversity scores. This results in a better understanding of where data might be missing and where observed diversity might be inflated due to local sampling effects. The results support an initial rise in abundance of herbivorous taxa from the Late Carboniferous, through a dip in diversity around the Guadalupian, to an increase in a peak in the Permian. A gradual increase in taxic diversity in the Palaeozoic indicates that establishment of diversity in terrestrial ecosystems occurred progressively and not exponentially. The end-Permian extinction event shows as a marked decrease in diversity over the boundary, with species numbers recovering in the Triassic even though residual diversity estimates suggest that the diversity of tetrapod herbivores might be underestimated during this crucial Late Permian-Early Triassic transition.

NEW DATA ON THE ARCHOSAUR FAUNA OF THE MIDDLE TRIASSIC (ANISIAN) NTAWERE FORMATION OF ZAMBIA

PEECOOK, Brandon, University of Washington, Seattle, WA, USA; SIDOR, Christian, University of Washington, Seattle, WA, USA; NESBITT, Sterling, University of Washington, Seattle, WA, USA; ANGIELCZYK, Kenneth, Field Museum of Natural History, Chicago, IL, USA; STEYER, Sébastien, Muséum National d’Histoire Naturelle, Paris, France

The Luangwa Basin of Zambia is one of several rift basins in southern and eastern Africa that preserves Triassic strata. Collections made in the 1960s recovered therapsid fossils from the Ntawere Formation, including diademodontid and tracheryodontid cynodonts and karnemeyeriid and stiackneriid dicynodonts, as well as a mastodontid temnospondyl. Biostratigraphic correlation with the main Karoo Basin of South Africa suggested that the Ntawere includes at least two faunas, correlating with those of the Cynognathus B and C subzones. The upper unit of the Ntawere has also been correlated with the better-sampled Manda beds of Tanzania. In 2009, we collected from the upper unit a new, derived tracheryodontid and cranial evidence. Possible postcranial material of microsyopids has been reported but remains undescribed.

TARSALS OF NIPTOMOMYS (MAMMALIA: MICROSYOPIDAE) FROM THE CASTLE GARDENS LOCALITY, WYOMING (EARLY EOCENE)

PENKROT, Tonya, Arizona State University, Phoenix, AZ, USA; ZACK, Shawn, University of Arizona, College of Medicine-Phoenix, Phoenix, AZ, USA; STRAIGHT, Suzanne, Marshall College of Osteopathic Medicine, Old Westbury, NY, USA

Microsyopidae is a family of relatively generalized Plesiadapiformes that is known from the Paleocene and Eocene of North America. Microsyops are generally considered to be relatively basal in the radiation of plesiadapiforms, a determination supported by dental morphology. The distributions and features of palatal and pterygoid teeth in amniotes have been used as phylogenetic characters and as a means of interpreting dietary specializations, yet very little is known about them, especially in fossil groups. Questions abound about whether pterygoid teeth develop in similar ways to maxillary and dentary teeth, particularly with regard to implantation, growth rates, and what factors affect crown morphology. To begin to rectify this, we sectioned a pterygoid tooth of Niptomomys maximus from the Cretaceous of New Jersey, along with a maxillary/dentary tooth of the same taxon to control for preservational effects that may possibly bias interpretations. Like maxillary/dentary teeth, the pterygoid tooth is conical and recurved, with an enamel surface texture that contains longitudinal grooves and crests everywhere except for the regions near the tip and very base of the crown. This has the same appearance seen in some other squamate teeth, including Dracaena and Uromastyx. As in Dracaena and Uromastyx, the enamel-dentine junction (EDJ) is smooth in both teeth and enamel thickness varies, indicating that this surface morphology is primarily due to enamel development, not underlying dentine structure like that seen in archosauriforms. In the dentine, incremental lines of von Ebner are visible in the pterygoid tooth, and these are uneven in thickness. This may possibly represent a period of accelerated growth, although further studies of tooth families of pterygoid teeth will be needed to confirm this.

A NEW TROODONTID (DINOSAURIA: THEROPODA) FROM THE LATE CREATAUCOSMIC DZADOKHTA FORMATION OF MONGOLIA

PEI, Rui, American Museum of Natural History, New York, NY, USA; NORELL, Mark, American Museum of Natural History, New York, NY, USA

Troodontids are widely distributed bird-like dinosaurs that are known from Late Jurassic to the end of Cretaceous. A new troodontid specimen was discovered from the Late Cretaceous bed of Dzadokhta Formation, Ukhaa Tolgod, Mongolia, where many important dinosaur fossils were reported. This specimen represents a new troodontid taxon with juvenile features. The specimen is preserved with an almost complete skull, dorsal ribs, sacral and caudal vertebrae, the pelvic girdle and partial hindlimbs. The skull is about eight centimeters long, comparable to that of Mei long, but less than half the size of the skull of Byronsaurus jaffei, another troodontid taxon reported from the same locality. Like Byronsaurus jaffei, this new taxon has un serrated maxillary and dentary teeth, but a recessed maxillary interenamelary bar and much shorter maxillary teeth than in other troodontids. The skull is not anteroposteriorly elongated, more than twice of the length of the attached caudal centra, which is a primitive condition of maniraptoran dinosaurs. A preliminary phylogenetic analysis reveals that this new taxon is the sister group of the clade of Byronsaurus jaffei, Sinornithoides, Sinornithoides, Zanabazar and Troodon, and is more derived than Mei, Anchisaurus and Sinovenator. This result also indicates the un serrated teeth is a plesiomorphy of troodontids that are more derived than Sinovenator, and serrations of teeth were evolved in derived troodontid forms secondarily. A comparison with the perinatal troodontid IGM 100/972 shows that IGM 100/972 is more closely related to this new taxon than to Byronsaurus jaffei, evidenced by the shape of the snout and the number of maxillary teeth. The discovery of this new species increases the diversity of troodontid theropods of Late Cretaceous in Mongolia, and provides an opportunity to further examine the ontology of coelurosaurian dinosaurs.
NEW AGE CONSTRAINTS FOR THE EARLY MIocene FAunas OF RusingA AND MFANgAno ISLANDS (Lake Victoria, Kenya)

Peppe, Daniel, Baylor University, Waco, TX, USA; Deino, Alan, Berkeley Geochronology Center, Berkeley, CA, USA; Lehmann, Thomas, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany; Dunsworth, Holly, University of Rhode Island, Kingston, RI, USA; Harcourt-Smith, William, Lehman College CUNY, New York, NY, USA

More than 90 species of mammals, including the stem hominoid Proconsul, have been documented from early Miocene deposits on Rusinga and Mfangano Islands (Lake Victoria, Kenya). The significant number of holotypes, the diversity of represented orders, as well as the quality and quantity of material recovered in these sites are some of the reasons why these faunas form an important comparative reference for understanding the evolution of Miocene mammalian lineages in East Africa. Thus, accurate determination of the age of the faunas is crucial for developing an understanding of Miocene mammalian paleontology. Previous researchers used five select K-Ar dates from Rusinga to suggest that all of the Miocene fossiliferous beds were deposited during an interval of less than 500 kyr at c.17.8 Ma. However, the dates were from a limited stratigraphic interval, and all were obtained by the conventional K-Ar bulk total-fusion technique, preventing any investigation of internal argon systematics of the samples.

Our recent field studies aimed at clarifying the paleoecological and geochronological contexts of Early Miocene mammalian evolution have yielded new age constraints for the faunas from Rusinga and Mfangano. Preliminary 40Ar/39Ar incremental heating analyses of biotite from the top of the Hiwgei Formation, and palaeomagnetism analyses from the Hiwgei and Wayando Formations indicate that most of the fossiliferous deposits on both islands were likely deposited from ~18 – 20 Ma. These results suggest that the deposits are considerably older and represent more time than previously thought. Further, it implies that taxa from Rusinga and Mfangano may be closer in age to species from other early Miocene localities (i.e. Songhor, Napak, and Koru). Thus, the taxonomic dissimilarities noticed by previous studies between these sites may be related to paleoenvironmental differences and/or relatively rapid (~100 kyr) turnover in faunal composition.

Technical Session X (Friday, November 4, 10:15 am)

COMPUTED-TOMOGRAPHY SCAN ANALYSIS OF THE INTERNAL FACIAL ANATOMY OF THE MIDDLE MIocene Ape PIERolAPITHECUS CATALANuICA (PRIMATES: HomINIDae): PHYLOGEnETIC IMPLICATIONS

Pérez de los ríos, Miriam, institut Català de Paleontologia/ universitat Autònoma de Barcelona, Barcelona, Spain; MoYA-solà, salvador, institut Català de Paleontologia/ universitat Autònoma de Barcelona, Barcelona, Spain; Fortuny, Josep, institut Català de Paleontologia/ universitat Autònoma de Barcelona, Barcelona, Spain

The Middle Miocene (11.9 Ma) dryopithecine ape Pierolapithecus catalanicus (hominidae), from the Vallés-Penedès Basin (catalonia, Spain), has been interpreted as a stem great ape on the basis of external cranial and postcranial morphology. The internal anatomy of the face—paranasal sinus size and shape, nasolacrimal duct orientation, palate configuration and turbinals development—provide additional informative features for further clarifying the phylogenetic position of this taxon. Here we report the internal morphology of the splenonochoane of P catalanicus (IP21350, holotype) by using non-invasive, computed-tomography techniques. This specimen displays a restricted maxillary sinus that expands posteriorly occupying the ethmoidal area, as in the Miocene pongine svipithecus and extant orangutans (Pongo). The frontal area of Pierolapithecus is characterized by the lack of a true frontal sinus, being occupied by a slight porosity, thus differing from the pneumatized condition of most fossil and extant great apes (except for Pongo and Svipthecus). The nasolacrimal duct is less vertically-oriented than in extant African apes (Pant and gorilla), thus more closely resembling the procumbent condition of orangutans, which might be interpreted as a pongine synapomorphy correlated to the greater projection of the nasals. The largest development of the turbinals is attained quite posteriorly, over the distal M2 level, thus more closely resembling orangutans (M3 level) than African apes (M1 level). Due to bone damage, it cannot be ascertained whether the premaxilla minimally overlapped the hard palate, although it surely displayed a more primitive condition than extant great apes. Overall, the internal facial anatomy of Pierolapithecus more closely resembles that of the Pongo-clade than that of African apes (Homininae), by displaying several putative pongine synapomorphies that suggest that the former might be interpreted as a stem ponginae s.l. (including both Dryopithecini and Pongini) instead of a stem Hominidae or Homininae (as previously suggested).

Cavioida s.s. along a single phyletic axis, our analysis shows that the history of the group was characterized by three major radiations. The first radiation occurred during the Deseadan (late Oligocene), was previously undetected, and generated the basal cavioid Asteromys and all major lineages leading to later appearing protohydodont species. The second radiation can be traced back to the Santacrucian (early Miocene), marking the appearance of numerous protohydodont lineages. The third radiation is evidenced by the clade of derived Aegyptopithecinae. However, it differs in many characters, such as the size, the
A short series of fused posterior caudal vertebrae, tentatively identified as a pygostyle, has been previously described in the oviraptorosaurs *Nommingia* and *Similicaudipteryx*. Two additional oviraptorid specimens from Mongolia, plus a second *Nommingia* specimen with a pygostyle, confirms the conclusion that the original was not simply an injury or some other ontogenetic aberration. These new finds show that pygostyles and, by association, infer- ence, tail-tip feathers were widespread amongst both advanced and primitive ovirap- torosaurs. In addition to pygostyles, oviraptorosaur caudal osteology is unique among the- rapsods and is characterized by a distal transition point, exceptionally wide caudal ribs, and anteroposteriorly short centra. The results of a morphological study indicate a high degree of flexibility across the pre-pygostyle caudal vertebral series. New three-dimensional digital muscle reconstruction techniques reveal that, while oviraptorosaur tails were reduced in length relative to the size of the limb bones, they were more muscular. Critically, the rela- tive size of the *M. caudofemoralis* was maintained in oviraptorosaurs, despite overall caudal length reduction. Similarities between the tails of oviraptorosaurs and birds appear to be convergent and, contrary to previous assertions, provide no evidence that supports the phylo- genetic placement of oviraptorosaurs within, or as a sister group to, the Avialae. Combined, these results indicate that oviraptorosaurs had the necessary anatomy to dexterously flaunt their caudal plumage, and that the tails of oviraptorosaurs were uniquely adapted to serve as dynamic intrinsic display structures.

**Symposium I (Wednesday, November 2, 9:00 am)**

**COMPARATIVE LIMB RANGE OF MOVEMENT IN THE DEVONIAN TETRAPOD *ICHIHTHYOSTEGA* AND THE EVOLUTION OF TERMINAL Locomotion**

PIERC, Stephanie, Royal Veterinary College, London, United Kingdom; CLACK, Jennifer, Museum of Zoology, Cambridge, United Kingdom; HUTCHINSON, John, Royal Veterinary College, London, United Kingdom

The origin of tetrapods and the transition from swimming to walking was a pivotal step in the evolution and diversification of terrestrial vertebrates. During this time, modifications of the limbs - particularly the development of joints and the structures that guide their motions - fundamentally changed the ways in which early tetrapods could move. Nonetheless, little is known about the biomechanical consequences of limb anatomy in early tetrapods and how that anatomy influenced locomotor capabilities. We examined the maximum range of movement in the shoulder and hip joint of the Devonian tetrapod *Ichthyostega* and compared it to a broad array of extant aquatic and semi-aquatic animals with distinct modes of locomotion (e.g. amphibians, reptiles and mammals). Joints were modelled in 3D musculoskeletal simulation in the shoulder and hip joint of the Devonian tetrapod *Ichthyostega* and compared to that of a mouse (121 grams for *Phenacomelurum jepseni*) to that of a large squirrel (414 grams for *Phenacomelurum praecox*). *Phenacomelurum* developed enlarged incisors and a reduced dentition. *Phenacomelurum* species superficially appear to have a strong similarity in their dental characteristics but with closer observation, it becomes clear that there is significant variation in tooth number, morphology, and dental wear patterns. *Phenacomelurum* species exhibit a wide range of locomotion and can be interpreted to be adaptations for different diets and evidence of evolutionary adaption to paleo-environments. Teeth are involved in food acquisition and their morphology reflects food acquisition strategy. Using SEM dental microwear analysis, along with dental morphology and statistical analysis, I show distinctions between three of the closely related species (*P. jepseni*, *P. citatus*, and *P. praecox*). These differences in dentition between *Phenacomelurum* species reflect differences in diet, and indicate paleo-environmental/evolutionary adaptations in this early primate that permeated closely related (basal to placental) primate species to live in the same areas of the San Juan Basin, NM and Bighorn Basin, WY concurrently.

**Poster Session I (Wednesday, November 2)**

**SHAKE YOUR TAIL FEATHERS: THE FLAMBOYANT, ATHLETIC, AND POSSIBLY FLIRTATIOUS CAUDAL MORPHOLOGY OF OVIRAPTORAURS**

PERSONS, Walter, University of Alberta, Edmonton, AB, Canada; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada; NORELL, Mark, American Museum of Natural History, New York, NY, USA

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width/length ratio of the skull, the cranial morphology in lateral view, the relative size of the orbits, the ornamental pattern, and the morphology and arrangement of several skull bones.

Sandalomia was considered one of the oldest known cryptodiran turtles. The new Spanish taxon may provide additional insights into the evolution and diversity of this group in the Lower Cretaceous, and probably on the origin and diversity of the Testudiniformes.

**Poster Session II (Thursday, November 3)**

**MIOCENE CHONDRICTHYANS FROM PANAMA**

PIMIENTO, Catalina, University of Florida, Gainesville, FL, USA; HENDY, Austin, University of Florida, Gainesville, FL, USA; MACPADDEN, Bruce, University of Florida, Gainesville, FL, USA; EHRET, Dana, University of Florida, Gainesville, FL, USA; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Panama, Panama

During the Miocene, a marine seaway connecting the Pacific Ocean and the Caribbean Sea existed in Panama. Consequently, the Panamanian Miocene marine faunas existed during a time of active transoceanic interchange and dispersal before the time of the full closure of the Isthmus about 4 million years ago. This closure was a key vicariant event for tropical biotic evolution that resulted in increased habitat and biogeographic complexity. Fossil chon- drichthysans from Panama are poorly represented in the literature. We have sampled three dif- ferent Miocene sites from Panama. These include new localities from the well-known Gatun Formation (12-9 Ma) that have been exposed as a result of the Canal expansion project and local quarrying operations. Furthermore, we studied the early Miocene Culebra Formation (21-19 Ma) from the canal area, and the late Miocene Chucunaque Formation (6-7 Ma) from Darien Province. Based on surface prospecting and screen-washing techniques, we have collected more than 1000 isolated teeth and vertebra centra from these three localities. We found high biodiversity including ~ 35 taxa of sharks and batoids. Of these, only six species are extant, indicating the presence of relatively long-lived taxa. The Panamanian Miocene comprised a variety of shallow coastal habitats, including mangrove, estuary, and reef eco- systems.

**ECOLOGY OF EARLY EOCENE SAN JUAN BASIN, NM PHENACOMELUR JEPSENI WITH PHENACOMELUR CITATUS AND PHENACOMELUR PRAEOX FROM BIGHORN BASIN, WY - A STUDY OF MICROWEAR AND DENTAL VARIATION**

PILBRO, Clayton, University of New Mexico, Albuquerque, NM, USA

*Phenacomelur* was a widespread genus of Plesiadapiformes (primate-like animals) that lived from the late Paleocene to early Eocene of North America and Europe. Members of this genus were small, varying in size from that of a mouse (121 grams for *Phenacomelur jepseni*) to that of a large squirrel (414 grams for *Phenacomelur praecox*). *Phenacomelur* developed enlarged incisors and a reduced dentition. *Phenacomelur* species superficially appear to have a strong similarity in their dental characteristics but with closer observation, it becomes clear that there is significant variation in tooth number, morphology, and dental wear patterns. *Phenacomelur* species exhibit a wide range of locomotion and can be interpreted to be adaptations for different diets and evidence of evolutionary adaption to paleo-environments. Teeth are involved in food acquisition and their morphology reflects food acquisition strategy. Using SEM dental microwear analysis, along with dental morphology and statistical analysis, I show distinctions between three of the closely related species (*P. jepseni*, *P. citatus*, and *P. praecox*). These differences in dentition between *Phenacomelur* species reflect differences in diet, and indicate paleo-environmental/evolutionary adaptations in this early primate that permeated closely related (basal to placental) primate species to live in the same areas of the San Juan Basin, NM and Bighorn Basin, WY concurrently.

**Poster Session II (Thursday, November 3)**
in Crocodyliformes (e.g., absence of basipectyloid process, highly pneumatic basipterygoid, posterior closure of otic notch by triple contact of squamosal, quadrate, and otocipital). A phylogenetic analysis that includes both “sphenosuchians” and representatives of the major lineages of Crocodyliformes depict the new taxon as the closest relative of Crocodyliformes, being closer to this clade than Jangurusuchus. The morphology of the braincase of the new taxon coupled with its phylogenetic position reveals that modifications in the articulars of the braincase with both the palate and the quadrate occurred before the origin of Crocodyliformes and therefore predated the remarkable changes in the snout, jaws, and dentition of the phylogenetically more derived crocodyliforms.

Symposium 2 (Wednesday, November 2, 11:30 am)

STANDING UP TO CLIMATE CHANGE: COMMUNITY Locomotor ECMORPHOLOGY AND PALEOVIRONMENT IN THE Plio-Pleistocene POLLY, P. David, Indiana University, Bloomington, IN, USA; DUNDAS, Robert, California State University - Fresno, Fresno, CA, USA; LAWING, A. Michelle, Indiana University, Bloomington, IN, USA

Ecological domains are broad geographic areas with coarsely similar macroclimates. While classification differs in detail, North America has approximately four such domains, each with its own characteristic pattern of temperature and precipitation. The Polar Domain has no warm season, the Humid Temperate Domain is rainy with mild to severe winters, the Humid Tropical Domain is rainy with no winters, and the Dry Domain is arid regardless of temperature. Macroclimate has an affect on the macrovegetation and, in turn, the animal species that inhabit an area. We showed previously that in mammalian Carnivora, the average locomotor morphology of local faunas is strongly correlated with macrovegetation and ecological province, suggesting that the locomotor morphology of a community or guild can serve as a proxy for macroenvironment.

We tested the usefulness of locomotor morphology as a proxy by using maximum likelihood to estimate the most likely ecological domain for faunas of living North American carnivores. We measured calcaneum gear ratio (the position of the sustentacular process relative to the length the calcaneum) in non-marine North American species of carnivore and measured its mean, standard deviation, skewness, and kurtosis in 8,148 carnivore faunas sampled at 50 km intervals across North America, from which characteristic distributions of calcaneum gear ratio were extracted for each domain. Cross-validation correctly identified domain in 70.6% of the 50 km faunas.

We used these data to estimate ecological domain of four Pleistocene carnivore assemblages. The most likely estimates based on the distribution of calcaneum gear ratio for Rancho La Brea (California), McKitrick (California), Friesenhahn Cave (Texas), and Little Box Elder Cave (Wyoming) were all Humid Temperate Domain. While the cross-validation test showed that certain domains can sometimes be difficult to distinguish ecometrically, broad categorization of macroenvironment are feasible based on taxon-free measurements of the locomotor system.

Technical Session XVIII (Saturday, November 5, 1:45 pm)

A NEW BASAL CROCODYLOMORPH FROM THE LATE JURASSIC OF PATAGONIA AND ITS IMPLICATIONS FOR THE EVOLUTION OF THE CROCODYLIFORM BRANCHE

POL, Diego, CONICET-Museo Paleontologico Egido Feruglio, Trelew, Argentina; RAUHUT, Oliver, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; LEUCUNA, Agustina, CONICET-Museo Paleontologico Egido Feruglio, Trelew, Argentina; LEARDI, Juan, CONICET- Departamento de Ciencias Geológicas, Universidad de Buenos Aires, Buenos Aires, Argentina

Crocodyliformes is a group of highly modified archosaurs that achieved a remarkable taxonomic and ecological diversity during the Mesozoic. The sequence of transformations leading from the typical basal archosaurian skulls of “sphenosuchians” to the derived and akinet skull of crocodyliforms is still poorly understood, with only the late Middle Jurassic Chinese form Juyuanosuchus providing some information. A new crocodylomorph from the Late Jurassic Cañadon Calcáreo Formation of Patagonia is reported here that is represented by the posterior region of the skull (including a well preserved braincase), and fragmentary remains of the rostrum, palate, mandible, and postcraic. The skull remains bear autapomorphic features (e.g., laterally concave external margin of the squamosal and postorbital, large quadrate fenestra) combined with a unique combination of pleistomorphic characters of basal crocodylomorphs (e.g., paired frontal, supracomical participating from the foramen magnum, absence of well developed skull table) and apomorphies previously known only in Crocodyliformes (e.g., absence of basipectyloid process, highly pneumatic basipterygoid, posterior closure of otic notch by triple contact of squamosal, quadrate, and otocipital). A phylogenetic analysis that includes both “sphenosuchians” and representatives of the major lineages of Crocodyliformes depict the new taxon as the closest relative of Crocodyliformes, being closer to this clade than Jangurusuchus. The morphology of the braincase of the new taxon coupled with its phylogenetic position reveals that modifications in the articulars of the braincase with both the palate and the quadrate occurred before the origin of Crocodyliformes and therefore predated the remarkable changes in the snout, jaws, and dentition of the phylogenetically more derived crocodyliforms.
from the Antarctic into a number of distinct variables and examining the relationship of each
to changes in mammal diversity and turnover, it is possible more accurately investigate
the effect of climatic changes on faunal events. Climatic stability was measured in these
analyses in terms of cycles per unit of time, the amount of variation in temperature per unit
of time, and the magnitude of change between the modal temperature of one interval less
the modal temperature from the preceding interval. The data presented here suggest that
the primary effect of climatic change is on the levels of extinction of large mammals and diver-
sity of small mammals.

Technical Session XI (Friday, November 4, 3:45 pm)

A LITTLE BIRD TOLD ME: WETLANDS DOMINATED THE PLIO-
PLEISTOCENE LANDSCAPE (LOWERMOST BED II DEPOSITS, ~1.75 MA) AT
OLDUVAI GORGE, TANZANIA

PRASSACK, Kari, CHES/Rutgers University, New Brunswick, NJ, USA

Fossil birds are used here to reconstruct the Pliocene-Pleistocene landscape (Lowermost Bed
II (LMBI), ~1.75 Ma) at Olduvai Gorge, Tanzania. These birds come from small-scale, landscape archaeology style trench pits that were excavated by the Olduvai Landscape Pale-
ontrology Project (OLAPP). Excavations covered an area of ~4km leading out from the
eastern extent of paleo-Lake Olduvai. These resulting paleontological and archaeologi-
cal data provide a unique opportunity to assess landscape scale habitat variability at this
early hominin site. Of the approximately 90 avian specimens recovered, 136 could be
identified to the level of genus. The majorities of specimens are of extant wetland or water
taxa, many of which occur in East Africa today. Cormorants are most common (58%) and
represented by at least three species. There are eight genera of anatids and four of rallids,
including to grebes, flaminigos, and pelicans. The distribution of these birds differ in ways
that suggest deep water marsh/swamp lands were widespread, but interspersed with areas of
higher ground capable of supporting nesting and roosting trees. Fossil birds can provide
paleoenvironmental data on a fine spatial scale, especially at Olduvai, where primarily extant
birds occur. Many of the taxa described here provide important palo-environmental and
ecological that will greatly aid in interpreting changes in early hominin land use-
age at Olduvai. For example, these bird points to locations where potable water, safety trees,
and food resources, such as water lilies and bird nests, may have occurred. This is the first
study to use fossil birds to reconstruct the LMBI landscape and to help understand hominin
land use for this time period at Olduvai.
neosuchian origins and highly unusual palatal conditions, the cranial osteology of a goniopholidid has not been fully described.

A well-preserved, complete skull of the North American goniopholidid Eutreptiurus bimaculatus (AMNH 570) is described. The skull was subjected to CT scans, which revealed a well-preserved palatal and braincase. As in Calosaurus variegatus, Amphicoelopus sp., and other specimens of Eutreptiurus bimaculatus, the secondary palate in AMNH 570 is incompletely formed, with the palatal processes of the palatines approaching but not contacting one another in the midline. As in Calosaurus variegatus, the anteriormost portion of the open trough exposes the primary choana. Posteriortly the vaulted nasopharyngeal passage is exposed ventrally, as in primitive crocodyliforms (e.g. Ortochelon). A complex septal complex divides the nasopharyngeal passage in the midline. Bilateral vomeral laminae divide the passage anteriorly. At the anterior margin of the suborbital fenestra, the vomeral laminae diverge to fit around a midline pterygoid-derived septum. Dorsoventral crushing has distorted certain braincase elements, such that the rostrum of the parabasisphenoid is somewhat dorsally displaced. However, most of the elements are preserved in anatomical position. The capitate processes of the laterosphenoid are transversely broad and the laterosphenoid bridge is angulated ventromedially, resembling the condition in Gavialis.

Incorporation of AMNH 570 into a phylogenetic analysis recovers the specimen in a clade of derived goniopholidids including Amphicoelopus, Calosaurus variegatus, Eutreptiurus bimaculatus, and Sunosuchus. Such a position is congruent with the unique palatal morphology shared among these animals.

Poster Session III (Friday, November 4)

A NEW SPECIES OF THE PECCARY MACROGENIS FROM THE LATE CLARENDONIAN (LATE MIOCENE) BLACK HAWK RANCH LOCALITY, CONTRA COSTA COUNTY, CALIFORNIA

PROTHERO, Donald, Occidental College, Los Angeles, CA, USA; POLLEN, Audrianna, Occidental College, Los Angeles, CA, USA

Numerous nearly complete skulls and jaws in the University of California Museum of Paleontology collections from Black Hawk Ranch (near Mt. Diablo) pertain to a new species of Macrognathus, a diverse genus of late Miocene peccaries. The Black Hawk Ranch fauna, recovered from a large quarry in the Sycamore Formation, has been paleoecologically dated as latest Clarendonian (9.9-9.5 Ma). The new species is referable to the Macrogenis-Tayassu clade, but is distinguished by its broad dentary and cheek teeth. In addition, it is distinct from other species in lacking a contact between the maxillary and the suborbital bulla, which is anteriorly narrower, and a narrow tympanic process. The prominent facial crest extends anteriorly over the rostral muscle fossa, but is not as wide and flaring as the facial-zygomatic crests of other late Miocene Macrogenis species. This taxon is one of numerous species of Macrognathus from the late Clarendonian, including an additional newspecies from Love Bone Bed in Florida, from Macheherodus Quarry in Nebraska, and Leptarcysis Quarry in Nebraska. The high diversity of peccaries at this time is largely a function of their diverse array of facial-zygomatic crests in males.

Technical Session XVI (Saturday, November 5, 11:30 am)

CRANIAL ANATOMY OF A PRIMARY OSTEOCHITHYAN PAROLEPIS BASED ON HIGH-RESOLUTION COMPUTED TOMOGRAPHY

QIAO, Tuo, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; LU, Jing, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; ZHU, Min, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; JOHN, A. Long, Natural History Museum of Los Angeles County, Los Angeles, CA, USA

Psarolepis, from Upper Silurian and Lower Devonian strata of China and Vietnam, exhibits a unique character combination for the understanding of the origin and early evolution of osteichthyans. Together with other primitive osteichthyans (e.g., Ligulalepis, Dialipina, Achoanias, Megamantia and Gavialis), Psarolepis provides a morphological link between osteichthyans and non-osteichthyans groups, and highlights a possible morphotype for the Achoanias, Meemannia, Psarolepis, and Sunosuchus. Such a position is congruent with the unique palatal morphology shared among these animals.

Poster Session II (Thursday, November 3)

WHAT IS A PORE-CANAL SYSTEM?

QU, Qingming, Subdepartment of Evolution and Development Department of Organismal Biology, Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden; AHLBERG, Per, Subdepartment of Evolution and Development Department of Organismal Biology, Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden; BLOM, Henning, Subdepartment of Evolution and Development Department of Organismal Biology, Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden; ZHU, Min, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Chinese Academy of Sciences, Beijing, China; LI, Gang, Beijing Synchrotron Radiation Facility, Institute of High Energy Physics, Chinese Academy of Science, Beijing, China

Traditionally, the pore-canal system is described as a structure that forms part of the so-called ‘cosmine’ characterizing early lobe-finned fishes. There are two main defining characteristics of the system: (1) it lies in the dentine upper part of the dental bone or scale and opens onto the outer surface; and (2) the pore-cavities are connected by horizontal ‘Maschenkanäle’. This terminology has long been confined to lobe-finned fishes, although disagreement exists for its function. Even though in many primitive actinopterygian taxa, scattered small openings have been frequently reported to exist on the surface of dental bones and scales, they are called ‘small vascular openings’. This is partly because the covering tissues on dental elements of actinopterygians and sarcopterygians are considered different (ganoin vs. cosmine), and also because detailed work to reconstruct the canal system in actinopterygians is missing.

Here we report the 3D reconstruction of the canal system in the trunk scales of three early osteichthyan taxa: Lepidosiren, Andropholis and Paralepis. Paralepis is considered a basal sarcopterygian, and a true ‘pore-canal system’ exists in the scale. Comparison with the canal systems in Lepidosiren and Andropholis shows many similarities. Each of them possesses a well-developed horizontal canal-system just above the bony tissue, although in Paralepis it is much more regular than in the other two taxa. In addition, Paralepis has a connected, weakly developed and less regular canal system at a slightly deeper level within the bone. This thin layer may correspond to the thicker spongia layer in crown sarcopterygians, such as Parolepis. The horizontal canal system, which we argue is part of the vascularization of the scale, is most likely homologous across early osteichthyans. The use of phylogenetically restrictive but poorly defined terminology like ‘pore-canal system’ should be avoided, and focus should be placed instead on reconstructing the canal architecture in different taxa to identify phylogenetically informative characters.

Poster Session III (Friday, November 4)

THE FIRST MAJOR VERTEBRATE FOSSIL FROM THE PLOCENE OF ICELAND: AN ODONTOCETE (CETACEA: ODONTOCETI) FROM THE TJÖRNES FORMATION

RACICOT, Rachel, Yale University, New Haven, CT, USA; FIELDS, Daniel, Yale University, New Haven, CT, USA; VINTHER, Jakob, Yale University, New Haven, CT, USA; BEHLKE, Adam, Yale University, New Haven, CT, USA; GAUTHIER, Jacques, Yale University, New Haven, CT, USA

Toothed whales (Cetacea: Odontoceti) are a disparate and species-rich group. Despite their diversity, including ranges that extend into the northernmost Atlantic Ocean, their fossil record in that region is largely enigmatic. Field exploration of the early Pliocene Tjörnes Formation in northeastern Iceland revealed the partial skull of an undescribed odontocete. The TJÖRNES formation includes near-shore and terrestrial deposits that alternate with lava flows. A new age model for the outcrops was recently determined using palynological and paleomagnetic analyses, constraining the sections to 4.5–4 million years old. The fossil discovery is important both in terms of exploring the evolutionary history and biogeography of cetaceans in the North Atlantic, and the fossil record of Iceland itself. The specimen represents the northernmost occurrence of a Pliocene odontocete, bringing the fossil record into closer agreement with modern distributions. As a volcanic island, fossiliferous strata containing vertebrates are uncommon in Iceland, thus this specimen represents both a unique discovery and an opportunity to contribute to our understanding of the former biodiversity of the North Atlantic. In addition, this is the first major fossil vertebrate from the Pliocene of Iceland, and implies promise for the discovery of a more extensive fauna in the region.
A NEW DISSORIPHID TEMNOSPONDYL FROM THE LOWER PERMIAN OF OKLAHOMA
REISZ, Robert, University of Toronto Mississauga, ON, Canada; FRÖBISCH, Nadia, Museum für Naturkunde Leibniz-Institut für Evolutions- and Biodiversitätsforschung an der Humboldt-Universität zu Berlin, Berlin, Germany

The Dolose Brothers limestone quarry near Richards Spur, Oklahoma is well known for the preservation of the richest assemblage of dissorophid amphibians, including the diminutive Doleraspeton unnectens and Passavioops mayi, the moderately sized Cacops morrisi, and the spectacularly large Acheloma dunnii. There is evidence of additional dissorophid taxa being present in the fissure fills because of the presence of dermal armor that is attributable to Dissoropus and Aspidoasaurus. Here we report on the discovery of yet another dissorophid on the basis of a well-preserved skull that is similar in morphology to C. morrisi. The new dissorophid is characterized by the relatively low profile of the skull, dorsally located orbits, a sculpturing pattern consisting of radiating ridges and grooves, and an L-shaped, narrow opening in the tympanic emplacement. It differs from C. morrisi in the absence of a lateral exposure of the ectopterygoid (LE) in juveniles, the lack of a sutureal contact between the prefrontal and the lateral exposure of the palatine (LEP), the lack of a sutureal contact between the LEP (or LEE) and the jugal. It also differs from C. morrisi in having a small posterior process of the postorbital that contacts the supratemporal, the presence of an ectopterygoid fang, and in the shape of the basal plate of the parasphenoid, which is anteroposteriorly elongated and laterally flaring. Phylogenetic analysis of 14 dissorophid taxa and 54 cranial characters resulted in a single most parsimonious tree, and yielded a sister-taxon relationship between this new dissorophid and Cacops morrisi. The new dissorophid thus falls within the clade of species of Cacops, allowing us to identify it as a new species of the genus. The new Richards Spur Cacops species highlights the morphological diversity of species within this enigmatic genus, with variation surrounding a distinct cranial morphology.

THE DERMAL SCALES OF TITKAALIK ROSEAE
RICHTER, Martha, Natural History Museum, London, United Kingdom; DAESCHLER, Ted, Academy of Sciences, Philadelphia, PA, USA; SAMSON, Ivan, University of Birmingham, Birmingham, United Kingdom; SHUBIN, Neil, University of Chicago, Chicago, IL, USA

The origin of tetrapods and the "fish-tetrapod" transition remains an area of active research. Transitional forms exhibit a mosaic of anatomical features that relate to respiration, locomotion, feeding and sensory systems. Previous studies of the squamation of various sarcopterygian fishes have demonstrated that even in one of the most primitive sarcopterygian genera, the lobe-finned T. roseae, that of other Late Devonian sarcopterygians from the Fram Formation in Arctic Canada and the Catskill Formation in Pennsylvania, USA, as well as with osteoderms (epidermal scales) of extinct stem tetrapods and living amphibians. A sample of the squamation in the holotype of T. roseae was utilized for micro-CT scan studies and some scales were thin-sectioned for histological description. The scales of Titkaalik are rhombic, thick and ornamented with regular round tubercles, and the base is undulating. They articulate with each other through...
an overlapping surface. The scales are entirely made of cellular bone, presenting a basal layer of lamellar bone, trabecular bone in the middle of the scale and a compact bone layer forming the osteodermic tabulars. Primary osteons and resorption lines are abundant in the trabecular layer with relatively large canals crossing the scales both basally and superficially.

Technical Session I (Wednesday, November 2, 11:00 am)

**A BASAL THYREOPHORAN (DINOSAURIA, ORNITHISCIA) FROM AFRICA CLARIFIES THE EARLY EVOLUTION OF ARMORED DINOSAURS**

RIDGWELL, Nicole, University of Chicago, Chicago, IL, USA

Basal thyreophoran phylogeny has been limited to three genera, *Sceladonella*, *Emausaurus*, and *Scelidosaurus*. This phylogenetic transition - from bipedal basal ornithischians to quadrupedal and elaborately armored euryodonts - is clarified by a new taxon from the Tsaurarén Formation of Niger. Cladistic analysis places the African thyreophoran between *Sceladonella* and *Scelidosaurus*. At present there is not enough data to resolve the relationship of the taxon with *Emausaurus*. One feature unites the African thyreophoran with *Scelidosaurus* and euryodonts. Although the preacetabular process is narrow in *Sceladonella*, in the new taxon, it twists into a horizontal plane and expands transversely towards its distal end. More derived thyreophorans are characterized by an overall transverse widening of the ilium. The widening seen in the new taxon is the beginning of this trend. The dermal armor on the new taxon is proportionately larger than in *Sceladonella*, and more similar to that in *Scelidosaurus*; the largest pieces are approximately three to four times the length of the vertebrae. The armor is also more complex and includes a wider variety of forms, including rhomboidal scutes, long and narrow scutes without an expanded base that posses a slight lateral curve, and a least one scute that has a sutured edge for contact with another scute. Other features suggest that this taxon is more basal than *Scelidosaurus*. As in *Emausaurus* and basal ornithischians, the antorbital fossa is large. In *Sceladonella* and other more derived thyreophorans, the transverse processes of the dorsal vertebrae are horizontally expanded. The lateral margin of the ilium, although widened anteriorly, is elsewhere narrow compared with the condition in *Scelidosaurus*. The taxon is probably an obligate quadruped, the earliest positive evidence of this posture among thyreophorans. The humerus, femur, and tibia are approximately the same length. Obligate quadrupedality, thus, appears to have evolved first among early thyreophorans of small body size and is not a consequence of body size increase.

Technical Session IV (Wednesday, November 2, 3:15 pm)

**INTERNAL AIRWAY MORPHOLOGY AND SOUND PRODUCTION IN PLEISTOCENE GIANT BEAVERS**

RINALDI, Caroline, University of Missouri-Kansas City School of Medicine, Kansas City, MO, USA; MARTIN, Larry, University of Kansas Natural History Museum and Department of Ecology and Evolutionary Biology, Lawrence, KS, USA; TIMM, Robert, University of Kansas Natural History Museum and Department of Ecology and Evolutionary Biology, Lawrence, KS, USA; COLE III, Theodore, University of Missouri-Kansas City School of Medicine, Kansas City, MO, USA; KUMAR, Vandana, University of Missouri-Kansas City School of Dentistry, Kansas City, MO, USA

The skull of an adult Late Pleistocene giant beaver, *Castoroides ohiensis*, from eastern Kansas was studied using high resolution cone-beam computed tomography (CT). CT scans and 3D reconstructions reveal unique internal airway morphology, not known in any other mammal. The internal nares are divided into dorsal and ventral passageways. Posteriorly, the dorsal passageway is continuous with the mesopetrosal fossa, a recessed depression in the basioccipital that underlies the auditory bulla. Anteriorly, the dorsal passageway is continuous with the nasolacrimal canal and the external nares. The ventral passageway is continuous with the nasopharynx, but anteriorly separated from the condition in *Scelidosaurus*. In the new taxon, it twists into a horizontal plane and expands transversely towards its distal end. More derived thyreophorans are characterized by an overall transverse widening of the ilium. The widening seen in the new taxon is the beginning of this trend. The dermal armor on the new taxon is proportionately larger than in *Sceladonella*, and more similar to that in *Scelidosaurus*; the largest pieces are approximately three to four times the length of the vertebrae. The armor is also more complex and includes a wider variety of forms, including rhomboidal scutes, long and narrow scutes without an expanded base that posses a slight lateral curve, and a least one scute that has a sutured edge for contact with another scute. Other features suggest that this taxon is more basal than *Scelidosaurus*. As in *Emausaurus* and basal ornithischians, the antorbital fossa is large. In *Sceladonella* and other more derived thyreophorans, the transverse processes of the dorsal vertebrae are horizontally expanded. The lateral margin of the ilium, although widened anteriorly, is elsewhere narrow compared with the condition in *Scelidosaurus*. The taxon is probably an obligate quadruped, the earliest positive evidence of this posture among thyreophorans. The humerus, femur, and tibia are approximately the same length. Obligate quadrupedality, thus, appears to have evolved first among early thyreophorans of small body size and is not a consequence of body size increase.
cal community. The goals for the Cooper Center are to begin processing the large backlog of unprepared fossil material, to bring the collection up to modern curation standards, and to reduce overcrowding that prevents the accessioning of any new collection material. The bulk of this effort will require the support of students and volunteers, through community involvement and the development of a vertebrate paleontology program at Cal State Fullerton. This unique partnership may serve as a template for the management of other collections in the future.

Preparators’ Session (Thursday, November 3, 10:15 am)

THE PREPARATION OF YPM 57103, A CASE STUDY
ROACH, Brian, Yale Peabody Museum, New Haven, CT, USA; FOX, Marilyn, Yale Peabody Museum, New Haven, CT, USA; BHULLAR, Bhart-Anjan, Harvard University, Cambridge, MA, USA

In 2005, a Yale Peabody Museum team working in the Triassic Chinle Formation of Utah’s Grand Staircase - Escalante National Monument excavated the complete, articulated skeleton of an as yet undescribed 1.5 meter long crocodylomorph. This case study will describe the preparation of this specimen; the materials and methods used in its preparation and its molding and casting, and why these were chosen. It will also describe the challenges presented by abundant calcium-carbonate concretions, the need to work the matrix block from two sides, and repairs necessitated by damage from a water leak while in the preparation lab. Because the specimen is both fragile and complex, it was impossible to remove it from its matrix block; however, it was necessary to reduce the block dramatically to optimize the specimen for CT scanning. Before molding, cracks were filled with a polyethylene glycol 1000/3350 mixture. The specimen was molded with silicone rubber. Support jackets of specialized high strength plastic and fiberglass cloth were made to support the smaller block while allowing preparation and research on both sides. Since water damage was confined to the matrix, repairs were made using a paste of ground matrix and methyl methacrylate, to reinforce thin areas. CT scanning required beam adjustment to maximize grayscale values in the range of the bone because of challenging aspects of matrix composition, in particular the abundance of concretions in close proximity to the bone. Size limits necessitated the use of both micron CT and medical CT. Even after scanning parameters were optimized, scans showed considerably less morphology than was visible by examining the fossil itself because of excellent color separation between bone and matrix. Thus, in this case, scans proved to be no substitute for good manual preparation, which ultimately provided the primary data for analyzing the specimen’s morphology. This specimen experienced many usual and unusual aspects of the complete preparation process from excavation to research.

Symposium 3 (Thursday, November 3, 8:30 am)

BASIN-SCALE CONTROLS ON CONTINENTAL VERTEBRATE TAPHONOMY: INSIGHTS FROM THE CAMPAIGN OF LARAMIDIA
ROBERTS, Eric, James Cook University, Townsville, Australia; TAPANILAI, Leif, Idaho State University, Pocatello, ID, USA; ROGERS, Raymond, Macalester College, Saint Paul, MN, USA; FOREMAN, Brady, University of Wyoming, Laramie, WY, USA

The Campanian of Laramidia represents one of the most widespread and voluminous records of continental vertebrate fossil preservation in the world. Ongoing geologic investigations are focused on the development of a high-resolution chronostratigraphic framework for Campanian strata across the Western Interior Basin. The addition of new radiometric ages from the Abcoude Basin, the Western Interior Basin, and the Hostalets Superiors—allow us to provide a more detailed description of this species than previously available, with Sansanosmilus jourdani vallesisensis being considered as its junior subjective synonym. A cladistic analysis, combining previously-published data with those provided by the new remains from the Vallès-Penedès, strongly supports the monophyly of barbourofelids, which appear more closely related to felids than to nimravids. The analysis further indicates that the tribe Afrosmilini is paraphyletic, with some Afrosmilus species being more closely related to the Barbourfelini than other barbourofelids. On the contrary, the analysis supports the monophyly of the Barbourfelini, with Sansanosmilus palmioides being its basalmost member, and Sansanosmilus jourdani being the sister-taxon of the Barbourfelis clade. This indicates that, as currently conceived, the genus Sansanosmilus is paraphyletic, with S. jourdani sharing several derived features with Barbourfelis spp. This might justify resurrecting the genus Albsansanosmilus, currently considered a junior subjective synonym of Sansanosmilus, for S. jourdani. From a paleobiogeographic viewpoint, our results suggest that (1) barbourofelids originated in Eurasia during the early Middle Miocene, following at least two dispersal events of African afrosmilids into that continent; (2) Barbourfelis originated during the late Middle Miocene, following the dispersal of Eurasian Sansanosmilus into North America; (3) the presence of Barbourfelis in Turkey during the Late Miocene is most likely interpreted as a later independent dispersal event from North America back into Eurasia.

PHYLOGENETIC RELATIONSHIPS OF THE PTERANDONTOID PTEROSAURS FROM THE LOWER CRETACEOUS OF BRAZIL
RODRIGUES, Taissa, Universidade Federal do Espo Santo, Alegre, Brazil; KELLNER, Alexander, Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

Pterosaurs from the Lower Cretaceous Araripina Basin of Brazil were first described some 30 years ago and, thanks to their exquisite preservation, have been extensively studied since. The most speciose group of flying reptiles from this unit concerns the anhanguerids and putatively related taxa, which some authors refer as ornithocheirids. Anhanguerids and ornithocheirids (as presently defined) concern two of the most important groups of Cretaceous pterosaurs, but still their relationships were never tested in a cladistic context. Therefore, we performed the first analysis of the phylogenetic affinities between anhanguerids, non-anhanguerid Brazilian pteranodontid pterosaurs, and Ornithocheirus simus from the Cretaceous of Europe. The species were included in a slightly modified version of a previously published data matrix, which was analyzed in TNT with the traditional search algorithm. As the consensus tree was largely consistent with the wild tree resulting from a search with the aid of the agreement subtree command. Subsequently, the least incomplete taxa from the groups being investigated were not pruned from the tree buffer. Results confirmed the monophyly of the Anhangueridae, including the genera Anhanguera and Tropeognathus. Caucichephalus trimicrodon and Cearadactylus atrox were recovered in a polytomy, as the sister-groups of the Anhangueridae; this lack of resolution is due to the missing data regarding the mandible of the former. Their sister-group was the clade 'Cearadactylus ligabuei + Caudipteryx sibbicki'. 'Anhanguera cavieri' was found as their sister-group. These results suggest that 'Cearadactylus ligabuei' and 'Anhanguera' cavieri' must be relocated to new generic. Ornithocheirus simus was one of the wildcard taxa and had a dubious position. Therefore, we propose that the Ornithocheiridae should be restricted to its type-genus.

PHYSICAL TRANSPORTATION OF Fossils FROM THE LOWER CRETACEOUS OF BRAZIL: TECHNIQUE FOR THE DESTRUCTION OF THE EXCAVATION MATERIAL
RODRIGUES, Taissa, Universidade Federal do Espo Santo, Alegre, Brazil; KELLNER, Alexander, Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

Pterosaurs from the Lower Cretaceous Araripina Basin of Brazil were first described some 30 years ago and, thanks to their exquisite preservation, have been extensively studied since. The most speciose group of flying reptiles from this unit concerns the anhanguerids and putatively related taxa, which some authors refer as ornithocheirids. Anhanguerids and ornithocheirids (as presently defined) concern two of the most important groups of Cretaceous pterosaurs, but still their relationships were never tested in a cladistic context. Therefore, we performed the first analysis of the phylogenetic affinities between anhanguerids, non-anhanguerid Brazilian pteranodontid pterosaurs, and Ornithocheirus simus from the Cretaceous of Europe. The species were included in a slightly modified version of a previously published data matrix, which was analyzed in TNT with the traditional search algorithm. As the consensus tree was largely consistent with the wild tree resulting from a search with the aid of the agreement subtree command. Subsequently, the least incomplete taxa from the groups being investigated were not pruned from the tree buffer. Results confirmed the monophyly of the Anhangueridae, including the genera Anhanguera and Tropeognathus. Caucichephalus trimicrodon and Cearadactylus atrox were recovered in a polytomy, as the sister-groups of the Anhangueridae; this lack of resolution is due to the missing data regarding the mandible of the former. Their sister-group was the clade 'Cearadactylus ligabuei + Caudipteryx sibbicki'. 'Anhanguera cavieri' was found as their sister-group. These results suggest that 'Cearadactylus ligabuei' and 'Anhanguera' cavieri' must be relocated to new generic. Ornithocheirus simus was one of the wildcard taxa and had a dubious position. Therefore, we propose that the Ornithocheiridae should be restricted to its type-genus.
associated with leaping in prosimians (high talar body, elongation of the talar trochlea, tarsal chain rather than the talus, and the cleidoarc). Additional traits observed in Anchomomys reinforce its generalist locomotor behaviour (as opposed to specialized), and reflect its efficiency in the use of vertical supports more than horizontal ones. Among living taxa, members of the genus Cheirogaleus may be good analogues for Anchomomys frontaniensis in terms of locomotion.

Poster Session II (Thursday, November 3)

NEW EARLY TRIASSIC FISH FAUNAS FROM THE WESTERN UNITED STATES AND THE RECOVERY OF FISHES AFTER THE END-PERMIAN MASS EXTINCTION

ROMANO, Carlo, Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland; BRINKMANN, Winand, Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland; WARE, David, Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland; JENKS, Jon, West Jordan, UT, USA; LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA

The end-Permian mass extinction is the largest known crisis in the history of life, with more than 90% of marine species not surviving into the Mesozoic. While some organisms had a slow rate of recovery during the subsequent Early Triassic, others reached high diversity very soon after the main extinction event. Here, we present the results of an updated analysis on the diversity dynamics of Early Triassic chondrichthyan and osteichthyan fishes. Most localities yielding marine Early Triassic fishes are from the Tethys Realm (e.g. Madagas- car) or the Boreal Sea (e.g. Greenland, Spitsbergen). Early Triassic fish occurrences in the United States are rare. Until recently, only one locality was known: Bear Lake in south-eastern Idaho. However, an additional site yielding Early Triassic fishes was discovered near Candelaria (Mineral County, Nevada). We herein report new Early Triassic fish faunas from the Bear Lake and Candelaria areas. The new marine fish fauna from Bear Lake is derived from late Smithian (early Olenekian) deposits of the Thaynes Formation. This is the first time that fishes are reported from the late Smithian of this region. The age of the new ichthyofauna from Candelaria can be restricted to the Dienerian (late Induan) based on ammonoids. The Early Triassic ichthyofauna from Bear Lake and Candelaria contain mainly lower actinopterygians but also actinistians. Knowledge regarding Early Triassic fish faunas from the United States is crucial in order to understand the recovery of fishes of the eastern Panthalassa Ocean in the wake of the end-Permian mass extinction. The study of Early Triassic fishes from Bear Lake and Candelaria is especially important as these sites were located close to the southern Panthalassan Realm during the Early Triassic – a part of this super-ocean for which we so far have no record of Early Triassic fishes.

Symposium 4 (Friday, November 4, 12:00 pm)

CONTRASTING PATTERNS OF ROCK AND BIOTIC DIVERSITY IN THE MARINE AND TERRESTRIAL FOSSIL RECORDS OF NORTH AMERICA

ROOK, Deborah, University of Wisconsin-Madison, Madison, WI, USA; HEIM, Joel, University of Wisconsin-Madison, Madison, WI, USA; MARCOT, Jonathan, University of Illinois at Urbana-Champaign, Urbana, IL, USA; PEETERS, Shanan, University of Wisconsin-Madison, Madison, WI, USA

Macrostratigraphy examines the relationship between sedimentary dynamics and biotic diversity in the marine realm. Using packages of continuous sedimentation bound by hiatuses of non-deposition, erosion, or alternations between marine and non-marine sediments, we are able to quantify large scale patterns of sedimentation through the rock record. We linked macrostratigraphic data in the Macrostrat database to fossil collection data in the Paleobiol- ogy Database (PaleoDB), which connects fossils to the rocks in which they were originally found. Using the information from these two linked databases, we have shown that the geo- logic completeness of paleontological sampling, a measure of the available rock with at least one recognized fossil occurrence, is similar for the marine and the non-marine. Here, we test the hypothesis that the temporal distribution of lithologies (in the form of evenness) has a re- lationship to genus-level taxonomic diversity in both the marine and non-marine realms. Our approaches include 1) a spatial approach, following the spatial distribution of taxa in order to identify areas of high and low diversity, and 2) a time approach, following the temporal distribution of taxa in order to identify patterns in the rate of change. We find a strong relationship between lithologic evenness and marine diversity. This demonstrates a distinct difference in the relationship between biologic and sedimentary processes at work in the marine and non-marine realms, and possibly differences in the magnitude of the bias imposed by the rock record on the underlying biologic patterns.
Three species of freshwater gastropods occur in the assemblage: Gyraulus circumstriatus, Gyraulus parvus, and Physella virgata, all of which are still extant. P. virgata lives in ephemeral bodies of water and is capable of migrating between shallow pools. The most abundant species are G. circumstriatus and G. parvus, both of which inhabit ephemeral pools and marshes.

The gravely sediment occurs in 1-to-2-m-thick, fining-upward cycles. Cross-bedding and clast imbrication show a predominantly southwestward paleocurrent direction, which matches the modern flow direction of Pleistocene White River. That river drained into the Colorado River via Meadow Valley Wash.

We interpret this biota and associated sediments to represent a floodplain ecosystem with a shallow, gravel-bed river. The finer-grained deposits represent abandoned channels; these became marshy pools teeming with tiny gastropods. Alder was a conspicuous riparian species, with a woodland of oak, juniper, and pines occurring in nearby drier habitats. Xeric habitats apparently also existed in the vicinity.

Technical Session XV (Saturday, November 5, 9:45 am)

MIDDLE PERMIAN BIODIVERSITY CHANGES AND THE GUADALUPEAN EXTINCTION ON LAND; UNRAVELING EVIDENCE FROM THE BEAUFORT GROUP, SOUTH AFRICA

RUBIDGE, Bruce, University of the Witwatersrand, Johannesburg, South Africa; DAY, Mike, University of the Witwatersrand, Johannesburg, South Africa; ANGIELCZYK, Kenneth, The Field Museum, Chicago, IL, USA; GUVEN, Saniye, University of the Witwatersrand, Johannesburg, South Africa

The Beaufort Group of South Africa chronicles a near continuous record of fluvial sedimentation from the Middle Permian to the Mid Triassic. The lowermost formation in the group, the Abrahamskraal Formation, has the potential to record the end-Guadalupian extinction, if indeed it occurred on land. This formation, which is up to 2.5 km thick and has a rich diversity of fossil tetrapods, corresponds with the Tapinocephalus Zone and Tapinocephalus biozones. Despite its potential significance, it has received relatively little research attention because fieldwork has been hampered by the intensely folded nature of the rocks. Extensive fieldwork over many years combined with the application of the newly developed GIS-based database for Beaufort fossils has begun to remedy this problem, and allowed important new insights into faunal change in the Abrahamskraal Formation. In particular, taxonomic refinement for diverse mammalian and dicynodont taxa has enabled a more detailed delineation of stratigraphic ranges and biogeographic distributions of various elements of the tetrapod fauna. The recent discovery of several new dicynodont genera from the Tapinocephalus Zone has brought the diversity of this clade up to levels that are similar to those of the Late Permian. In addition, dicynodonts display a stable pattern of turnover throughout the stratigraphic range of the Abrahamskraal Formation, with no apparent extinction event. In fact, the appearance of the common genus Dicostus predates the disappearance of dicynodonts, and it retains its high abundance into succeeding biozones. Apart from providing a greater understanding of biodiversity changes throughout the stratigraphic succession, these new data make it possible to biostatigraphically subdivide the Tapinocephalus Assemblage Zone and to refine stratigraphic correlation with other Middle Permian continental deposits.

Poster Session I (Wednesday, November 2)

A HUMERUS OF A GIANT LATE EOCENE PSEUDO-TOOTHED BIRD FROM ANTARCTICA

RUBILAR-ROGERS, David, Museo Nacional de Historia Natural, Santiago de Chile, Chile; YURY-YQEZ, Roberto, Universidad de Chile, Santiago de Chile, Chile; MAYR, Gerald, Forschungsinstitut Senckenberg, Frankfurt, Germany; GIUSSTEIN, Carolina, Universidad de Chile, Santiago de Chile, Chile; OTERO, Rodrigo, Consejo de Monumentos Nacionales, Santiago de Chile, Chile

We report a nearly complete right humerus (SOG.PV 22001) of a huge pseudo-toothed bird (Odontopterygiformes) from the Late Eocene of La Meseta Formation, Seymour Island, west Antarctica, collected during the XLVII Chilean Antarctic Scientific Expedition (2011). The fossil was found in glacial moraine deposits belonging to the stratigraphical unit “Teml 7”, approximately 1.5 km to the west from the Marambio base. Its preserved length is 85 cm and only the distal end is missing. The fragmentary material from Seymour Island is not identifiable at genus- and species-levels. It is notable, however, that by its morphological features, the fossil more closely resembles Neogene than Paleogene Odontopterygiformes. Features in which it agrees with Palaeognathae are those of Palaeognathae and include the greater cranial prominence of the caput humeri, which also has a more abrupt and straighter distal border. Although the tuberculum dorsale is badly preserved, it is wide and protrudes proximally to the level of the caput. The diaphysis is flat and also distinguished the fossil from Dasornis. Judging from the size of the humerus, the fossil appears to have been larger than the largest known pelagornithid, Pelagornis chilensis. Together with another large-sized humerus from the middle Eocene of Belgium, which was tentatively assigned to Dasornis emuinus, the Pelagornis-like morphology of the fossils supports a single origin of giant pseudo-toothed birds as has been previously suggested.
One traditional strength of Quaternary paleoecology is the ability to reference modern biota. Taking advantage of that, I established correlations, using ecoregion maps and published distribution data, between taxonomic diversity of modern mammals and climatic variables. The predictive equations from the significant correlations can then be used to produce estimates of paleoclimates. These methods can provide more than gestalt interpretations; quantitative predictive equations may be generated from these data. Based on previous uses of these predictive equations, temperature estimates appear to be more reliable than those for precipitation; therefore, only temperature values were generated in this study.

I examined published lists of fossil mammals for more than 200 Pleistocene and Holocene localities in Illinois. Some of these are superimposed sites (many archaeological); some are isolated specimens. Because the correlations based on modern biodiversity have better resolving power with more diverse paleoassemblages, analyses were done separate for sites with progressively higher minimum numbers of species. Taken collectively, the more speciose localities provided estimated temperatures trends expected for faunas before, during, and after the last glacial maximum. However, a broader geographic perspective would better show any patterns. Therefore, this ongoing project is extending the scope to include the entire Midwest, and eventually the continent’s entire fluctuating ice margins.

POSTER SESSION II (Thursday, November 3)

PRAIRIE PALEOECOLOGY: ICE AGE MAMMALS AND TEMPERATURES IN THE U.S. MIDWEST
RUEZ, JR., Dennis, University of Illinois at Springfield, Springfield, IL, USA

One traditional strength of Quaternary paleoecology is the ability to reference modern biota. Taking advantage of that, I established correlations, using ecoregion maps and published distribution data, between taxonomic diversity of modern mammals and climatic variables. The predictive equations from the significant correlations can then be used to produce estimates of paleoclimates. These methods can provide more than gestalt interpretations; quantitative predictive equations may be generated from these data. Based on previous uses of these predictive equations, temperature estimates appear to be more reliable than those for precipitation; therefore, only temperature values were generated in this study.

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Poster Session II (Thursday, November 3)

PATTERNS OF BODY MASS AND DIET OF LARGE UNGULATES FROM MIDDLE AND LATE PLEISTOCENE OF UK AND GERMANY AND THEIR CONNECTIONS WITH ENVIRONMENT
SAARINEN, Juha, University of Helsinki, Helsinki, Finland; FORTELIUS, Mikael, University of Helsinki, Helsinki, Finland

Ecomorphology of ungulates reflects the environments they live in. The average diets of ungulates vary following differences in vegetation, and their body size is affected by a complex set of ecological and physiological connections. In this study we analyze Middle and Late Pleistocene British and German ungulate palaeocommunities in order to test whether there are significant correlations of diet and body size of the ungulates with climate and vegetation openness. This can be robustly done for well-sampled Pleistocene sites because of the great amount of fossil material, possibility to combine local mammal and pollen fossil records, and the drastic fluctuations of Pleistocene climate and environmental conditions. We used mesowear analysis for dietary analyses and regression equations for estimating body mass from dental and skeletal measures. The results show a good average correlation between ungulate mesowear and non-arboreal pollen percentages of the localities, but there are differences in the patterns of different species. Body size is on average larger in open than in closed environments and in glacial than in interglacial ungulate communities with the important exception of horses (Equus ferus), which show a significantly strong opposite pattern compared with the other ungulates. The results indicate that the connection of body size and environment is not as straightforward as the connection of diet and vegetation. This is likely to reflect varying effects of population density and ecological adaptations together with environmental conditions on body size in different species.

SYMPOSIUM 2 (Wednesday, November 2, 10:30 am)

MICROVERTEBRATE FAUNA AND PALEOECOLOGY OF THE TULE SPRINGS LOCAL FAUNA, CLARK COUNTY, NEVADA
SAGEBIEL, James, San Bernardino County Museum, Redlands, CA, USA; SPRINGER, Kathleen, San Bernardino County Museum, Redlands, CA, USA; MANKER, Craig, San Bernardino County Museum, Redlands, CA, USA; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, USA

The Upper Las Vegas Wash north of Las Vegas, Nevada, yields the Tule Springs local fauna (TSLF), the largest open-site late Pleistocene vertebrate fossil assemblage known from the Mojave Desert and southern Great Basin. The TSLF includes diverse megafauna along with newly documented microvertebrates that occur within the extensive groundwater discharge deposits of the Las Vegas Formation. Megasaurofaunal remains have been reported, but systematic sampling for microvertebrates across all members of the Las Vegas Formation has not previously been conducted.

Groundwater discharge deposits form during times of relatively cool temperatures and enhanced effective precipitation. This complex depositional environment records the interplay between hydrophytic plants, trappedolian sediments, and invertebrate and vertebrate faunas. Groundwater discharge deposits are themselves effective climate proxies containing important data relating to the timing and the magnitude of past climate change.

High-resolution stratigraphic control is attained for vertebrate sites by using a detailed sedimentologic and chrononstratigraphic scaffold that allows snapshot reconstruction of microvertebrate assemblages. This scaffold enables documentation of long-term trends in taxonomic representation and relative abundance through multiple glacial and interglacial cycles, effectively tracking the responses of organisms to changing climatic conditions through geologic time.

Microfauna include Lithobates, Anniella, Masticophis, cf. Arizona, Marmota flaviventris, Neotoma cf. N. lepida, Keisbrooktonmys, and cf. Orychomys. The microfauna presents a mixed environmental signal in multiple members of the formation. This juxtaposition of differing paleoenvironmental indicators accords fully with the complex spring discharge habitat envisioned for the region by previous studies. Where sample sizes are sufficient, the relative abundance of represented taxa is coupled with sedimentologic data to yield precise reconstructions of microvertebrate responses to changing climate.

Poster Session IV (Saturday, November 5)

TAPHONOMY OF THE "DRAGON'S TOMB" SAUROLOPHUS (DINOSAURIA/HADROSAURIDAE) BONEBED, NEMEGT FORMATION (LATE CRETACEOUS), MONGOLIA
RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; BELL, Phil, Philip J. Currie Dinosaur Museum, Grande Prairie, AB, Canada; TSAOTGBAATAR, Khishigjav, Paleontological Laboratory and Museum, Ulaanbaatar, Mongolia; BADAMGARAV, Demchig, Paleontological Laboratory and Museum, Ulaanbaatar, Mongolia

One of the richest Late Cretaceous dinosaur faunas is found in the Nemegt Formation of Mongolia. Dinosaur fossils are typically encountered as articulated skeletons, with bonebeds being relatively scarce. A notable exception is the famous “Dragon’s Tomb” bonebed at Altan Ula II that preserves multiple complete skeletons of Sauroplophus with skin impressions. In the 1940’s, a Russian-led expedition collected five virtually complete skeletons and a juvenile skull from the locality. Although some of the specimens have been prepared and studied, the taphonomy and sedimentology of the bonebed has never been documented in detail. Partially in response to illicit poaching, a multi-national team began an on-going project in 2009 to document this historic locality. The surface of the bonebed was cleaned and in situ sections totaling 13m2 were mapped in detail. Every fossil, including those displaced by poaching, was identified, measured, and taphonomic data collected. The approximate placement of the original five skeletons was determined and portions of at least five additional articulated Sauroplophus specimens were identified, as well as previously unreported occurrences of multiple disarticulated bones. At least three size classes (young ju-
TAXON REPLACEMENT: INVASION OR SPECIATION? FIRST RESULTS FROM A SUPERTREE OF NEOGENE MAMMALS
SÁLÁ Laura, University of Helsinki, Helsinki, Finland; FORTELIUS, Mikael, University of Helsinki, Helsinki, Finland; WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden; CORFE, Ian, University of Helsinki, Helsinki, Finland; TUOMOLA, Aino, University of Helsinki, Helsinki, Finland

The NOW (Neogene of the Old World) database contains extensive information about Eurasian Miocone to Pleistocene land mammal taxa and localities. For the last 20 years the NOW database has been used to study varied aspects of the evolution and changing diversity patterns of Eurasian mammals and the effects of climate change on their population dynamics and occupancy patterns, but the scope has been restricted by the lack of a comprehensive phylogenetic framework, which has prevented analyses that require knowledge of relatedness. In order to allow resolution of taxon extinction and replacement in the fossil record with respect to phylogeny-related factors such as speciation and invasion, we are constructing phylogenetic supertrees for a number of major mammalian clades. We have initially constructed supertrees of the carnivorn families Felidae and Canidae, and the order Proboscidea. A wide variety of supertree construction methods were used, along with strict protocols for synonymy and phylogenetic tree inclusion or exclusion. The carnivorn and proboscidean supertrees aim to include all valid species and existing genera, with special focus on taxa present in the NOW database: at present, over 100 felid and 200 proboscidean species, and nearly 100 canid species, have locality records in NOW. This information, together with the supertrees, allows testing of numerous phylogeographical hypotheses, and examination of a wide array of questions related to taxon replacement. Results with the European felid record indicate that after the Vaillesian crisis (9.5 Ma), local speciation within the subfamily Machairodontinae filled the ecological niches of the expanding Pekerman bione mainly with large-sized felids. At the end-Miocene (5.3 Ma) Pekerman collapse, the returning woodland felids were mainly occupied by medium- to large-sized machairodonts originating in Africa and Asia and several small- to medium-sized Felineae lineages originating in Africa and North America. The results highlight the importance of using well-defined geographical areas and species with goodecommetric information in studies of taxon replacement dynamics in the fossil record.

MORPHOLOGICAL DISPARITY, ALLOMETRY AND PHYLOGENETIC SIGNALS IN THE SKULLS OF EXTANT AND FOSSIL CATS (FELIDAE, CARNIVOREA)
SAKAMOTO, Manabu, University of Bristol, Bristol, United Kingdom; RUTA, Marcello, University of Bristol, Bristol, United Kingdom

While modern felid species occupy various niches in terrestrial ecosystems, they are remarkably uniform in terms of diet (hypercarnivory) but also skull morphology; it is often difficult to distinguish species from cranial specimens alone. However, some felid species exhibit subtle but distinct within-species morphological variation. This morphological variation was quantified in 33 extant and 8 extinct species of cats, through multivariate ordination (principal components analysis, PCA) of 29 linear variables of the skull. The resulting two-dimensional or three-dimensional morphospace shows considerable overlap in morphospace occupation in the various small-sized cat species. Spatial statistics indicates a single peak in spatial landscape corresponding to this high-density distribution of the small-sized cats. However, nonparametric multivariate analysis of variance shows significant differences between the major groups of cats (eight genetic lineages + Machairodontinae), and revealing significant differences in post-hoc pairwise comparisons. The first principal component axis strongly correlates with body size, with large-sized cats converging on a similar region in morphospace. To quantify the “hyper-volume” and spread in morphospace of each group, disparity metrics were computed at various taxonomic levels. At the species-level, the ocelot and puma have exceptionally high disparity. Similarly, at the lineage level, the Puma Lineage has particularly high disparity, followed by the Leopard Cat, Ocelot and Panthera Lineages. The two subfamilies, Felinae and Machairodontinae show similar levels of disparity, indicating that while machairodonts are superficially vastly disparate (from the feline-like group, disparity metrics were computed at various taxonomic levels. At the species-level, the element axis strongly correlates with body size, with large-sized cats converging on to a similar region in morphospace, which has revealed a number of novel specializations, including distinct regionalization of the vertebral column. *Tatarsius* possesses three clearly defined trunk regions exhibiting ossified centra, modified articels, and articular processes. In contrast, the caudal vertebrae are marked by thin neural and hemal arches connected by an ossified band around the notochord. Although detailed axial morphology is only known for a handful of early fishes, Paleozoic actinopterygians were thought to lack regional specialization based on partial elements and modern forms. Similar vertebral modifications in early tetrapods have been linked to the transition to land. However, *Tatarsius* was not terrestrial or even necessarily benthic: pectoral fins originate laterally and pelvic fins are absent. As just as in tetrapods, specialized trunk regions in *Tatarsius* likely worked to limit torsion and lateral undulation. Therefore, vertebral specialization might have driven by a need for greater stability and control during caudal fin-driven locomotion. Interestingly, the similarly eel-like *Paraturamia* from Bear Quad, genetically united with *Tatarsius* by a number of homoplastic characters, did not share *Tatarsius*’ axial morphology, probable locomotor mode, or general ecology.
This new glimpse into the fossil record of Malagasy anurans has great potential to help rates what is implied by other subfossil groups: that the natural vegetation of this region was of the largest extant Malagasy frog, the ranid Subaerial connections of previously isolated landmasses constitute some of the most signifi- environments, salinity tolerance is variable in some groups, and there can be no question that been attributed to human introduction within the last 2500 years. As Madagascar has been should thus be incorporated as part of the standard “toolbox” in the investigation of molecu- Poster Session I (Wednesday, November 2)

LARGE SUBFOSSIL FROG FROM NORTHWESTERN MADAGASCAR
SAMONDS, Karen, University of Queensland, Brisbane, Australia; CONWAY, Sarah, McGill University, Montreal, QB, Canada

Despite decades of research on Madagascar’s extant fauna, one of the most unique and endemic on the planet, the origin and evolution of the Malagasy amphibian fauna remains relatively poorly understood. Dispersal and vicariance scenarios have been suggested to explain the occurrence of most groups on Madagascar, while the presence of a few groups has been attributed to human introduction within the last 2500 years. As Madagascar has been isolated for more than 88 million years, any dispersal scenarios require crossing a formidable marine barrier (~400 kilometers). Whereas amphibians tend to have low tolerance for marine environments, salinity tolerance is variable in some groups, and there can be no question that amphibians have crossed marine barriers successfully, given their presence on geologically young, volcanic oceanic islands. The subfossil record of Malagasy anurans is limited to one report of microhylid limb ele- ments collected from Ampasambazimba, central Madagascar. We describe here the first of the mole digital plate, but the apical ridge (identified by Msx2-expressing tissue at the anterior border of the autopod, whereas changes to digits 2-5 seem interdependent, changes to digit 1 are}

CARNIVORE DIVERSITY THROUGH THE CENOZOIC OF OREGON
SAMUELS, Joshua, John Day Fossil Beds National Monument, Kimberly, OR, USA; VALENKENBURY, Blair, University of California, Los Angeles, Los Angeles, CA, USA

The John Day Basin of Oregon includes a rich fossil record, with a nearly complete se- quence of beds spanning the late Eocene through the latest Miocene (~50 – 5 million years ago). Carnivore guilds are well represented from the John Day Formation, Hemingfordian, Barstovian, and Hemphillian of Oregon, allowing us to closely track changes in species richness, body size, and feeding types. Craniodental measurements including skull length and dental dimen- sions were measured for each species and used to estimate body mass and relative tooth sizes, carnassial blade length, and molar grinding area. A multidimensional morphospace was used to analyze divergence among sympatric species and examine morphospace occupa- tion through time. Absolute species richness was highest in the mid Oligocene, and declined through the mid Miocene. This is a consequence of a spectacular diversity of small canids in the Oligocene and the decline of hesperocyonines and hypocarnivorous borophagine in the early Miocene. Unlike overall species richness, the diversity of hypercarnivores, characterized by a trenchant heeled talonid, was relatively stable through time despite the fact that there was a repeated turnover of large hypercarnivores. Morphospace comparisons reveal that nimravids were replaced by hesperocyonine canids followed by amphicyonids and then felines. Similarly, the small canids of the Oligocene and early Miocene occupy the same area of morphospace as mustelids and procyonids later in the Miocene. These results are consistent with previous studies, suggesting that selection for adaptive divergence and hypercarnivory drives evolution within carnivore guilds, despite differences in taxonomic composition and time.

Symposium 1 (Wednesday, November 2, 11:15 am)

CIRCUMVENTING CONSTRAINTS IN LIMB EVOLUTION: THE MOLE’S “THUMB” AND LATE GROWTH IN LIVING AND FOSSIL FORMS
SÁNCHEZ, Marcelo, University of Zurich, Zurich, Switzerland; MITGUTSCH, Christian, University of Zurich, Zurich, Switzerland; JIMENEZ, Rafael, Universidad de Granada, Granada, Spain; RICHARDSON, Michael, University of Leiden, Leiden, Netherlands

Some fossil taxa possessed more than the usual number of five fingers characteristic of crown tetrapods, providing relevant evidence to address rare structures of living species. Among the latter are the Panda’s ‘thumb’ and the remarkable digit-like ‘os falciforme’ of moles, used in concert with the true fingers during digging. These cases may involve the evolutionary remodelling of wrist bones or mechanisms so far unexplained. Preaxial ele- ments have evolved numerous times in tetrapod evolution and the use of the term prepollex and prehallux concern a purely positional matter and should not imply phylogenetic homol- ogy of the adult structures. We examine the molecular limb development of moles and shrews and discovered that novel developmental peculiarities facilitated the inclusion of the mole’s ‘thumb’ into the evolutionary older digit series. The expression pattern of Sox9, Msx2 in embryonic specimens revealed that the os falciforme develops in an originally proximal position and extends distally into the digit area after Sox9 expression in the true digits has faded. The os falciforme develops in domain of Msx2-expressing tissue at the anterior border of the mole digital plate, but the apical ridge (identified by Fgf8 expression patterns) overlying this domain regresses before a digit-like skeletal pattern can be specified. The discovery of the modularity of the developmental program of the region of the first digit, suggests that the phalanx pattern around the pentadactyl pattern should originate at late stages in that region of the autopod, whereas changes to digits 2-5 seem interdependent, changes to digit 1 are independent.

The circumscribing of a constraint, in the number of digits in the mole’s case, is one of many examples of the plasticity of developmental programs. These can be reconstructed with some confidence and to some extent for fossils based on their adult phenotypes. Several aspects of late growth are relevant in this context, including developmental sequences, limb bone microstructure and the sequence of epiphyseal fusion.
HIGH MAXIMUM GROWTH RATE IN CF. MAMENCHISAUROUS ARGUES AGAINST LOW BASAL METABOLIC RATE AS THE EXPLANATION FOR SAUROPOD DINOSAUR GIANTISM

SANDER, P., Martin, University of Bonn, Bonn, Germany; OLIVER, Wings, Museum fr Naturkunde, Berlin, Germany; GRIEBLER, Eva, University of Mainz, Mainz, Germany; FOWLER, Denver, Montana State University, Bozeman, MT, USA; HENDERSON, Donald, Royal Tyrrell Museum of Paleontology, Drumheller, AB, Canada

Compared to other lizards, Varanidae have a relatively high basal metabolic rate (BMR), but varanid BMR is only one fifth of mammalian BMR. Such a low basal metabolic rate, leading to a field energy expenditure (FEE) one fifth that of large mammals, was recently hypothesized to explain the unique gigantism of the sauropod dinosaurs. We test the varanid BMR hypothesis of sauropod gigantism by deriving the first well constrained growth curve and maximum growth rate (MGR) estimate for a sauropod dinosaur. The test is based on the relationship between BMR and MGR expressed in Case 2 curves. MGR can be obtained from the cyclical growth record in the histology of dinosaur bones. We use Case curves to constrain BMR of a giant individual of cf. Mamenchisaurus from the Late Jurassic part of the Shishugou Formation (Junggar Basin, NW China). Its large ulna (preserved length: 96 cm) and associated humerus show an external fundamental system (EFS), indicating that the individual was fully grown. Based on the 3-D mathematical slicing method, we estimate the mass of the individual at death at 25,075 kg. Assuming isometry in body mass vs. shaft circumference, we calculate mass gain per annual growth cycle from the percentage of increase in cortical thickness. Preserved cycle 13 records a GMR of 1667 kg/year (4567 g/day). We also calculate MGR from growth models fitted to the growth record. A logistic growth model indicates a MGR of 3006.33 g/day, and a von Bertalanffy growth model indicates a MGR of 2837.94 g/day. These values compare with values for mammals and precocial birds scaled to sauropod size but are inconsistent with those for a varanid lizard scaled up to 25 metric tons body mass (1761 g/day), thus we reject the varanid BMR hypothesis of sauropod gigantism.

NEW FOSSIL PROBOSCIDAE FROM MID-PLIOCENE WORANSO-MILLE, ETHIOPIA: IMPLICATIONS FOR ELUCIDATING THE DIVERSIFICATION AND EVOLUTION OF BASAL TAXA OF CROWN ELEPHANT LINEAGES

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Recent fieldwork in the Woranso-Mille area of the central Afar depression, Ethiopia has produced an abundant, diverse Pliocene mammalian fauna that contains a significant early hominim fossil sample. Proboscidea are also well represented at Woranso-Mille localities, primarily by teeth, mandibles, and partial crania. Most of these specimens are dated to 3.82-3.72 Ma. They document a number of taxa, including rare fossils of advanced anancine gomphotheres, and more common remains of several elephant species. The mid-Pliocene is an interesting interval of proboscidean evolution, as the first, archaic elephants were completely replaced by basal constituents of crown elephant lineages, taxonomic diversity was high (with multiple genera of elephants, stegodonts, anancine gomphotheres, and deinotheres co-occurring in Africa), and substantial changes in the craniodental apparatus are observed in elephants from this time, presumably in response to more open habitats and greater competition for grazing resources. The Woranso-Mille sample is important because there are few African sites of this age, and more needs to be known about the adaptive diversification of early crown elephants. Comparative morphometric study of dentition indicates that many as four elephant species are present in the sample: Elephas recki brumpti, cf. E. eokesinis, cf. Loxodontia adaurasa, and cf. Mammuthus sp. (“Hadar” type). Differences in hypsodonty among these taxa presage the later success of E. recki and replacement of other elephants by this species in East Africa during the early Pleistocene, and contrasts between E. recki from Woranso-Mille and late Pliocene Hadar, Ethiopia provide evidence for rapid evolutionary change in the lineage. The Woranso-Mille sample also yields information critical for understanding the pattern and mode of African elephant evolution, which in E. recki appears to have been anagenetic and strongly directional for enhanced grazing effectiveness.

THE CHINESE COLOSSUS: AN ANALYSIS OF THE PHYLOGENY OF RUYANGOSAURUS GIGANTEUS AND ITS IMPLICATIONS FOR TITANOSAUR EVOLUTION

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For many years the taxonomic history of Titanosaurus has been a puzzle, and even today the phylogenetic positions and even the general morphological and evolutionary affinities of many titanosaurs and titanosauriforms are not well-understood, particularly the gigantic new Asian forms. One of the largest examples is the massive Chinese titanosaur Ruyangosaurus giganteus – though comprised of only six bones, the holotype preserves enough diagnostic features to offer several clues to its phylogenetic affinities. A preliminary review of literature on Ruyangosaurus shows that its initial classification as a member of Andesauridae is based on three weak characters that do not make for a definite diagnosis. Ruyangosaurus differs from the three taxa traditionally included in Andesauridae in multiple diagnostic characters of the vertebrae, femur, and tibia. Several plesiomorphies of Ruyangosaurus are rare or non-existent in titanosaurs outside the clade Lognkosaurus and its close relatives. The vertebrae are particularly distinctive, with a strong resemblance in its extremely wide, flattened proportions to the anterior dorsal of Puertasaurus. The recovered posterior dorsal vertebra of Ruyangosaurus shares a number of synapomorphies with Mendosaaurus and Pitekunsaurus. External pneumatization of the vertebrae is moderate, and fine internal camellae are present, indicating a transitional position between the largely external pneumatic diverticulae in basal titanosaurs like Andesaurus and the heavily internalized pneumatization of derived lithostroths. The slender and proximally rugose femur is unusual in shape among titanosaurs, having the fourth trochanter and lateral bulge located unusually high on the shaft, similar to Malawisaurus, Truksantit, and Pitekunsaurus as well as a referred specimen of Titanosaurus indicus and two unnamed South American taxa. Ruyangosaurus is phylogenetically recovered as a probable logkosaurian, with significant implications for the geographic distribution and evolution of that group and the paleobiology of Late Cretaceous China.
more derived theropod clades with arctometatarsalian pes length 200mm; width at proximal end 75mm). The cnemial crest is well developed, brooch of fibulae, the tibia. Only proximal portion of the tibia is preserved including part of the shaft (preserved length 200mm; width at proximal end 75mm). The cnemial crest is well developed, preserved in close connection to the tibia. Only proximal portion of the tibia is preserved including part of the shaft (preserved length 200mm; width at proximal end 75mm). The cnemial crest is well developed. The distal end of the femur also preserves connecting bone in both alligators and birds. The second stage of development, the similarity in the formation of the primary bronchus and the most proximal secondary bronchi in both alligators and birds is striking. Furthermore, the second bronchial division in the alligator appears to be homologous with the first ventrobronchial in the chicken. The lungs differ in that chickens have four ventrobronchi while only one was clearly present in the alligator. Both dorsobronchi and lateral bronchi are present in both taxa. These pilot data suggest that similar molecular and genetic programs may underpin the morphogenesis of these lungs.
COMPARATIVE PALEAEHOLOGY OF TRIASIC RAUISUCHIAN AND AETOSAURIAN OSTEODEMERS (ARCHOSAURIA: PSEUDOSUCHIA)

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Osteoderm material of eight rauisuchian taxa (Batrachotomus loricellensis from Germany, Prestosuchus chiniquensis, P. loricatus and Rauisuchus tiradentes from Switzerland, Tikishus romeri and the putative Varasuchus decceanus from India), ten aetosaurian taxa (incl. Aetosaurus ferratus and Paratoposaurus andressorum from Germany, Stagonolepis olkenae from Poland, and Adamanasuchus eisenhardtae, Calyptosuchus wellesi, Desmatosuchus spp., Paratoposaurus sp., Stagonolepididae, and Typhosuchus coccinarus), and a possible juvenile rauisuchian from Switzerland, Prestosuchus chiniquensis from Petrified Forest National Park, Arizona, as an outgroup were sampled histologically to elucidate the morphogenesis and structure of dermal armour in these diverse and widespread lineages of pseudosuchian archosaurs. Whereas the rauisuchian samples were found to be rather compact bones, usually lacking significant bone remodelling or large areas of cancellous bone, thus presenting good growth records, the aetosaurian samples showed well developed diploë structures in which the cancellous part can be quite extensive. This is in contrast to previously sampled Aetosaurusinae osteoderms from South America (including Aetosauroides scagliai), which generally lacked a larger area of interior cancellous bone. In the rauisuchians, highly vascularised woven- or fibrolamellar bone tissue deposited in the core areas indicates higher growth rates early in development, whereas a more compact parallel-fibred bone matrix indicates reduced growth rates later in development. In the aetosaurian samples, woven- or fibrolamellar bone tissue, previously described also in Aetosaurusinae osteoderms from South America, was found in T. coccinarum, whereas the other aetosaur osteoderms were predominantly composed of parallel-fibred or lamellar-zonal bone. In the R. callenderi osteoderm, the interior core consisted of dense cancellous bone, with dense trabecular bone being present only in the thick central region. Otherwise the specimen was composed of (often densely remodelled) parallel-fibred bone tissue.

Romer Prize/Technical Session 5 (Thursday, November 3, 12:00 pm)

EMPLO-SPATIAL PATTERNS IN THE EVOLUTION OF EXTANT AFRICAN BOVVIDAE BASED ON MOLECULAR, FOSSIL AND CLIMATE NICHE DATA

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The Bovidae are the dominating large mammal group within fossil assemblages of African Neogene fossil sites. Due to a wide range of habitat adaptations, the presence of certain species within fossil assemblages provides detailed information about prevailing environmental conditions. However, this information is locally and / or temporally restricted due to a biased distribution and availability of fossil sites. Furthermore, taphonomic biases particularly affected species with low body size and / or adaptation to humid and forested environments.

Molecular analyses and climate niche models can help to overcome these difficulties. We produced a fossil calibrated phylogeny of 76 extant Afro-Arabian bovid species (95% of full sample). 11 fossil records served as calibration points, giving the first appearance dates of tribes and higher taxa. Analyses of divergence times show temporal patterns within the evolution of lineages adapted to humid and arid environments. Evidently major speciation processes occurred between 8.5 and 2.5 Ma. These events are in accordance with turnover pulses in fossil assemblages.

Additionally, we used the climate niche modelling approach usually applied for future distribution predictions. For the extant bovids this resulted in five major polyphyletic climate groups depending on 7 climatic variables: hot-wet, hot-dry, chilled-wet, chilled-dry, and intermediate. A projection of the group’s preferences on climate scenarios for the two significant periods in bovid evolution shows a potential distribution during the Late Miocene and Pleistocene. The resulting hypothetical distribution maps connect fossil sites spatially and bridges gaps in the fossil records. Our approach combines palaeontological and molecular methods and improves our understanding of macro-evolutionary processes.

Symposium 3 (Thursday, November 3, 8:15 am)

VOLCANIC TECTONIC PARTITIONING OF LARAMIDA: INFLUENCE ON CAMPAIGN TERRESTRIAL ENVIRONMENTS AND ECOSYSTEMS

SCHMITT, James, Montana State University, Bozeman, MT, USA; VARVICCHIO, David, Montana State University, Bozeman, MT, USA

CAMPANIAN TERRESTRIAL ENVIRONMENTS AND ECOSYSTEMS

SCHMITT, James, Montana State University, Bozeman, MT, USA; VARRICCHIO, David, Montana State University, Bozeman, MT, USA

CAMPANIAN (83.5-70.6 Ma) Laramidia comprises a north-south trending paleogeographic province separated from the mainland of the North American continent (Appalachia) by the Western Interior seaway. Terrestrial vertebrate faunas of Laramidia, particularly those of late Cretaceous age (76.0-70.6 Ma), exhibit evidence of endemism hypothesized to represent either latitudinally discrete regional faunas or gradation between northern and southern faunal extremes and attributed to latitudinal climatic gradients.

We suggest that tectonically controlled elements along the north-south trending Sevier orogen basin active during Campanian time also served as important physical and ecological barriers, partitioning the Laramidia landmass into latitudinally distinct provinces and influencing associated terrestrial depositional systems. These tectonic features include: 1) Elkhorn Mountains volcanic field (Helena salient of western Montana), 2) three major cross-strike structural discontinuities (CSD) within the Sevier orogen and related long-lived fluvial megafan systems (SW Montana/NW Wyoming, NE Utah, central Utah), and 3) zones of impingement between Laramide foreland uplifts and Sevier thrusting (SW Montana, NW Wyoming, NE Utah).

The 80-70 Ma explosive Elkhorn Mountains volcanic center impacted adjacent fluvial systems through input of volcaniclastic sediment, affecting channel morphology and floodplain ecosystem dynamics. Large, integrated drainage basins developed in the orogenic wedge at CSD locations (thrust belt recesses), providing large volumes of coarse sediment to large, braided fluvial megafan systems. Zones of impingement of Sevier thrust and Laramide reverse faults likely had lesser effects on depositional systems, as these Laramide uplifts (Blacktail/Snowcrest, ancestral Teton/Gros Ventre, Uinta) were nascient during Campanian time, providing primarily fine-grained detritus to fluvial systems. Each of these differing fluvial system styles partitioned the Laramidian alluvial plain into distinct ecosystems capable of engendering latitudinal faunal divergence that should be testable with more detailed sampling of the vertebrate fossil record.

Symposium 1 (Wednesday, November 2, 8:30 am)

AUTOPODIAL EXPRESSION IN MOUSE LIMBS DRIVEN BY A HOXD ENHANCER OF PINNED VERTEBRATES

SCHNEIDER, Igor, The University of Chicago, Chicago, IL, USA; ANEAS, Iy, The University of Chicago, Chicago, IL, USA; NOBREGA, Marcelo, The University of Chicago, Chicago, IL, USA; SHUBIN, Neil, The University of Chicago, Chicago, IL, USA

The evolutionary transition of the fins of fish into tetrapod limbs involved genetic changes to developmental systems that resulted in a novel skeletal configuration. Approaches to understanding this problem have entailed the search for antecedents of the tetrapod limbs in the fins of fishes, genes, and embryos. Previous studies have revealed that the expression of posterior Hox genes of the A and D paralogues in distal fins appears similar to that of tetrapod digits. These analyses of expression have stood in contrast to studies of Hox gene regulation, which suggested that Hox expression in distal appendages of tetrapods is regulated by novel enhancers not present in fish. Here, using a phylogenetic approach to transgenesis, we reveal that the enhancer-sequence characteristics of zebraline and skates can drive expression in mouse digits and zebraline fins. Our results reveal that the Hox enhancer, previously associated with the origin of digits, was present in the common ancestor of gnathostomes and that the capacity to drive expression in the autopod arose in fish.
NEW INFORMATION ON PACHYCEPHALOSAUR DINOSAUR DIVERSITY IN THE FOREMOST FORMATION (CAMPANIAN) OF ALBERTA

SCHOTT, Ryan, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada

The diversity and interrelationships of pachycephalosaurian dinosaurs (Ornithischia: Marginocephalia) remain poorly resolved, due in part to the incomplete nature of their remains. Many taxa, including the enigmatic Coleoplosaurus lambie from the Foremost Formation (FF) of Alberta, are known only from partial frontoparietal domes. New fieldwork in the FF has recovered a number of new pachycephalosaur specimens including the first complete parietal and partial squamosals. The squamosal, which was found in the same sandy interval and in close proximity to a new frontoparietal dome of C. lambi, has two corner nodes and a secondary node row on the dorsal surface. An identical pattern of ornamentation is found in two squamosals collected from the lower Judith River Formation of Kennedy Coulee, Montana, and we conclude that these squamosals are from the same taxon, most likely C. lambei. A complete evaluation of pachycephalosaur material from the FF identified several frontoparietal domes that do not conform to the diagnostic morphology of C. lambei. Here we test the hypothesis that these specimens are distinct from C. lambei with both qualitative morphological comparisons and linear and geometric morphometric analyses of frontoparietal shape. Results suggest that these specimens are distinct from C. lambei, but we are unable to sufficiently distinguish the specimens from other taxa, notably S. validum, due to the limited nature of the material. This result doubles known pachycephalosaur diversity in the FF. We incorporate the new morphological information into a series of phylogenetic analyses of Pachycephalosauria, which include the FF squamosal as a distinct taxon and as C. lambei, to test the systematic position of FF taxa. When the squamosal is considered as a distinct taxon, it falls in a polytomy with Goswychephe and a clade containing all other pachycephalosaur excaevae of Wannanosaurus, Stegoceras, Coleoplosaurus, and Hunsuesia. Inclusion of squamosal morphology in the scoring for C. lambi has no effect on the tree topology. These results are an important step towards an increased understanding of pachycephalosaur evolution and diversity during the Late Cretaceous.

Preparers’ Session (Thursday, November 3, 10:45 am)

USING NEUTRON RADIOGRAPHY TO QUANTIFY CONSOLIDANT PENETRATION IN FOSSIL BONE

SCHULP, Anne, Naturhistorisches Museum Maastricht, Maastricht, Netherlands; SCHOUTEN, Remmert, University of Bristol, Bristol, United Kingdom; METTEN, Lango, Institute for Energy, JRC EU, Petten, Netherland; VAN DE SANDE, Alan, Institute for Energy, JRC EU, Petten, Netherland; BONTENBAL, Aad, petten, Petten, Netherlands

When applying solvent-based consolidant systems in vertebrate palaeontological conservation, it is important to understand the factors determining the distribution of the consolidant in the fossil. Of particular interest is the question under which conditions the consolidant may be dragged back to the bone surface by the evaporating solvent. This may result in the unwanted buildup of a thick layer of consolidant on the surface of the fossil, while generally a deep and isotropic penetration is preferred instead.

Physical sectioning of a fossil provides a quick, affordable and destructive assessment of the penetration characteristics of a solvent-based consolidant system. Neutron imaging instead, apart from being non-destructive, has the advantage of providing a much more quantitative, spatial impression of the actual distribution of the consolidant. Because of its non-destructive nature, it could potentially also provide better insight into the effect of multiple applications of consolidant.

As a proof-of-concept, bone material from the type Maastrichtian (SE Netherlands) was partially consolidated and imaged using the High Flux Reactor facility (HFR) in Petten. As neutrons are particularly well absorbed by hydrogen bonds, many consolidants become clearly visible in otherwise neutron-radiolucent materials such as the fossils considered here. The fossil material was stored in a climate-controlled museum collection at 50-60% RH prior to making the radiographs. Air RH at the HFR facility was controlled at 55%. Neutron radiographs were made using sub-thermal neutrons, flux 7.88·10⁹m⁻²s⁻¹ with a reactor power of 45MW; exposure time 50 minutes, using a gadolinium backscreeen. Field of view was 230 mm.

Neutron imaging of an acetone/methylmethacrylate system applied on type Maastrichtian mosasaur material showed that in this case, the consolidant distribution was rather even, and that the penetration of the consolidant, poorly visible and hard to assess on a physical section, turned out to be effective.

Technical Session XIII (Friday, November 4, 2:30 pm)

STRUCTURE AND FUNCTION OF DRYOLESTID MOLARS (MAMMALIA, CLADOThERIA)

SCHULTZ, Julia, Universität Bonn, Bonn, Germany; MARTIN, Thomas, Universität Bonn, Bonn, Germany

The mesio-distally compressed and linguo-buccally widened pretribosphenic dryolestid molars are characterized by embrasure shearing. During occlusion the triconids of the lower molars fit into the triangular spaces between the “primary trigon basins” of the upper molars. Striation analysis and virtual simulation of the chewing process using the newly developed “Occlusal Fingerprint Analyser”-software (OFA) were applied to study the function of the occlusal surface of the molars. The main cusps have mainly a puncture-crushing function, whereas the sharp pairs of leading edges paraconid/protoconid and metaconid/paraconid act as cutting devices probably for slicing hard exoskeletons of insects. In addition dryolestids evolved accessory shearing surfaces, mesial to the “primary trigon” and distal to the trigonid for further processing softer parts of food items. The unicuspidae talonid of the lower molars with its bucally sloping hypoflexid groove has a guiding and shearing function, when the paracone slides along the groove in buccal direction during mastication. This groove is homologous to the hypoflexid of the tribosphenic molar, although in tribosphenic molars it is variably inclined and less involved in the occlusal contacts. The parazylar wing mesial to the “primary trigon” of the upper dryolestid molars has additional guiding function during the mastication process. The striations on the shearing surface at the distal side of the protoconid are more steeply inclined than the guiding groove of the hypoflexid. This indicates that the lower molar moves in two phases into occlusion during the chewing cycle: an initial puncture-crushing phase and a subsequent shearing phase before full centric occlusion. A grinding phase after centric occlusion as typical for tribosphenic molars does not occur in dryolestid molars. During the evolution of the talonid basin, the shearing area of the hypo- flexid was displaced buccally and rotated in mesial direction. In combination with the formation of the talonid basin a functional shift in the chewing cycle from shearing to grinding occurred and the hypoflexid lost its function as a main shearing area.
WHERE DO ALL THE PITS COME FROM? THE EFFECT OF ABRASIVE SILICA PARTICLES ON TOOTH WEAR AND ITS IMPLICATION FOR PALEODIETARY INTERPRETATIONS

SCHULZ, Ellen, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; PIOTROWSKI, Vanessa, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany; CLAUS, Marcus, Clinic for Zoo Animals, Exotic Pets and Wildlife, University of Zurich, Zurich, Switzerland; GILDAS, Merceron, 3UMR 5276 (CNRS, ENS, University Lyon 1), research center of geology: earth, planets, environment, Villeurbanne Cedex, France; KAISER, Thomas, Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany

The dental microwear and 3D areal surface texture analyses are useful in reconstructing the diets of extinct and extant carnivores, ungulates and rodents. Both methods are based on comparing extinct with extant species. Based on microwear, a predominance of scratches had initially been interpreted as to indicate highly abrasive grazing diets, while a predominance of pits had been referred to a less abrasive browsing diet. But it is still debated if the ptyoliths and/or the grit components scratch or pit the teeth. To evaluate the effects of abrasive silica particles and better understand the relationship between surface textures and paleodiet, controlled feeding experiments were conducted on a captive population of 32 rabbits (Oryctolagus cuniculus) over a period of 25 weeks using four blended animal feeds with known composition. The feeds consisted of grass meal (GG), grass meal with crushed oat (GO1), alfalfa with crushed oat (LH1) and alfalfa (LL). These represent a spectrum between C3 graze and leafy browse. Each type of animal feed was controlled for concentration of silica. The highest amounts of silica were observed in the GG feed the lowest in the LH feed. Moulds were made of the rabbit’s lower molars after extended exposure to each diet and analyzed with dental microwear and 3D areal surface texture analysis. Based on both methods, the GG group has a high proportion of scratches and thus indicates the most abrasion-dominated wear signature. The LH group in turn has a high pit ratio and indicates the most attrition-dominated signature. Silica content was thus identified as the agent scratching dental surfaces. But high pit ratios were observed in the GG group as well. This is related to the higher chewing pressure needed to comminute grass components. We therefore conclude that pitting is not only a measure of browsing.

GEOLOGY AND MAMMALIAN PALEONTOLOGY OF THE CVANCARA LOCALITY (PALEOCENE), TONGUE RIVER MEMBER, FORT UNION FORMATION, GRANT COUNTY, NORTH DAKOTA

SCHUMAKER, Kewaunee, University of North Dakota, Grand Forks, ND, USA; KHIIM, Allen, Minot State University, Minot, ND, USA; WEILER, Matthew, University of North Dakota, Grand Forks, ND, USA; HARTMAN, Joseph, University of North Dakota, Grand Forks, ND, USA

The Cvancara Locality is a vertebrate-bearing channel-lag deposit of the Tongue River Member. Fossils are found within an ironstone concretion conglomerate approximately 40-60 cm above the inferred Cannonball-Tongue River contact. Vertebrate fossils were the primary focus of collecting efforts in 2000 and 2010. The conglomerate unit has produced abundant fish, turtle, chimaera, and mammal fossils. The mammalian taxa present include multituberculates, primates, and condylarths. The multituberculates include Mesodoma sp. and Neo plagiaulax cf. N. robustus. The primates are represented by Piriodictis and Piriodictis silberlingi, with the latter being a useful biostratigraphic indicator. The identification of Pro nothodectes is problematic in that it falls between the size ranges of the two known species of the genus, Pr. matthewi and Pr. jeff. A lower molar of Tetracaenodon puerensis was also recovered from the locality. The preliminary NALMA interpretation of the Cvancara locality is late Torrejonian (To3). This age interpretation is based on the presence of Piriodictis silberlingi, an index taxon for the To3. If the multituberculate material, tentatively assigned to Neo plagiaulax hazeni, does in fact represent N. hazeni, then the age assessment will become more complicated as N. hazeni is only known from Tiffanian. Additional material may allow for a more confident age assessment. The geological setting of the Cvancara Locality is very similar to the Lloyd and Hares II locality, which has also been interpreted to be either late Torrejonian (To3) or early Tiffanian (T1). The age interpretation for the Cvancara locality helps to delineate the timing of the retreat of the Cannonball Sea and the subsequent development of fluvial systems of the Tongue River Member.

Technical Session IV (Wednesday, November 2, 2:15 pm)
SHOW ME YOUR EAR: LOCOMOTORY ADAPTATIONS IN THE INNER EAR OF SCIUROMORPHA (RODENTIA, MAMMALIA)

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Spatial orientation and body movements in three-dimensional space are detected by the vestibular system of the inner ear inside the bony labyrinth of the petrous bone. Sciuromorph rodents are particularly suitable subjects for studies on functional adaptations of the inner ear organ as they represent different modes of locomotion (arborial, gliding, fossorial, general, and aquatic). Petrosals of four Late Oligocene (MP28) and Early Miocene (MN2) sciuromorph rodents as well as thirty extant taxa were studied by high-resolution computed tomography (µCT). For comparison, gliding and actively flying species of other groups (Marsupialia, Chiroptera) were included, and Tapuia sp. was taken as outgroup. The width, height, length, and diameter of the semicircular canals were used to study adaptations of locomotion and posture. A regression analysis and Principal Component Analysis (PCA) revealed a highly significant positive correlation between the diameter of the semicircular canals and the locomotor adaptation. The diameters of the semicircular canals of the ear (Sciuromorpha) and gliding (Pteromyini) Sciuromorpha are significantly smaller than in fossorial taxa (Xerini). This morphology is caused by different sensitivities of the inner ear, depending on the locomotor habits of the respective taxa. For a better locomotor coordination in the three-dimensional space, flying and gliding species possess a larger sensitivity of the inner ears, which is caused by thin semicircular canals. Due to close anatomical correspondence, the bony labyrinth provides information on the soft parts and the accordant physiological parameters in fossorial taxa. The morphological analysis of the semicircular canals within the petrosal can provide important information on the locomotory adaptations of fossorial taxa, even if no postcrania evidence is available.

NEW PLESIOSAURIDAE FROM THE PLIENSCHBACHIAN OF GERMANY AND ITS EVOLUTIONARY IMPLICATIONS

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In June 2007, a partly articulated skeleton of a plesiosaur was discovered in a clay pit in North Rhine-Westphalia, Germany. Previously, plesiosaur specimens had only been found in the Lower Lias (Hettangian and Sinemurian of England) and Upper Lias (Toarcian of southern Germany, England, and France) of Europe. The stratigraphic horizon of the new specimen is Pliensbachian in age, filling this stratigraphic gap in the plesiosaur fossil record. The skull and anterior part of the neck as well as the distal elements of the limbs are missing, but most of the axial skeleton is preserved. Altogether, there are 76 vertebrae (23 cervicals, one or two pectorals, 20-22 dorsals, 3 sacrals, and 28 caudals). Comparison with related taxa suggests that there were at least 10 more cervical vertebrae. The limb girdles and the proximal parts of the fore- and hindlimbs are also well preserved. Carpals, tarsals, and phalanges are scattered over the slab on which the specimen is preserved. A comparison of the new taxon with Lower Jurassic plesiosaurs in the collections of the Natural History Museum in London and the Museum of Natural History in Stuttgart and descriptions in the literature showed it to distinctly differ from known taxa. To corroborate the hypothesis of the specimen being a new taxon, it was added to an existing phylogenetic data matrix, and the analysis was performed using the same settings as in the original matrix. As a result, the specimen was described as a new taxon, Westphaliasaurus simonsensis, based on seven unambiguous synapomorphies. The new taxon was found to fit within the monophyletic Plesiosauridae, together with Plesiosaurus dolichodeirus, Seeleysaurus guelminimperatoris, Microcleithrum homalopondylus, Occitanosaurus tournemirensis, and Hydorion brachypterygus. Both, phylogeny and geographical distribution of the Plesiosauridae suggest that the radiation of the Plesiosauridae was a Europe-wide event.
NEW OSTEOSTRACAN TAXA FROM THE LOWER DEVONIAN (LOCHKOVIAN) MAN ON THE HILL LOCALITY IN CANADA, INCLUDING A NEW NON-CORNUATE OSTEOSTRACAN

SCOTT, Bradley, University of Alberta, Edmonton, AB, Canada; WILSON, Mark, University of Alberta, Edmonton, AB, Canada

The Osteostraci are armored jawless vertebrates considered to be the sister group to the Gnathostomata. Osteostracans are known from the Early Silurian to the Late Devonian. Osteostracans include both primitive, non–cornuate osteostracans (those lacking cornual processes), but retaining pectoral fins and with a headshield composed of small testaeae), and the more derived cornuate osteostracans. The geographic distribution of the Osteostraci was limited to the Laurentia, Avalonia, Baltica, and Kara terranes, and the Alaidas. Non–cornuate osteostracans are distributed across Laurentia and Avalonia, with members of the Ateleaspididae from the Ontarioland basin of the Baltica terrane. The ancestral distribution of the cornuate osteostracans has been traced by previous work as being in the Spitsbergen region, by each of the three major clades of cornuates from this region. The new species from the Lower Devonian (Lochkovian) Man On The Hill (MOTH) locality, Mackenzie Mountains, NWT, Canada, include one in the genus Machairaspis along with a new species of Waerg-Jsoaspis. Two species form a clade with Superiellaaspis, previously known from MOTH. A fifth is placed in Zenaspidha as it shares characters with some members, but it does not share any of the previously proposed synapomorphies of the group. A sixth is the only known non–cornuate osteostracan from the Lower Devonian. It has clearly differentiated pectoral fins and trunk scales that share a number of features with early chondrichthyanas. Based on a maximum-parsimony reconstruction of osteostracan biogeography following earlier work, the ancestral distribution of the clade containing the new non–cornuate osteostracan is resolved as Ostålsland, whereas that of Waerg-Jsoaspis is unchanged in being resolved as Spitsbergen. The remaining MOTH osteostracans belong to the Zenaspida and several of them are in a clade unique to MOTH. For the Zenaspida as a whole, addition of the new taxa from MOTH reduces resolution of the group; however, the earlier proposed ancestral distribution of Spitsbergen for this clade cannot be rejected. The additional taxa quadruple the known species-level diversity of osteostracans at MOTH.

NEW SPECIES OF UNUCHINIA (MAMMALIA, APATOTHERIA) FROM THE PALEOCENE OF ALBERTA, CANADA: PHYLOGENETIC AND BIOSTRATIGRAPHIC IMPLICATIONS

SCOTT, Craig, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; BOYER, Doug, Brooklyn College, City University of New York, Brooklyn, NY, USA

Apatotherians are an unusual group of extinct mammals known primarily from the late Paleocene through Oligocene of North America and Europe. They are characterized by having enlarged upper and lower incisors, peculiar blade-like lower second premolars, and, where preserved, postcranial adaptations indicative of arboriality, including elongate manual digits that may have been used in ways analogous to those of the extant Aye-Aye. The higher level relationships of the group are uncertain, although recent analyses suggest a possible link to Euarctochoerus. Whereas members of one of the included subfamilies, the Euarctochoeridae, are generally well known and represented by cranial and postcranial material, those of the second subfamily, the North American Unuchini, are poorly understood, owing to rarity of specimens. We report here on a new species of Unuchinia from the Paleocene Paskapoo Formation of Alberta, Canada. The new species, represented by several dentigerous jaws and isolated teeth, presents important information on unuchinines, including the first documented upper post-incisor dentition. The characteristic “can opener” shaped I1 and enlarged blade-like p2 confirm referral of Unuchinia to Apatotheria. Unuchinia differs from aptemices in having two enlarged lower incisors, a two-rooted P2, a well-developed two-rooted P3, a large three-rooted P4, transverse upper molars, relatively large p3 and p4, and lower molars with tall trigonids that lack a strong anterolateral projection of the paracristid. Unuchinia has previously been considered the most basal apatotherian on the basis of lower incisor number and lower molar structure; the suite of newly identified characters, including most importantly the large P3/p3 and transverse upper molars, supports this hypothesis. Fragmentary specimens of Unuchinia from the middle Torrejonian (To2) Who Nose? locality and the late Tiffanian (?Ti5) Gao Mine locality indicate that the fossil record of unuchinines spanned most of the Torrejonian and Tiffanian in Alberta, and that Unuchinia and, more rarely Apetemex, are the only apatotherians presently known from the Paleocene of western Canada.

Plio-Pleistocene Equus in Western North America: Morphology, Molecules, and Changes in Diversity Through Time and Space

SCOTT, Eric, San Bernardino County Museum, Redlands, CA, USA

Recent investigations have highlighted discrepancies between anatomy-based and molecular studies assessing the diversity of Plio-Pleistocene North American Equus. Metrical, three basic groupings may be discerned: large and small stout-legged horses, and “stilt-legged” horses. Within each of these groups, subsets can be distinguished on the basis of dental morphology. Based on these data, as many as ten species of Equus can be recognized in Plio-Pleistocene North America, although nowhere did all these species co-occur. In contrast, molecular studies of fossil and modern Equus have proposed that both stout-legged and stilt-legged lineages may each have comprised single, wide-ranging, morphologically-plastic species. The present study employs morphologic and metric data from large Equus at Plio-Pleistocene localities throughout the American west, documenting changes in representation and distribution of equid morphospecies through geologic time. Results are not in accord with interpretations advanced from molecular studies. The highly-successful large horse species Equus scotti is present in multiple early and middle Pleistocene faunas from throughout the region. Exhibiting a relatively consistent size and morphology at different latitudes and showing little morphologic change through multiple glacial-interglacial transitions. This stability conflicts with inferences of high morphologic plasticity for Equus proposed from molecular studies.

In the late Pleistocene, following the immigration of Bison into midlatitude North America ≤240 ka, the species Equus “occidentalis” replaces E. scotti as the common large horse in the southwest. Equus scotti remains the common large species north and east of this range. The co-occurrence in geologic time of these two distinct morphologies, through multiple climatic oscillations, and the retention of their metric and morphologic distinctiveness for tens of thousands of years despite close geographic proximity and possible overlap of the two forms, indicates reproductive isolation and separation at the species level. This rebuts arguments that only one species of stout-legged Equus was present in late Pleistocene North America.

Dental Microwear Texture Analysis of Extant African Bovidae

SCOTT, Jessica, University of Arkansas, Fayetteville, AR, USA

Bovids are often used as paleoenvironmental proxies because they are among the most ubiquitous taxa at fossil sites and because modern ruminants fall into discrete dietary categories that reflect habitat preferences. Traditionally, bovids have been classified on a grazer-mixed feeder-browser continuum based on the percentages of monocots and dicots in their diet. However, actual bovid diets are more complex than these categories suggest and many intermediate classifications have been proposed, including variable grazers, browser-grazer intermediates, frugivores, and generalists. Studies of fossil bovids typically apply the principle of taxonomic uniformitarianism, and while rarely questioned for recent faunas, its utility for reconstructing the paleoecology of extinct species is uncertain. It is critical that ecological similarities of extant and fossil taxa be tested using an epigenetic signal in order to have confidence in these assumed relationships. Here we present a new database of dental microwear texture data for 25 species of extant African bovids, representing 6 dietary categories and various levels of mixed feeding. Point clouds were generated from M2 and M2 enamel bands using a white-light confocal profiler, and data were collected at a lateral sampling interval of 0.18 µm (resolution= 0.005 µm) over an area of 276 x 204 µm. Scale-sensitive fractal analyses of attributes used to separate extant taxa with differing diets were calculated. The results show significant variation among the dietary classifications and confirm that grazing taxa have less complex, more anisotropic surfaces with smaller features than browsing taxa. The results also indicate that microwear texture analysis can successfully distinguish beyond the classic grazer-browser continuum and accurately classify various levels of mixed feeding. Some significant differences within dietary categories were also present, suggesting that texture analysis may have the potential to reveal seasonal and geographic differences in diet. These data have important implications for faunal-based paleoenvironmental reconstructions and can be applied to fossil taxa from sites and time periods across Africa.

Evolution of the “Other” Part of the Limb: Fossil and Developmental Perspectives on Mammalian Shoulder Girdle Evolution

SCOTT, Karen, University of Illinois, Urbana, IL, USA; HÜBLER, Merla, University of Illinois, Urbana, IL, USA; ROSS, Darcy, University of Illinois, Urbana, IL, USA; BECK, Allison, Augustana College, Rock Island, IL, USA

The shoulder girdle (SG) is comprised of the bones that attach the forelimbs to the axial skeleton. In the ancestors of mammals, these bones included the scapula and large, well-developed coracoids. In modern mammals, the SG consists of a single main bone, the scapula, and the coracoid has been reduced to a small scapular process. The reduction of the mammalian SG was associated with the evolution of an upright stance, and thereby many classic mammalian traits (e.g., endothermy, increased foraging, etc.). Evolutionary modifications in SG structure are also associated with the diversity of locomotor strategies employed by modern mammals. By incorporating data from paleontological, embryological, genetic and molecular sources we have begun to investigate the intrinsic mechanisms by which (a) the modern mammalian SG evolved, and (b) was subsequently modified in mammals with diverse locomotor strategies. The modern mammalian scapula is an amalgam of several elements with independent developmental and/or evolutionary origins (i.e., coracoid, scapular blade, scapular head, acromion). Our morphometric investigations of the integration of these elements in extant mammals, and the recent evolution in fossil groups, suggest that these elements tend to vary independently among and within species. In line with this, the development of each SG element appears to be controlled by largely independent genes. For example, Hoxc6, Pax1, and Emx2 have been linked to the development of the coracoid, acromion, and scapular blade, respectively. Using in situ hybridization to assay expression pattern and qPCR to

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assay expression level, we have found that relatively subtle modifications in the timing and level of the expression of these genes coincide with the evolution of species-specific scapular morphologies in pig, mouse, bat and opossum, and likely drove the evolution of the modern mammalian SG as well. Taken together, our analyses suggest that the elements of the scapula develop and evolve in a highly modular manner, which may have contributed to the evolution of an upright stance and scapula, and thereby locomotor, diversity in modern mammals.

Technical Session X (Friday, November 4, 9:15 am)

FOREST STRUCTURE, CLIMATE, AND TIMING OF MAMMALIAN IMMIGRATIONS DURING THE PALEOCENE–EOCENE THERMAL MAXIMUM IN NORTH AMERICA

SECORD, Ross, University of Nebraska, Lincoln, NE, USA; BLOCH, Jonathan, University of Florida, Gainesville, FL, USA; CHESTER, Stephen, Yale University, New Haven, CT, USA; BOYER, Doug, Brooklyn College/CUNY, Brooklyn, NY, USA; KRIGBAUM, John, University of Florida, Gainesville, FL, USA

Global warming of 5–10⁰C opened high-latitude dispersal routes between Asia, North America, and Europe during the Paleocene–Eocene Thermal Maximum (PETM), which began ~56 Ma and lasted ~175 ky. The carbon isotope excursion (CIE) associated with the PETM is well defined in the Cabin Fork Area of the southern Bighorn Basin, Wyoming, based on δ13C values in mammalian tooth enamel and soils. It spans 34 m of strata. A large, stratigraphically well-resolved fossil collection from Cabin Fork shows that the first PETM immigrants to arrive in this part of North America were cursorial perissodactyls and artiodactyls, first appearing near the onset of the CIE. In contrast, arboreal euripimorphs first appear ~8–10 m stratigraphically higher in the CIE, implying a substantially later arrival. We use δ13C values from mammalian tooth enamel to test the idea that differences in forest structure, specifically forest canopy, were associated with changing climate and the timing of mammal immigrations. A forested canopy can be recognized by mammals with exceptionally negative δ13C values, relative to the rest of the fauna, that reflect consumption of leaves from the understory. Because canopy development is precipitation dependent (~170 cm for closed canopy), we also calculate a humidity proxy by comparing δ18O values from the pantodont Coryphodon (aridity insensitive) with those from the euripimorph Siphthirus (aridity sensitive). Carbon isotope results are not consistent with the presence of a canopy, lacking negative δ13C outliers during the CIE. However, this could be explained by the absence of understory browsers in the fauna. The humidity proxy suggests a pattern of dry/wet/dry cycles in the PETM. The cursorial immigrants first appear in the lower dry interval at the beginning of the CIE, whereas the first euripimorphs appear in the succeeding wet interval. These results are consistent with the idea that drier conditions during the PETM resulted in more open forests favoring the dispersal of cursorial mammals, whereas later wetter conditions resulted in denser vegetation, although perhaps lacking a fully developed closed canopy, favoring the dispersal of arboreal euripimorphs.

Poster Session I (Wednesday, November 2)

INJURY IN A THEROPOD DINOSAUR FROM THE EARLY CRETACEOUS OF SPAIN

SELLES, Albert, Institut Català de Paleontologia (Universitat Autònoma de Barcelona), Sabadell, Spain; SANTOS-CUBEDO, Andrés, Grup Guix, Vila-real, Spain; POZÁ, Begoña, Consorci Ruta Minerà, Cercs, Spain

The Ana locality is one of several dinosaur bone sites located in the Arcillas de Morella Formation (Aptian, Lower Cretaceous, eastern Iberian Chain, Spain). Over 700 fossils have been collected, including vertebrate and invertebrate species. Dinosaur bones (Theropoda, Ornithopoda and Sauropoda) are abundant. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod. A bulbous and rugose callus is located on the left side of the chevron. This callus measures 12 cm dorso-ventrally, 6 cm cranio-caudally, and 3.5 cm laterally. The new osteological tissue exhibits low alienation with respect to the previous bone elements. This callus measures 12 cm dorso-ventrally, 6.5 cm cranio-caudally, and 3.5 cm laterally. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod.

Poster Session IV (Saturday, November 5)

DIETARY RECONSTRUCTION OF CHINESE SHOVEL-TUSKED GOMPHOTHERES (MAMMALIA: PROBOSCIDEA): EVIDENCE FROM DENTAL MICROWEAR OF MOLAR TEETH AND TUSKS

SEMPREBON, Gina, Bay Path College, Longmeadow, MA, USA; TAO, Deng, Institute of Vertebrate Paleontology and Paleoanthropology Chinese Academy of Sciences, Beijing, China; SOLOUNIANS, Nikos, New York College of Osteopathic Medicine, Old Westbury, NY, USA; HASIANOVA, Jelena, Bay Path College, Longmeadow, MA, USA

The new osteological tissue exhibits low alienation with respect to the previous bone elements. This callus measures 12 cm dorso-ventrally, 6.5 cm cranio-caudally, and 3.5 cm laterally. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod. Here, we report a pathological chevron of a theropod, which shows a big callus that deforms most of the upper part of the bone. Pathology in dinosaur bones has been reported for many groups, but it seems to be common in theropod dinosaurs. The specimen corresponds to a proximal chevron (26.8 cm in length) belonging to an undetermined theropod.
towards herbivory compared to the evolution of the chewing system towards flesh-eating in simonycones, thus presenting a remarkable example of mosaic evolution.

Technical Session XVIII (Saturday, November 5, 12:15 pm)  

NEW REMAINS OF MIADANASUCHUS OBLITA FROM THE LATE CRETACEOUS OF MADAGASCAR AND A REEVALUATION OF TREMATOCHAMPSIDAE  
SERTICH, Joseph, Denver Museum of Nature and Science, Denver, CO, USA

Significant new material of the enigmatic crocodyliform Miadanasuchus obliata from the Upper Cretaceous Maevarano Formation of northwestern Madagascar permits a detailed diagnosis of the species and facilitates comparisons with other Cretaceous trematochampsids from South America and Africa. Originally identified several decades ago on the basis of fragmentary specimens, new remains including a well preserved partial skull and numerous isolated cranial and postcranial elements permit a comprehensive assessment of its morphol- ogy. Miadanasuchus is notable among crocodyliforms generally, and trematochampsids in particular, for its wide, short rostrum; fused nasals; prominent, ventrolaterally expanded anterior maxilla bounded posteriorly by a deep notch for reception of a hypertrophied 10th dentary tooth; robust and relatively short mandibular symphysis with a relatively short splenial contribution; and prominent, ornamented ventralflange of the angular. Miadanasuchus compares closely with other trematochampsid crocodyliforms including Montevoltasuchus arrudaecamploi, Trematochampsa taqueti, and Ramaspisuchus rebouxi in having a well-developed periartial fossa, a prominent series of enlarged anterior maxillary teeth, and a laterally concave series of reduced mid-dentary alveoli. Reevaluation of taxa assigned to Trematochampsidae (and ‘Peirosauridae’) reveals a total of 12 valid members. A phylogenetic analysis of crocodyliform relationships incorporating many of these taxa recov- ers a monophyletic clade of Trematochampsidae incorporating members of the traditional ‘Peirosauridae’ in a close relationship with Mahajangasuchidae and Araripesuchidae spp. Within Trematochampsidae the monophyletic clade including Peirosaurus, Montevoltasuchus, and Lomasuchus suggests a Late Cretaceous radiation within South America. The presence of the trematochampsid Miadanasuchus in the Late Cretaceous of Madagascar is likely related to vicariance of a geographically widespread Trematochampsidae during Gondwanan fragmentation.

Technical Session III (Wednesday, November 2, 3:30 pm)  

THE CLAWLESS OTTERS OF AFRICA (AONYX): MORPHOLOGY, ECOLOGY, AND FOSSIL RECORD  
SHABEL, Alan, Univ. of California Berkeley, Berkeley, CA, USA

The African clawless otters (Aonyx) occur today throughout sub-Saharan Africa in the vicinity of perennial water sources. These otters are relatively large-bodied (12–20 kg) and large-brained (~100 cm3), and they forage by hand for animal prey at the land-water ecotone. Aonyx includes two major forms: a craniodentally robust and megadont form that relies heavily on decapod crustaceans in both freshwater and marine environments, and a microodont form whose morphology and unique ecology are described here in detail for the first time. This study is based on an analysis of over 500 museum specimens (both fossil and modern) as well as field observations in the Democratic Republic of Congo. The microodont and megadont forms of Aonyx are allopatric, with the microdents closely associated with the Guineo-Congolese forest zone and the megadonts broadly distributed across the rest of the subcontinent (excluding deserts). Within the megadont group, a geographic gradient in tooth size is apparent in both the Pleistocene and modern records, with the most robust specimens recorded from the coast of South Africa, somewhat less robust specimens from the southern African interior and West Africa, and the least robust of the megadonts from eastern Africa. Although the African clawless otters are usually grouped in a single species (Aonyx capensis), the microdont otters of the equatorial forest zone differ strikingly in morphology, behavior, and ecology, and they warrant specific recognition (Aonyx congicus). The fossil taxa, Aonyx robustus, is available for the massive Pleistocene specimens from South African archaeological sites, however these fossil otters clearly fit within the range of variation of extant populations from the same regions. The clawless otters of Africa provide a fascinating example of the interplay of morphology and ecology in mammal evolution.

Poster Session I (Wednesday, November 2)  

THE SEXUAL DIMORPHISM OF SHASTASAURUS TANGAE (REPTILIA: ICHTHYOSAURIA) FROM GUANLING BIOTA, CHINA  
SHANG, Gunshou, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LI, Chun, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LIU, Jun, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

The taxonomy is highly problematic for ichthyosaurs of Guanling Biota (early Carnian, Guizhou, SW China), especially long-nosed large ichthyosaurs. Recently, all published 12 species, which had been named as different genus and species, were referred to one spe- cies, Shastasaurus tangae. Three additional ichthyosaur specimens have been prepared and are available for this study. These specimens can be confidently referred to S. tangae based on the cranial features; however, they are differentiated from the holotype of S. tangae by the limb morphology. In published specimens, the hindfin is thin and long and the metatarsal and proximal phalanges of digit II smaller or missing (Type A). In new specimens, the hind- fin is relatively wider with well-developed preaxial accessory digit, and the metatarsal and proximal phalanges of digit II is similar in size as in digits III and IV (Type B). Furthermore, the postaxial accessory digit is distinct on the forefin of new specimens but not of published specimens. The specimens also show some variation on the relative width of skull and the angle of the bifurcated parietal sagittal crest. Measuring the size of each specimen these dif- ferences are not ontogenetic variation, but could be attributed to sexual dimorphism.

Poster Session II (Thursday, November 3)  

ELUCIDATING SEMI-ARBOREAL LOCOMOTION OF SMALL GROUND SLOTHS (SUPERORDER XENARTHRA, ORDER PILOSA) THROUGH INDEX ANALYSES  
SHAW, Barbara, Colorado State University Extension, Montrose, CO, USA; RUEDAS, Luis, Portland State University, Portland, OR, USA

Order Pilosa (anteaters, ground, and tree sloths) are an ancient group of mammals, isolated on South America for 90 million years. Approximately 9 million years ago, ground sloths arrived in North America probably island hopping across the Caribbean. After the Isthmus of Panama arose, sloths disbursed as far north as Alaska. Their modes of traveling include the bipedal mode or bearing weight across the 5th carpal, metacarpal, and distal phalange bones of the manus and the 5th tarsal, metatarsal, and distal phalange bones of the pes. The extant two families of tree sloths are pendumoporal (moving by hanging on the underside of branches). The two families of tree sloths are not closely related, and there lacks much evidence of an extinct ground sloth of closely shared ancestry. These distinct adaptations to the fore and hind limbs of a trivaporal ancestor should provide a clear marker in evaluating the move from trivaporal through semi-arboreal to penduloporal locomotion. By reducing the limbs into levers, measuring the length of the lever, load, lift, and fulcrum and formulating a series of indices of arboreal and semi-arboreal locomotion based on those measurements of both the fore and hind limbs for anteaters, ground and tree sloths, tree squirrels, pangolins, primates, and an opossum. The results were graphed in 2D and 3D scatterplots, placing smaller ground sloths from Caribbean islands within the 95% confidence ellipsoid with the semi-arboreal xenarthran species, supporting the small ground sloths' transition towards trees.

Poster Session I (Wednesday, November 2)  

VALIDATING DIMETRODON SPECIES FROM THE BRIAR CREEK BONE BED (LOWER PERMIAN, ARCHER COUNTY, TEXAS) USING BONE HISTOLOGY AND MORPHOMETRICS OF FEMORA AND HUMERI  
SHELTON, Christen, University of Bonn, Bonn, Germany; SANDER, P., Martin, University of Bonn, Bonn, Germany

The Briar Creek Bone Bed (BCBB) (Antinskian, Nocona Formation) in western Archer County is one of the richest sources of Dimetrodon bones in the Lower Permian of Texas, USA. Based on size, a small (D. natalis), an intermediate (D. booneorum), and a large species (D. limbatus) have been described from here and other localities of the same age. Alternatively, it has been proposed that these traditionally recognized species represent an ontogenetic series of only one species. This hypothesis was based on a regression analysis of the distal epiphysis width as a function of length in humeri. The ontogenetic series hypoth- esis, coupled with environmental interpretations of the sites, led to the suggestion that adults and juveniles of Dimetrodon preferred different habitats. However, the ontogenetic series hypothesis is inconsistent with the late ontogenetic state of the small bones as suggested by their morphology.

Histologic analysis of newly excavated material from the BCBB, procured over two field seasons, has resolved the decision between these two competing hypothesis. The histologic data is complemented by regression analysis of the minimal femora and humeri diaphysis circumference as a function of length from the various Dimetrodon species. The hypothesis of the cross-section of the diaphysis of the new specimens indicates that D. natalis is not the juvenile of a larger species and thus likely a valid taxon. Histology of the long bones consists of prominent lamellar zonal periosteal bone and a medullary region filled with cancellous bone. Analysis of the juvenile femora revealed no visible growth cycles in the cortex, bones of intermediate size contain two growth marks, and the largest specimens show up to four growth cycles, ending in a well developed external fundamental system. Radial canals and osteocytes seem to be more dense in the juvenile specimens. Large erosional cavities in the peristeme and secondary cancellous bone are abundant in the intermediate humeri. Validation of D. booneorum and D. limbatus is still unresolved.

Poster Session I (Wednesday, November 2)  

A NEW SPECIES OF TSAIDAMOTHERIUM (BOVIDAE, MAMMALIAN): SECOND DISCOVERY OF THE UNICORNOUS ANTELOPE RESTRICTED TO CHINA IN THE LATE MIocene  
SHI, Qinxin, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

When Tsaidamotherium hedini was first discovered on the bank of Tossun Lake in the Thaidam Basin, it impressed the researchers by having only one robust plate-like horn core which is more than 700 kilometers away from the original locality. Both of the species be- long to the Hippius fauna in north China, and the fauna that the type species belongs to is relatively more primitive. The new species resembles the type species in a lot of aspects,
including the large size, a round horn plate of inflated parietal, a pair of stunted real horn cores above the orbit, obviously thickened basioccipital, and round condyles without ridges. However, the undeveloped horn cores of Tr proboscis are smaller and have a better fusion with the horn plate, representing a more specialized form. For the first time, the anterior part of the skull of Tsaidamotherium was found. The nasals and maxillae are extremely shortened and the nostrils are high and narrow, probably indicating a long nose. The premaxillaries are also extraordinary small. Although the phylogenetic affinities of Tsaidamotherium are still under debate, its close relationship with other large oviarches in north China in the late Miocene is unquestionable.

Poster Session II (Thursday, November 3)
FIRST ASSOCIATED SPECIMEN OF THE LATE CRETACEOUS SHARK, CRETODUS (ELASMOBRANCHI: LAMNOFORMES)
SHIMADA, Kenshu, DePaul University, Chicago, IL, USA; EVERHART, Michael, Sternberg Museum of Natural History, Hays, KS, USA; REILLY, Brian, Children’s Memorial Hospital, Chicago, IL, USA; RIGSBY, Cynthia, Children’s Memorial Hospital, Chicago, IL, USA
Approximately 120 teeth and 60 vertebrae of a large lamniform shark, Cretodus crassidens (Dixon), were recently collected from the Blue Hill Shale Member (Middle Turonian) of the Carlisle Shale near Tipton in Mitchell County, Kansas, USA. The specimen, now housed in the Sternberg Museum of Natural History, Hays, Kansas (FHSM VP-17575), is significant because it represents the first known reasonably complete, associated material of the genus Cretodus Sokolov. The tooth set includes both functional and replacement teeth in which the tallest fully developed tooth is about 41 mm in crown height and 52.5 mm in total tooth height. Although a strong tendency of monomorphic heterodonty is exhibited, the inferred dental pattern is of the lamnoid type with at least 10 tooth rows in each jaw quadrant. Because many teeth have a tall erect main cusp with at least one pair of lateral cusplets, the dentition was suitable for grasping prey. Unlike the teeth, many vertebrae occurred in articulation within irregularly-shaped concretions from which a total vertebral count was taken based on radiographic examination using a computed tomography scanner. The vertebrae are also of the lamnoid type, and they measure up to 74 mm in diameter. If one compares the dentition based on radiographic examination using a computed tomography scanner. The vertebrae are also of the lamnoid type, and they measure up to 74 mm in diameter. If one compares the dentition with the horn plate, representing a more specialized form. For the first time, the anterior part of the skull of Tsaidamotherium was found. The nasals and maxillae are extremely shortened and the nostrils are high and narrow, probably indicating a long nose. The premaxillaries are also extraordinary small. Although the phylogenetic affinities of Tsaidamotherium are still under debate, its close relationship with other large oviarches in north China in the late Miocene is unquestionable.

Poster Session IV (Saturday, November 5)
X-RAY COMPUTED TOMOGRAPHY OF TWO EXCEPTIONALLY PRESERVED NEONATE MAMMOTHS FROM SIBERIA
SHIRLEY, Ethan, University of Michigan, Ann Arbor, MI, USA; ROUNTREY, Adam, University of Michigan, Ann Arbor, MI, USA; FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA; TIKHONOV, Alexei, Zoological Institute, Russian Academy of Sciences, Saint-Petersburg, Russia; BURGUES, Bernard, International Mammoth Committee, Saint Mandé, France
Lyuba and Khroma, two neonate mammoths from northwest and northeast Siberia, respectively, are the best-preserved mammoth specimens yet recovered. Lyuba’s age-estimate is ca. 42,000 yrBP, but Khroma’s age-estimate was extrapolated to have measured between 4.2 and 5.1 m in total length. Because large individuals of Cretoxyrhina mantelli have been previously interpreted to be formidable predators, it is likely that large Cretodus individuals also occupied the highest trophic level within their preferred range. Whereas Cretodus crassidens and Cretoxyrhina mantelli lived contemporaneously, based on the fossil record the two taxa likely practiced resource partitioning within the North American Western Interior because the former occurs more commonly in near-shore deposits and the latter in off-shore deposits.

Neonate mammoths from the North American Western Interior because the former occurs more commonly in near-shore deposits and the latter in off-shore deposits.

Phosphate in Lyuba’s vivianite is interpreted as derived from her bones via lactic acid exposure, a process that evidently did not figure in Khroma’s diagenesis.

Symposium 1 (Wednesday, November 2, 8:15 am)
FOSSILS, GENES AND THE SEARCH FOR ANTECEDENTS OF THE TETRAPOD LIMB
SHUBIN, Neil, The University of Chicago, Chicago, IL, USA; SCHNEIDER, Igor, The University of Chicago, Chicago, IL, USA
Antecedents of the tetrapod limb are now known at every level of biological organization in fins. Fossils and the comparative anatomy of extant forms reveal that the three fundamental segments of limbs—stevolopod, zeugopod, and autopod—are present in finned vertebrates. Homologies extend across the skeleton as well, from features on the humeri to those in the proximal carpus. Indeed, the genetic processes that pattern these three segments are also present in fins; the suite major patterning genes are present and their regulatory architecture and function appears conserved. Aspects of tetrapod gait are also seen in diverse finned vertebrates, including dipnoans. Taken together, major characters of limb structure, development, and even walking, are more general in their phylogenetic distribution than digits. While functional, palaeontological, and genetic work continues to push apomorphies of crown tetrapods down the tree, numerous puzzles emerge. What are the regulatory processes that allowed limbs to evolve uniquely to tetrapods? New data from various extant and fossil vertebrates possess fins with a lungfish-like metapterygial axis? The search for antecedents brings new answers to old questions and thereby enables us to ask more precise questions going forward.

Technical Session II (Wednesday, November 2, 3:30 pm)
NEW INFORMATION ON THE TRIASSIC VERTEBRATE FAUNAS OF ANTARCTICA
SCHINDLER, DE, Christian, University of Washington, Seattle, WA, USA; SMITH, Roger, Iziko: South African Museum, Cape Town, South Africa; HUTTENLOCKER, Adam, University of Washington, Seattle, WA, USA; PEECOOK, Brandon, University of Washington, Seattle, WA, USA; HAMMER, William, Augastana College, Rock Island, IL, USA
Antarctic strata of the Fremouw Formation preserve the best record of Lower and Middle Triassic vertebrate life at high paleolatitude. In the austral summer of 2010–11, we made substantial collections of tetrapods from the Bearnmore Glacier region, central Transantarctic Mountains. At Graphite Peak, we collected a scattered skeleton representing the first vertebrate from the Buckley Formation (i.e., below the lowest Fremouw sand body), although adjacent paleoecological morphology suggests a Triassic age for this section of the Buckley. A near-complete skeleton of a small archosauromorph (likely Prolocatera) was found beneath a partially articulated Lystrosaurus and at the same stratigraphic level as ‘giant-type’ vertebrate burrows, and a larger archosauromorph (likely Proterosuchus) was recovered from...
slightly higher in section. At Coal slack Bluff, a small, scattered skeleton (therocephalian/ crocodilian) was found in an olive-green, root-filled silstone (i.e., Dolores paleosol) just above the last Buckley coal, possibly representing the oldest Triassic tetrapod yet recovered from Antarctica. We suggest that vertebrae found in the lower silstones of the lower Fremouw correspond to the post-recovery fauna of the Knox Basin, South Africa. Fossils from the upper Fremouw at Fremouw Peak document the second Middle Triassic vertebrate locality from the Transantarctic Mountains. Previously known to record an indeterminate species of Parotodusuchus, new collecting has yielded the ilium of a large dicynodont, a temnospondyl interclavicle, a large temnospondyl mandible, and possible archosauriform limb bones, among other specimens. We returned to Gordon Valley, the original Middle Triassic (Anisian) vertebrate site, and collected new material from the primary bone-bearing conglomerate, including a jaw tentatively assigned to Cynognathus. Importantly, we also collected the skull of what may represent a new, narrow-snouted temnospondyl from a second horizon ~4 meters lower in section. The fauna of Antarctica and South Africa evolved increasing dissimilarity from the Early to Middle Triassic, mirroring regionalization seen elsewhere in the Anisian of Gondwana.

Technical Session XV (Saturday, November 5, 8:30 am)

REASSESSMENT OF THE MORPHOLOGY AND PALEOBIOLOGY OF THE THEROCEPHALIAN TETRACYNODON DARTI (THERAPSIDA) BASED ON CT-SCANNING, AND THE PHYLOGENETIC RELATIONSHIPS OF BAURIOIDEA

SIGURDSEN, Trond, Université de Montréal, Montréal, QC, Canada; HUTTENLOCKER, Adam, University of Washington, Seattle, WA, USA; MODESTO, Sean, University College of Cape Breton, Sydney, NS, Canada; ROWE, Timothy, University of Texas at Austin, Austin, TX, USA; DAMIANI, Rossano, La Trobe University, Melbourne, Australia

The Lower Triassic baurioid theroccephalian Tetracynodon darti is here redescribed, partly based on the CT-scanning, and analyzed in the context of theroccephalian relationships and biology. The previous description of this taxon is found to be inaccurate in several respects, and the anatomical descriptions are therefore expanded and corrected. The presence of a maxillary shelf similar to that of Lycideops is present, and T. darti also shares a nasal-lacrimal contact with that taxon. Several internal ridges on the nasals are present, as in many other therapsids, and these may mark the attachment of nasoturbinals. However, there is no evidence for the presence of maxilloturbinal bones. The CT-data reveals the braincase in great detail, and the fact that the dorsal selle is formed by the prootics is confirmed. The postcranial skeleton is generally slender and similar to that of regisaurids and other small baurioids. A cladistic analysis of 34 therapsid genera and 129 craniodental and postcranial characters is performed to shed light on the relationships of T. darti. There is little unambiguous evidence for a sister taxon relationship between the two Tetracynodon species, although the validity of the genus cannot be rejected with confidence. Part of the problem is the possibility that some of the shared features of T. tenuis and T. darti may either be due to the juvenility of the specimens, or represent genuine synapomorphies. However, the analysis reveals evidence for a monophyletic Lycideoidea within Baurioidea. This clade includes Lycideops, Choeroaurus, and Karentes, as well as T. tenuis and T. darti.

Post Session II (Thursday, November 3)

COMPARATIVE STUDY OF TWO POPULATIONS OF THE SABERTOOTHED FELID PROMEGANTEZA OXYGYRA (FELIDAE, MACRODEONTINA) FROM BATALLONES-1 AND BATALLONES-3 SITES (LATE MIOCENE, MN 10, TORREJÓN DE VELASCO, MADRID, SPAIN)

SILICEO, Gema, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; SALESA, Manuel, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; ANTON, Mauricio, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; MORALES, Jorge, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

The fossil sites of Batallones-1 and Batallones-3 are located within the Cerro de los Bata- lones Late Miocene paleontological complex (Madrid, Spain), which has yielded an abun- dant and exceptionally preserved sample of fossils of the order Carnivora, around 98% of the total sample. Both localities were formed as cavities in sepiolite levels, acting as natural traps for the carnivorans, which were trapped while trying to scavenge on animals trapped in these cavities. Recent studies on the micromammals of Batallones-1 and Batallones-3 suggest a difference in age, with the former being older than the latter. The carnivoran sample from both sites also shows several differences, such as the presence in Batallones-3 of the ursid Indarctos sp., and the mustelid Eomellivora sp., which are absent in Batallones-1. In order to better understand these differences, we studied one of the most abundant carnivorans in both assemblages, the primitive saber-toothed felid Promegantereza oxygyra. Several significant biometrical and morphological differences were found between the populations. The dentity of P. oxygyra from Batallones-3 shows a relatively smaller lower canine, a reduced m1 talonid and P4 protocone, and a narrower P3, features that indicate more emphasis on cutting in the dentition. The postcranial skeleton of P. oxygyra from Batallones-1 is characterized by a straight and narrower calcaneus, a more elongated ischium II and an elongated attachment area for the muscle flexor carpi radialis (flexor of the hand) and an overall slender postcranial skeleton. Some of these differences can be related to a reduction in the weight of the hind limb, which points towards an increase in the cursorial abilities of the Batallones-3 form, whereas others indicate the presence of stronger flexor muscles of the hand, related with the need for prey immobilization during hunting. In summary, the population of P. oxygyra from Batallones-3 shows several derived characters compared with that from Batallones-1. Only future studies including the whole sample of fossils of P. oxygyra from Batallones-3 will establish the taxono- mistic status of this population.

Post Session IV (Saturday, November 5)

REMARKABLE NEW LIZARD SPECIMENS FROM THE EARLY CRETACEOUS OF BRAZIL

SIMÕES, Tiago, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil

The Mesozoic record of lizards can be considered rare compared to other fossil vertebrates, especially in the Gondwanic derived continents. This is due to, among other reasons, their extremely delicate skeletons, creating considerable taphonomic biases. One deposit of South America that has provided some lizard material, including two named species (Tiju- bina, Olindalacerta), is the Early Cretaceous (Aptian) Cato Formação of the Arapípe Basin, northeast Brazil. Here we report three yet undescribed specimens (all housed at the Museu Nacional, Rio de Janeiro) from this deposit, that provide not only a rich amount of new osteological data, but also an extremely rare quality of soft tissue preservation. The tech- nique of ultraviolet photography allowed the identification of several muscle striation marks and some other soft tissues. On the ventral side of MN 4817-V, granulated scales in the neck region, arms and trunk laterals were observed, with rhomboid scales on the trunk’s medial portion. Osteodermal plates are also visible beneath the mandible, being relatively large in comparison to the adjacent to the adjacent scales. The musculature is partially preserved, including portions of the ventral lower jaw muscles and, under the left femur, the M. puboischiotibialis which allows the flexion of the crus and adduction of the thigh. Specimen MN 7234-V exhibits the whole body contour, as well as soft tissue impressions around the pelvic girdle, hind limbs and tail which were attributed to connective tissues, such as tendons. Specimen MN 7233-V has granular scale marks around the neck and anterior trunk region, as well as unidentified soft tissue close to the pelvic region. To our knowledge the new specimens are the best preserved Mesozoic lizard fossils from South America and constitute a significant opportunity to establish a better understanding of the terrestrial squamate fauna of this continent and pro- vide a rare insight into the soft tissue anatomy of extinct lizards.

Technical Session XIII (Friday, November 4, 1:45 pm)

DETERMINING DIET FROM THE CROSS-SECTIONAL SHAPE AND INTERCUSPID NOTCHES OF THE TEETH OF CARNIVORANS FROM RANCHO LA BREA

SIMPLER, Elizabeth, Penn State University, State College, PA, USA; HARTSTONE- ROSE, Adam, Penn State University, Altoona, PA, USA; KRISTEN, MacNeill, Penn State University, Altoona, PA, USA; JONATHAN, Perry, Midwestern University, Downers Grove, IL, USA

The quality of the Rancho La Brea (RLB) carnivore collection allows for fine-grained comparisons of dental-dietary morphology. In this study we analyze two variables in the postca- nine dentition: intercuspid notches (ICN) and cusp radius-of-curved (ROC). We compare the large RLB carnivorans to a broad sample of modern carnivorans with respect to carcass- processing ability along a hypercarnivorous–diaphagous continuum. ROC data demonstrated that, the RLB felids (P. atrox and Smilodon) and canids (C. dirus, C. latrans and C. lupus) all have relatively blunt premolars. In fact, the premolars of the RLB taxa are blunt than those of any modern feline or canid species, nearly into the range of the modern hyaenids. This finding would support the assertion that the RLB carnivorans were capable of more thor- oughly processing carcasses than their modern equivalents because they were less likely to have suffered when processing harder carcass components (e.g., bone). The ICN data suggest a surprisingly different conclusion: by that measure the RLB carnivores appear fairly hyper- carnivorous; the RLB canids sort with the most hypercarnivorous canids and even approach some feline species. Likewise, both P. atrox and Smilodon plot at the hypercarnivorous end of the feline spectrum in their ICN scores. This strange combination of blunt cusps and highly notched premolars places the RLB carnivores outside the range of modern carnivores. In fact, this combination is found in the fascinating Chasmaporthetes – an extinct hyaenid that appears to have been fairly hypercarnivorous. Thus, because there are no modern analogues with this particular combination of anatomical signals, it is difficult to assess the carcass processing abilities of the RLB carnivores.

Post Session II (Thursday, November 3)

STRUCTURE AND FUNCTION OF A PROTOSUCHIAN MANDIBULAR SYMPHYSIS USING ANATOMICAL INSIGHTS FROM ALLIGATOR MISSISSIPPIENSIS

SKILJAN, Rebecca, University of Missouri, Columbia, MO, USA; GANT, Cortaiga, University of Missouri, Columbia, MO, USA; HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA

Mesozoic crocodylians evolved a variety of cranial adaptations associated with carnivory, herbivory, and a spectrum of intermediate dietary niches. Protosuchians were unlike most, more derived taxa in that they possessed fewer, blunter teeth, relatively shorter skulls, and more robust mandibular symphyses–features commonly associated with a daphagous lifestyle. As part of a broader study identifying evolutionary and functional patterns in cra- nial joints in crocodylians, we compared the structure and function of the jaws of a proto- suchian crocodyliform with those of Alligator mississippiensis with a focus on the role of the mandibular symphysis, a previously unstudied joint with key functional insights into feeding.
behavior. An ontogenetic series of alligator symposises was CT-scanned and histologically sectioned to identify key soft- and hard-tissue components of the joint including ratios of interdigitation, ligament structure, and Meckel’s cartilage. The osteological correlates of these tissues were then identified, reconstructed, and incorporated into a micro-CT-scan derived finite element model of the jaws of the Kayenta protosuchian, loaded with muscle forces and a molariform bite point and compared to a similarly built model of Alligator. Whereas older Alligator individuals possess class III, interdigitated symposises, the protosuchian taxon has a class I fibrous joint. However, like Alligator, Meckel’s cartilage appears to be continuous across the midline of the joint, and moreover, the splenials suture across the midline adding additional, albeit weak reinforcement of the joint. Modeling found both taxa experience significant working- to balancing-side transmission of forces, however those in Alligator were of higher magnitude. This suggests the relatively larger, class I protosuchian symposis may compensate for the lack of interdigitation and still effect a bite force capable of chewing hard foods. These results also suggest the protosuchian symposis was likely a transitional form between the fibrous joint of stem crocodylomorphs, and more derived crocodilyiforms.

Preparers’ Session (Thursday, November 3, 11:30 am)

SEISMIC MITIGATION FOR PALEONTOLOGICAL DISPLAY SPECIMENS

SMITH, Matthew, National Park Service, Holbrook, AZ, USA; NUNAN, Elizabeth, American Museum of Natural History, New York, NY, USA

Potential damage caused by seismic activity and rough handling of exhibits by museum visitors is a threat faced by all museum displays. Traveling exhibits are particularly at risk as they may move from localities with low probability of seismic activity to areas that are more prone to earthquakes. An American Museum of Natural History traveling exhibition, “Dinosaur Fossils: New Discoveries” was scheduled to travel to seismically active areas in southern California and central Italy. Seismic mitigation was not integrated into the exhibit design during the original fabrication in 2005.

After consultation with museum conservators, changes were made to twenty six specimen mounts or mounting techniques in an attempt to better secure specimens and minimize damages in the event of an earthquake. The modifications occurred during the 1-2 week periods between exhibition venues when specimens were accessible by museum staff. Due to time constraints, any modifications had to be simple, practical and inexpensive. The aim of these modifications was to decrease the potential for lateral and vertical movement due to seismic forces. Specimen mounts, anti-walkers, and removable clips were added to mounts that previously relied mainly upon gravity to secure paleontological specimens. Microcrystalline wax was used in some cases to secure casts, and it was avoided if possible with fossil material. Specimen mounts with removable clips have the added advantage of reducing damage caused by abrasion between the specimen and its mount while installing the object. Several of the earliest modifications were unintentionally tested by the April 4, 2010 Mexican Earthquake which shook San Diego with a Modified Mercalli Intensity scale of V-VI, with the result that no damage occurred.

Technical Session XII (Friday, November 4, 2:15 pm)

BODY MASS AND FORAGING ECOLOGY PREDICT EVOLUTIONARY PATTERNS OF SKELETAL PNEUMATIVITY IN THE DIVERSE "WATERBIRD" CLADE

SMITH, Nathan, The Field Museum of Natural History, Chicago, IL, USA

Extensive skeletal pneumativity is a distinguishing feature of birds. Pneumativity varies considerably among the >10,000 living species, with notable patterns including increases in large-bodied forms, and reductions in birds employing underwater pursuit diving as a foraging strategy. Selection for weight reduction related to locomotor demands, and foraging strategy, is a prominent causal explanation for the former pattern, while the latter pattern is often explained as an energy-saving adaptation driven by selective pressure to reduce buoyancy in pursuit divers. I assessed the relationship between skeletal pneumativity and body mass and foraging ecology, utilizing a dataset of the diverse ‘waterbird’ clade (including e.g., penguins, loons, and pelicans) that spans a broad range of trait variation. Inferred changes in pneumativity and body mass are congruent across different estimates of phylogeny, whereas pursuit diving evolved independently between two and five times. Phylogenetically informed ‘predictive’ analyses reveal that several pursuit divers (loons, penguins, cormorants, darters) are significantly pneumatic compared to their relatives, and demonstrate that significance depends on the amount of phylogenetic information included. These results provide the strongest support yet for hypotheses regarding the evolution of avian pneumaticity as (at least partly) an energy-saving adaptive feature influenced by body mass and foraging ecology. These findings are also supported by qualitative patterns of increased pneumativity in large-bodied taxa documented within pterosaurs, sauropterygia, and theropods.

Technical Session XV (Saturday, November 5, 9:15 am)

ANATOMY OF AN EXTINCTION: END-PERMIAN DROUGHT INDUCED DIE-OFF IN THE KAROO BASIN, SOUTH AFRICA

SMITH, Roger, Iziko South African Museum, Cape Town, South Africa; BOTHA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa

The southern Karoo Basin of South Africa contains an uninterrupted terrestrial record of the Permo-Triassic boundary (PTB). Isotope- and magneto-stratigraphy confirm that these fluvial strata are approximately the same age as zircon-dated marine PTB sections (252Ma). To date, our team has found 580 identifiable, in situ vertebrate fossils, mostly therapsids, in PTB exposures at four separate locations. Biostratigraphic range plots reveal a pronounced extirpation event within the same stratigraphic interval in each of the PTB sections as well as...
as a regular order of taxon disappearances and taphonomic signatures that are interpreted as reflecting real changes in the original populations due to rapid climatic drying and drought. Within the uppermost 45 meters of the Balfour Formation, the sequence of sedimentological faces reflects progressive streamlining of the channels and floodplain rubification. Although thicknesses vary, this sequence remains consistent across all sections and is interpreted as indicative of a rapid climatic warming and drying with the onset of a monsoon-type rainfall regime. In the lowlands of the Karoso basin ground level farms, clubmosses and liverworts were the most susceptible to the lowering of groundwater. Consequently the formerly flourishing populations of small gregarious herbivorous dicynodonts such as Dictodon and Pristerodon decreased and eventually disappeared along with their medium-sized gorgonopsian predators (Acroarchontus, Cyonosaurus). As droughts became more frequent the Glossoptris riparian woodlands thinned out causing large-bodied dicynodonts (Dicynodon, Aalacephalodon, Dinanomodon) and their attendant carnivores to die off. A terminal drought phase is recognizable in all the sections as a roughly 5 meter-thick interval containing 1-3 beds of generally rufified finely laminated mudrocks with very little pedogenic modification. Rare skulls and fragmental caniniform processes of the larger Permian taxa L. maccaigai, Meschorhinus and a very rare skull of Dicyonodontoides occur in this interval, the top of which is regarded as a reliable lithostratigraphic marker of end of the End-Permian mass extinction in the Karoso Basin.

Posters Session IV (Saturday, November 5)

**PRESENCE OF ONYCHONYCTERID BATS IN THE EARLY EOCENE OF EUROPE**

Smith, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; HABersetzer, Joel, Senckenberg Forschungsinstitut, Frankfurt, Germany; Schlosser-Sturm, Evelyn, Senckenberg Forschungsinstitut, Frankfurt, Germany; Simmons, Nancy, American Museum of Natural History, New York, NY, USA; Gunnell, Greg, University of Michigan, Ann Arbor, MI, USA

Onychonycteris finneyi from the late Wasatchian (Wa7) of the Green River Formation in Wyoming, represents one of the most primitive bats ever found. Together with Icaronycteris index, also from the Green River Formation, they constitute the best known early Eocene bats based on complete skeletons. Unfortunately, all other early Eocene bats are nearly exclusively known from dental remains only, making comparisons difficult. Micro-CT scanning of the teeth of O. finneyi has enabled study of occlusal tooth surfaces and allowed for a diagnosis based on the dental characters of Onychonycteridae to be formulated. Interestingly the molars present a plesiomorphic pattern whereas the premolars appear more derived, similar to those found in Erophyllum anglicus (middle Ypresian, MP8-9, Abbey Wood, London Basin, England); Agniga tobiens (Early Eocene, MP8-9, Mutiny, Marne, France); Honronrites tsuwayne (late Wasatchian, Wa7; Wind River Formation, Wyoming); and "Hassianycteris" joelli (late Ypresian, Belgium). Here transferred to the genus Honronvits. All of these taxa can be grouped in the family Onychonycteridae and differ from other bat families by: posteriorly tilted coronoid process of the dentary; P3/p3 and P4/p4 more reduced than in Icaronycteridae, Archaeonycteridae, Hassianycteridae and Paleoaechoorycteridae; M1-2 of relatively square shape, especially M1 that is nearly as long as wide with centrocrista that does not reach the labial border; paracone presents and metacone minute or absent; ectoflexus square shape, especially M1 that is nearly as long as wide with centrocrista that does not reach the labial border; paracone presents and metacone minute or absent; ectoflexus relatively wide and shallow; p4 metaconid very small to absent; M1-2 of relatively square shape, especially M1 that is nearly as long as wide with centrocrista that does not reach the labial border; paracone presents and metacone minute or absent; ectoflexus relatively wide and shallow; p4 metaconid very small to absent; m1-3 with short cristid obliqua and hypoconulid well developed and nearly median on the talonid. This characterization of onychonycterid teeth has clarified the taxonomic position of several European and North American bats that previously could not be identified at the family level, and indicates that these continents shared several generic and family level taxa in the early Eocene. Identification of members of this primitive family in Europe opens the possibility that Onychonycteridae – and perhaps the entire chiropteran order – might have originated in Europe.

Technical Session III (Wednesday, November 2, 3:15 pm)

**CONSTRAINTS ON TOOTH SHAPE AND JAW MOTION IN CARNIVOROUS MAMMALS**

SMIT, Peter, Monash University, Melbourne, Australia; EVANS, Alistair, Monash University, Melbourne, Australia

Dasyuromorpha is a group of Australian marsupial carnivores with ecological and morphological similarities to many of the placental carnivorans. While carnivorans have a single pair of carnassial teeth, in dasyurids each molar is adapted for shearing and slicing. Additionally, dasyurids have a greater overall number of teeth than most carnivorans. Both jaw motion and tooth shape have been studied in Carnivora, but similar work has not yet been done on dasyurids. The extinct creodonts are another interesting comparison to both dasyurids and carnivorans, having one or two carnassial pairs that are not homologous to that in Carnivora. 3-D morphometrics of carnivorous mammal skulls has also found that creodonts occupy a middle ground between carnivoran and dasyurid skull morphologies. Using 3-D scanning of teeth and skull elements, a mosaic of characters (molar formulae, molar complexity or number of surfaces) and jaw motion information were calculated. Jaw motion is quantified as both the angle between initial tooth contact and centric occlusion and the lateral distances between the initial tooth contact and centric occlusion. A diverse selection of dasyurid were sampled and compared to a survey of carnivoran taxa. Our analysis has shown a strong correlation between tooth shape and movement of the jaw during occlusion in both dasyurids and carnivorans. This is consistent with previous work showing a change in carnivorans, but has now been expanded to a morphologically conservative group of carnivorous mammals. This shows that form and functional relationships are consistent between distantly related taxonomic groups.

Poster Session IV (Saturday, November 5)

**INTERPRETATIONS OF A FOSSIL TRACKWAY FROM THE ST. LOUIS LIMESTONE**

SNYDER, Daniel, Middle Georgia College, Dublin, GA, USA

In the 1980s, a large slab of Early Carboniferous (Viséan) limestone was quarried in the vicinity of northern St. Louis, Missouri USA. Several sets of impressions on the slab’s surface were identified as tracks and the slab was donated to the St. Louis Science Center. The laminated sandy limestone and weathered surface, consistent with nearshore subaerial exposure, demonstrate the trackway is most likely from the nearshore marine Lower St. Louis Limestone. A series of six impressions in negative epirelief are approximately 40 mm by 45 mm, and 155 mm apart. Four or five indistinct sub- impressions are preserved, each with the smaller sub- impressions approximately perpendicularly to the largest sub- impression and the direction of travel. Small (1-2 mm) piles are present on at least two impressions. The series of six are likely real tracks, as they have a common structure, spacing and orientation. They do not bear close resemblance to known invertebrate tracks. Following the discovery of tetrapod remains from the St Louis Limestone, this slab was reexamined. However, the trackway is no more than broadly similar to known Carboniferous tetrapod tracks. The tracks may be impressions of digits, a manus/pes, or partial impressions of both. It is also not clear which of the associated impressions are part of the main trackway or are tracks from other organisms passing through. Three competing hypotheses are tested: the tracks are paired; the tracks are staggered; and the impressions are from multiple trackmakers, and therefore, posture and locomotory style cannot be determined from the trackway as preserved.

In light of these problems, no new ichnaxon is defined. Future work will include additional collection in quarries in the St. Louis area.
pean Region (Pr. Argentina). The fossiliiferous units were referred either to Early and/ or Middle Pleistocene (Ensenadan and Bonaerian PR stages, respectively), and to the Late Pleistocene-Early Holocene (Lujanian PR stage). More than 90 taxa were reported, many of them considered as endemic. We present here the preliminary results of a taxonomic revision (including a collection of fossil material collected during our field work) and analyze the diversity and probable age of the Tarija mammals. We proposed that: (1) with respect to the endemic species published, at least four are not endemic (Megatherium tarajense, Scleriodon tarajense, Artotherium tarajense, A. wingii), since they are registered in the PR, too; (2) in Tarija, there is a high frequency of panttheropods, gomphotherids, equids, hydrochoerids and tapirs, and a low taxonomic diversity of glyptodonts and tayassuids, compared with the PR; (3) two species that are distributed exclusively within the Ensenadan of the PR (Glyptodon musitu and Artotherium angustidens) are also recorded at Tarija. According to recently published data, the fossiliiferous levels are located at the upper part of the sequence, which was deposited during the Late Pleistocene, this implies a local survival of these species; (4) the lack of stratigraphic information for the previously collected fossils prevents us from assuming that every specimen comes from the upper levels of the Tarija sequence; and (5) some faunal elements (Hydrochoeridae, Tapiridae) suggest a predominance of wet and warm environments, in contrast with that proposed for the PR. Finally, we took samples of volcanic ash and sediment (associated with well identified fossil remains) for dating.

Technical Session XVII (Saturday, November 5, 2:45 pm)

SYSTEMATICS OF EXTANT AND EXTINCT AFRICAN SUIDAE INFERRED FROM LANDMARK-BASED GEOMETRIC MORPHOMETRIC ANALYSIS OF CRANIO-MANDIBULAR SHAPE

SOURON, Antoine, iPHIEP, UMR CNRS 6046, University of Poitiers, Poitiers, France

Fossil Suidae (wild pigs) are abundant in Plio-Pleistocene African sites and have been widely used as powerful bistratigraphical indicators due to their rapid changes in third molar morphology and size through time. However, their taxonomy is still debated and based mostly on dental evidence. In order to explore the potential of cranio-mandibular morphology as a taxonomic tool, it seems crucial to first quantify morphological variation in extant Suidae. To this purpose, 90 cranial and 45 mandibular landmarts were gathered using a Microscribe 3-D digitizer from a total of 200 specimens representing the five species of the three genera of extant African suids (Potamochoerus, Phacochoerus and Hydrochoerus). Landmark data were treated using Generalized Procrustes analysis to remove all non-shape differences. They were then subjected to Principal Components Analysis in order to assess major axes of shape variation and discriminate the relative effects of different factors (age, sex, geographic origin and inter-individual variation) on shape of the skull among and within living African said species. Variation in global skull size was also assessed using centroid size: Fossil specimens belonging to the genus Kolpocorax and coming from Plio- Pleistocene sites from Ethiopia and Kenya were then included into this comparative dataset and subjected to a similar analysis with special focus on the most frequently preserved parts (maxilla and mandibular symphysis). Comparisons of intra- and inter-specific variation in extant African Suinae to the patterns observed in the fossil record seem to confirm the division of the genus Kolpocorax into two long-lived and diverging agnostic lineages (K. limnetes and K. majus lineages). It also highlights the strong phonetic affinities of the middle Pleistocene K. majus specimens with the extant species Hydrochoerus meinertzhageni.

Technical Session XIV (Saturday, November 5, 8:30 am)

FUNCTIONAL 3D KINEMATICS AND SURFACE MORPHOMETRICS OF TERTIOPIG HOP-THREE

SOUTER, Thibaud, Muséum National d'Histoire Naturelle, Paris, France; ABOURACHID, Amick, Museum National d'Histoire Naturelle, Paris, France; BAYLAC, Michel, Museum National d'Histoire Naturelle, Paris, France; CORNETTE, Raphaeli, Muséum National d'Histoire Naturelle, Paris, France; HUTCHINSON, John, Royal Veterinary College, Hatfield, United Kingdom

Quantitative methods of motion and shape analysis offer promising tools to reconstruct the variation in pelvic and femoral morphology. Moreover, our results reveal the disparity in the terrestrial locomotor apparatus observed among modern birds and between early (Allosaurus, Albertosaurus) and derived (Velociraptor, Bambiraptor) non-avian theropods. As functional constraints act differently on the pelvis and femur, we show how they may have influenced the gradual evolutionary appearance of avian features in both structures. In particular, we discuss how the antitrochanter and hip joint evolved among non-avian theropods in the lineage giving rise to modern birds.

Poster Session III (Friday, November 4)

THE TAXONOMIC POSITION OF PALAEOGALE (MAMMALIA: CARNIVORAMORPHA)

SAPAULING, Michelle, Carnegie Museum of Natural History, Pittsburgh, PA, USA

Palaegale is uniformly agreed to be a member of the Carnivoramorpha, but this is the extent of the consensus to its taxonomic placement. Historically considered a mustelid, later cladistic studies reasigned it as incertae sedis within Feliformia. However, this affinity was suggested under the hypothesis of the early Cenozoic taxa that it resembled (Viverravidae) lying within Feliformia. As current studies have repeatedly rejected a close association of Viverravidae and Feliformia, the placement of Palaegale relative to both groups therefore also is called into question.

Palaegale is represented by cranial, dental, and postcranial material, ranging in age from the latest Eocene to early Miocene, and is known from localities in both North America and Europe throughout much of this temporal range. It is critically important to test the position of Palaegale, as it has potential dramatic implications on reconstructing the biogeography and temporal extent of the various clades with which it has been allied previously. If found to be a member of the Viverravidae, Palaegale will extend the range of that clade by over 20 million years, as no known viverravid has been found in strata younger than late Eocene. If a close relationship with Feliformia is supported, Palaegale is by far the earliest known feliform in North America, as the oldest assured North American feliforms date to the early Miocene.

Recent studies have developed a more comprehensive view of the relationships and evolution of Carnivoramorpha; therefore, the placement of Palaegale can be tested more rigorously than previously possible. Here a detailed examination of the morphology of Pal- aegale is conducted and the genus is incorporated into the largest matrix to date designed to test carnivoramorph relationships, consisting of over 60 taxa with over 200 characters (including cranial, dental, and postcranial). Preliminary results support a placement near the base of Carnivoriformes to the exclusion of any close relationship with the Feliformia.

Poster Session IV (Saturday, November 5)

DISTRIBUTIONAL PATTERNS IN ORNITHISCHIA: A COMPREHENSIVE SPECIES-LEVEL BIOGEOGRAPHICAL ANALYSIS

SPEICHER, Marc, Department of Geosciences, University of Iowa, Iowa City, IA, USA

As obligately terrestrial animals, ornithischian dinosaurs are ideal for analyzing global geographical vicariance and dispersal patterns. These patterns can potentially illuminate previously unknown geological features such as archipelagos and land bridges that have been otherwise unnoticed or uncorroborated in the geological record. The early ornithischian record is sparse and predominantly Gondwanan, but the group achieved a global distribution shortly after the Triassic-Jurassic mass extinction. The earliest known ornithischians are from the Late Triassic of present day southern South America and South Africa, the likely location of their evolutionary origin. Here, I present a global species-level biogeographical analysis of all Ornithischia throughout the Mesozoic. In total, 176 basal and derived species were included in a phylogenetic framework, built from the concatenation of multiple phylogenies of subclades (e.g., Hadrosauridae, Stegosauria), to illustrate the overall phylogeny of Ornithischia. A parsimony optimization of areas from which each species was represented delineates the putative area of origin for each of these subclades, such as Heterodontosauridae with a known temporal range of approximately 100 million years, ranged from southern Gondwana to Laurasia, but their phylogeny as presently understood is inconsistent with a vicariance model to explain their distribution. For larger well-established clades such as Thyreophora and Marginocephalia, ad hoc hypotheses of dispersal across Laurasia are required, either via “island hopping” from North America to Europe or across ephemeral land bridges between North America and Asia throughout the Cretaceous. The basal radiation of Ornithopoda is problematic in that there are multiple independent dispersals into present-day Asia, Australia, North America, and Europe that are inconsistent with the sequence of landmass fragmentation. These results suggest the presence of short-lived connections within and among these landmasses.

Symposium 2 (Wednesday, November 2, 10:15 am)

CARNIVORAMORPH LEGACIES AND PALEOENVIRONMENTAL FRAMEWORK OF THE LATE PLEISTOCENE TULE SPRINGS LOCAL FAUNA

SPRINGER, Kathleen, San Bernardino County Museum, Redlands, CA, USA; MANKER, Craig, San Bernardino County Museum, Redlands, CA, USA; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, USA; PIGATI, Jeffrey, United States Geological Survey, Denver, CO, USA; MAHAN, Shannon, United States Geological Survey, Denver, CO, USA

The ground water discharge deposits of the upper Las Vegas Wash north of Las Vegas, Nevada, entomb the Tule Springs local fauna (TSFL), one of the most significant late Pleisto- cene vertebrate assemblages from the American southwest. Ground water discharge deposits are excellent paleoenvironmental indicators, closely tracking paleohydrologic responses to climate perturbations through geologic time. Despite this rich source of data, no previous at- tempts have been made to relate vertebrate faunal responses to late Pleistocene regional and global climatic perturbations in the southern Great Basin and Mojave Desert. We therefore initiated a large-scale paleontologic and geologic investigation in the upper Las Vegas Wash with the goal of integrating the TSFL into a regional paleoclimatic framework. Our results include discovery of several hundred new fossil localities and detailed geologic mapping of...
the fine-grained paleowetlands deposits, informally named the Las Vegas Formation. This formation comprises stratigraphically ascending units A through G, with multiple intervening soils. We have redefined and established new geologic units within this formation and have reevaluated the geochronology throughout the sequence. This new geochronologic scaffold, based on high-precision radiocarbon dates, provides tight-resolution stratigraphic control for the TSLF. The new data expand the duration of the Las Vegas Formation from ~225 ka to at least 600 ka, encompassing multiple glacial-interglacial climatic shifts including the end-Pleistocene transition. The new chronology also refines the regional chronologic framework, enabling correlations with global climate drivers. Additionally, regionally unique, braided fluvial tufas occur iteratively within these deposits, as do multiple black mats—both important paleoenvironmental signals. This high-resolution geochronology provides a framework for using stable isotope analyses on ostracods, vertebrates, and tufa, which collectively provide new insights into climate change during the late Pleistocene in the southern Great Basin.

Poster Session IV (Tuesday, November 5)

ANATOMY AND RELATIONSHIPS OF A NEW TURONIAN HADROSAUROID FROM THE MATANUSKA FORMATION OF SOUTHERN ALASKA

STACK, Kevin, University of Alaska Fairbanks Geology and Geophysics Department, Fairbanks, AK, USA; DRUCKENMILLER, Patrick, University of Alaska Fairbanks Geology and Geophysics Department, University of Alaska Museum Earth Science Department, Fairbanks, AK, USA

The fossil record of hadrosauroids (Ornithopoda, Hadrosauridae) from the Albanian to Santonian is very sparse, with few described North American and Asian taxa compared to the diverse record of Campanian to Maastrichtian north hadrosauroids. In 1994, the partial postcranial remains of a hadrosauriform dinosaur were found in the Matanuska Formation of southern Alaska. The Matanuska Formation is a thick succession of Albian- Cretaceous-aged, dominantly marine, sediments deposited in a forearc basin along the actively accreting western North American margin. The Alaskan specimen is assigned a Turonian age based on molluscan biostratigraphy. The skeleton consists of postcranial elements including cervical, dorsal and caudal vertebrae, a partial pectoral girdle, proximal elements of the forelimbs, a partial pelvic girdle, and representative portions of the hindlimbs. This fossil represents the most complete, single skeleton of a dinosaur known from Alaska, and one of the few skeletal remains recovered outside of the North Slope. It is only the second North American Turonian hadrosaurid described, the other being Jaysavati rugoculus from New Mexico. This specimen also represents a new taxon of basal hadrosaurid that can be diagnosed by its unique combination of humeral, ilial, and femoral characters. A phylogenetic analysis recovers the new taxon nested within a paraphyletic assemblage of non-hadrosaurid hadrosauroids, being more derived than the North American Cenomanian taxa Eolambia and Protohadros but more basal than stratigraphically younger hadrosauroids from Asia, including Titanus, Bactrosaurus, and Gilmoreosaurus. The temporal and geographic occurrence of the Alaskan taxon provides an important new data point for hypotheses of hadrosaurid biogeography in the Late Cretaceous.

Symposium 2 (Wednesday, November 2, 8:30 am)

CHANGING LATE NEogene BIRD COMMUNITIES IN NORTHWESTERN MEXICO AND THE SOUTHWESTern UNITED STATES

STEADMAN, David, University of Florida, Gainesville, FL, USA

This study is based on bird fossils from Pliocene and Pleistocene localities (Blancan through Rancholabrean NALMA) from Sonora, Arizona, and New Mexico (ca. 107-114°W, 29-33°N). The birds identified from most of these local faunas are dominated by aquatic species such as grebes, pelicans, cormorants, herons, ibis, stork, swans, geese, ducks, cranes, rails, sandpipers, flamingos, and terns, reflecting the lacustrine (marsh, lake) and riparian environments in which the fossils typically accumulated. The non-aquatic species of birds (various vultures, hawks, eagles, falcons, cracids, quail, turkeys, pigeons, cuckoos, and owls) suggest habitats ranging from grassland to open woodland to desert scrub to tropical thornscrub. The fossil passerine (songbird) communities were dominated by icterids (blackbirds, cowbirds, grackles, orioles), which corroborate the non-passerine evidence that marshes, lakes, riparian, lacustrine communities, and tropical thornscrub dominated the vegetation at elevations >1000 m and dominated this vast region through much of the Plio-Pleistocene; today, this region mainly sustains desert scrub vegetation of the Sonoran and Chihuahuan deserts. The new chronostratigraphy of faunas in northern Chihuahua and Sonora, M�xico supports the hypothesis that much of the Sonoran region was a contiguous desert scrub phase throughout the Pleistocene, with some regional differences in vegetation and species composition.

This more tropical biogeographic affluence of some of these birds agrees with that suggested for certain associated reptile and mammal fossils. Modern (Holocene) bird communities are not as rich as those of the Pliocene-Pleistocene, largely because of extinctions at the very end of the Pleistocene. These extinctions disproportionately affected storks, ducks, flamingos, vultures (including condors), eagles, and icterids.

Symposium 4 (Friday, November 4, 11:45 am)

USING PALEONTOLOGICAL DATABASES TO ASSESS SPATIAL AND TEMPORAL CONSERVATION OF MAMMALIAN COMMUNITY STRUCTURE AS AN AID TO CONSERVATION PLANNING

STEGNER, M., UC Berkeley, Berkeley, CA, USA; HOLMES, Michael, UC Berkeley, Berkeley, CA, USA

Environmental and ecological changes are proceeding rapidly today, thus it is critical to conservation efforts that we understand natural ranges of variability experience by ecosystems in the past. Toward that end we used the NEOMAP database to examine how mammal size and dietary guilds varied through time and space in the Great Plains and Great Basin. Temporal variation was assessed using species occurrence data for the Northern Great Plains biogeographic province in the Holocene, Rancholabrean, Hemphillian, Clarendonian, and Barstovian, encompassing marked climate changes. Spatial variation was examined for the Rancholabrean across four regions (Northern and Southern Great Plains, Northern and Southern Great Basin) that represent pairs of neighboring biogeographic provinces that have been ecologically, topographically, and climatologically distinct since the Oligocene.

Species were grouped by dietary guild and body size (15 distinct groups) to investigate whether the distribution of species in diet/body size classes: (1) has changed over the past 16 million years, and; (2) differs among biogeographic provinces during a single time interval. We used pairwise Fisher’s exact tests to compare the distribution of species in diet/body size classes among provinces and time periods. The numbers of species in each dietary guild and body-size class showed no significant differences between the four Rancholabrean biogeographic provinces, nor did they show significant differences through time in the Great Plains. However, the Holocene fauna has a significantly different trophic and body size structure than that observed over the previous 16 million years: extra-large (≥44 kg) and small (<500 g) herbivores and small insectivores dramatically decline in diversity relative to the four previous time intervals. The long-term stability of diversity within these size and diet groupings suggests that tracking this metric into the future may be useful for monitoring whether current human activities are significantly changing existing faunal patterns.

Poster Session I (Wednesday, November 2)

OSTEOCYTE LACUNA DENSITY IN SAURISCHIAN DINOSAURS AND THE CONVERGENCE OF FIBROLAMELLAR BONE IN MAMMALS AND DINOSAURS: DIFFERENT STRATEGIES TO GROW FAST

STEIN, Koen, Steinmann Institut für Geologie, Mineralogie und Palaeontologie, Bonn, Germany; SANDER, P., Martin, Steinmann Institut für Geologie, Mineralogie und Palaeontologie, Bonn, Germany

Fibrolamellar bone (FLB) in mammals and dinosaurs looks identical on the histological and nanostructural level. Pavimorny, however, suggests FLB evolved convergently in both lineages. On the cellular level, significant differences between mammalian and dinosaur bone tissues can be observed in the osteocytes. Apart from a more organized canalicular distribution, mammals also have generally larger osteocyte lacunae than saurischian dinosaurs. Additionally, mammal osteocyte lacuna density (OLD) has been shown to correlate inversely with body mass, and speculation that OLD reflects the metabolic output of periosteal bone formation. However, mammal osteocyte lacuna density (OLD) has been shown to correlate inversely with body mass, and speculation that OLD reflects the metabolic output of periosteal bone formation. However, mammals also have generally larger osteocyte lacunae than saurischian dinosaurs. Higher, and ectotherms a much lower OLD than similar-sized mammals. High OLD in sauropods is linked with body mass, and speculation that OLD reflects the metabolic output of periosteal bone formation. Additionally, mammal osteocyte lacuna density (OLD) has been shown to correlate inversely with body mass, and speculation that OLD reflects the metabolic output of periosteal bone formation. However, mammals also have generally larger osteocyte lacunae than saurischian dinosaurs.

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Poster Session IV (Saturday, November 5)

3D METHODS OF DIETARY RECONSTRUCTION IN THE EARLIEST ANTHROPOIDS

STAÏT, Suzanne, Marshall University, Chesapeake, OH, USA; GUNNEL, Gregg, Museum of Paleontology, Univ Michigan, Ann Arbor, MI, USA; BOUDREAU, Joshua, Marshall University, Huntington, WV, USA; KISSEL, Daniel, Marshall University, Huntington, WV, USA

Dental morphology of extinct small-bodied primates and marsupials was compared with current primates and marsupials compared with current primates

First and second lower molars were scanned with a Laser Design Surveyor RPS-120 probe laser scanner. Scans were made with a step size of 0.01 mm and each specimen was scanned from six different angles for complete tooth coverage. Geomagic was then used to merge, clean, and decimate the scans into a single completed model. Using this 3D data, dental complexity, shape ratios, and 2D/3D surface area ratios were calculated. Dental complexity was calculated by the same method in Sisvar. All tooth data related to the same number of tooth crowns and topographic contour maps were created. Orientation patch count (OPC) was calculated as any time two or more patches had the same slope orientation (within a range of eight possible predefined orientations). Results indicated that more traditional measures appear to be better indicators of diet within tight taxonomic units with quantifiable homologous dental features, whereas OPC counts are more robust across more distantly related taxa.

Nine species of small-bodied middle-late Eocene primates were compared to this extant sample. Results indicate that Eosimias centennicus, E. sinensis, and Xanthorhysis tabrumi were the most insectivorous whereas Arctictis kallimnos, Catopithecus browni, Pliosigibites tarsi, Protopithecus syriacus, Quatruni wingi, and Serapia eocaenus were more similar to living frugivorous primates. These results indicate that primitive African anthropoids were ecologically distinct from insectivorous eomorphs and that the initial radiation of anthropoids involved diversification of feeding strategies.
rischians, compared to mammals, illustrates there are different ways to build fibrolamellar bone and hence grow fast. Both groups have high appositional growth rates, but saurischians have generally smaller osteocyte lacunae than mammals, and hence require higher osteoblast proliferation rates for similar bone apposition rates. Low OLD of poikilotherms is not compensated significantly by lacuna size, and rather reflects low bone apposition and growth rates. Moreover, high lacuna densities in saurischian dinosaurs compared with low lacuna densities in ectothermic poikilotherms provides additional strong evidence for sustained high metabolic activity in saurischian dinosaurs. These results demonstrate the potential of OLD quantification for life history and bone physiology studies of extinct and extant vertebrate clades.

**Poster Session III (Friday, November 4)**

**ECOLOGICAL PROFILE FOR SOUTH AFRICA AND EAST AFRICAN EARLY HOMININ FOSSIL SITES USING STABLE CARBON ISOTOPES FROM FOSSIL BOVID DENTITION**

STEYER, J. Sébastien, CNRS and MNHN, Paris, France; MATEUS, Octávio, Universidade TRIASSIC OF PORTUGAL

The conventionally held view of a uniform global trend of open grasslands after ca. 2.0 Ma for South Africa and East Africa is questioned with new isotopic data. Isotopic analyses of bovid dentition from these two regions indicate more complex palaeoecological settings. The new isotopic data suggest differential timing of grass expansion between East African and South Africa, with a C4-dominated ecosystem occurring in East Africa prior to South Africa. Early hominin assemblies from South Africa encompass a mosaic ecosystem that was more C3-dominated than contemporaneous East African sites.

**Poster Session IV (Saturday, November 5)**

**FAUNAL COMPOSITION OF THE LATE Oligocene SONGWE FORMATION MEMBER OF THE NSUNGWE FORMATION, TANZANIA**

STEVENS, Nancy, Ohio University, Athens, OH, USA; EGBERTS, Sebastian, Ohio University, Athens, OH, USA; ROBERTS, Eric, James Cook University, Townsville, Australia; O’CONNOR, Patrick, Ohio University, Athens, OH, USA

The Songwe Member of the Nsungwe Formation, exposed in southwestern Tanzania, is a 200+ m thick succession characterized by a myriad of micro-depositional environments. It represents a shallow wetland system that developed in a semi-arid climate approximately 25-24 Ma, early in the development of the modern East African Rift System. The presence of aquatic and semi-aquatic taxa (e.g., fish, frogs, crustaceans and aquatic molluscs) in many of the localities suggests potential availability of water with periodic or seasonal climatic fluctuation. Differential preservation of fossils at the ten localities presents rich potential for detailed taphonomic and paleoecological investigations. Sedimentological data suggest that fossil-bearing localities represent a range of depositional environments from fluvial to lacustrine to shoreline and deltaic deposits, each represented by different taphonomic modes of preservation. This study compares faunal composition and size sorting among the Nsungwe Formation localities. An analysis of 1409 identified specimens from ten localities indicates the following taxonomic breakdown: mammals comprise ~31% of the total fauna, with invertebrates and fish each just over 20%, anurans ~13%, crocodylians and turtles each < 5%, and squamates and aves together accounting for ~2%. The composition is highly variable across localities, with for example mammals ranging from 11% of the recovered specimens at one site to over 57% from a different but nearby locality. Maximum length was recorded for all prepared specimens (n=675; min = 1 mm, max 132mm), with the majority of specimens from well-sampled localities measuring between 2 and 5 mm in length. Recently discovered localities near the base of the Songwe Member represent wetland/lacustrine environments that preserve freshwater ostracods and a greater size diversity of vertebrates, from micromammals to megaherbivores, the latter likely transported by periodic discharge from local river systems. Notably absent from those localities, however, are some of the most common micromammal and invertebrate taxa of the Nsungwe fauna.

**Poster Session I (Wednesday, November 2)**

**A NEW METOPOSAURID (TEMNOSPONDYL) BONEBED FROM THE LATE TRIASSIC OF PORTUGAL**

STEYER, J. Sébastien, CNRS and MNHN, Paris, France; MATEUS, Octávio, Universidade Nova de Lisboa, Faculdades de Ciências e Tecnologia—CICEG & Museu da Lourinhã, Lourinhã, Portugal; BUTLER, Richard, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; BRUSATTE, Stephen, American Museum of Natural History, New York, NY, USA; WHITESIDE, Jessica, Department of Geological Sciences, Brown University, Providence, RI, USA

The end-Triassic extinction event (ETE), considered one of the ‘Big Five’ mass extinctions, marks a dividing line between early Mesozoic vertebrate assemblages, typically including abundant temnospondyls, basal synapsids and basal archosaurs, and ‘typical’ Mesozoic faunas dominated by dinosaurs, pterosaurs, crocodylomorphs, turtles and mammal-like reptiles. Recent geochemical work has provided strong evidence that the ETE is synchronous with, and likely caused by, the emplacement of the Central Atlantic magmatic province (CAMP). However, stratigraphic sections containing both terrestrial vertebrates and CAMP basaltal are scarce, complicating attempts to examine terrestrial faunal changes during this extinction event. The Triassic–Jurassic Algarve Basin, southern Portugal, is an extensional rift basin formed during Pangea breakup. The infill of this basin consists of a series of terrestrial- to-marine red beds (the ‘Grès de Silves’ Group) interbedded with CAMP basaltal. New expeditions in this basin have identified a rich, paucispecific, temnospondyl-dominated bonebed from the interval ‘AB1’ of the Grès de Silves. Preliminary excavations yielded at least nine well-preserved temnospondyl individuals represented by partial to nearly complete skulls and calcified postcrania of juveniles to adults. Nearly all material appears to represent a single species of metoposaurid referable to the genus Metoposaurus, well known from the late Carnian–early Norian of Germany and Poland. A number of characters of the occiput and mandible suggest that the Algarve material may represent a new species. This new material provides new data on the diversity and paleogeographical distribution of the metoposaurids, a highly autopomorphic and peculiar group composed of large aquatic carnivores with a unique elongated but brevirostral skull. This taxon also provides the best current age constraints for the bonebed, suggesting that at least part of the ‘AB1’ Horizon may be within or close to the late Carnian–early Norian. Additional bone-bearing horizons within the ‘Grès de Silves’ provide a rare opportunity to examine terrestrial faunal change in the lead-up to the ETE.
Poster Session IV (Saturday, November 5)

A NEW HIGH ALTITUDE LATE PALEOCENE INTERGLACIAL/GLACIAL SITE (MIS 5) PRESENT IN LARGE AND SMALL VERTEBRATE FOSSILS FROM WESTERN COLORADO: THE SNOWMASTODON SITE AT ZIEGLER RESERVOIR, PITKIN COUNTY


In October 2010, construction workers discovered bones of Pleistocene mammals at high altitude (~2671 m) near Snowmass Village, Colorado. The bones were preserved in an isolated lake basin (~15 acres) formed behind a lateral Bull Lake moraine. The site is radiocarbon dead and may range in age from >45,000 to ~150,000 years BP. Paleoenvironmental proxies include plants (pollen, leaves, wood) and invertebrates (ostracods, gastropods, insects). Exceptionally preserved remains of Mammut americanum (8+ individuals), Mammutthus columbi (4 individuals), Bison latifrons (4 individuals), Camelops hesternus (1 individual), cf. Odobexorus sp. (2 individuals), and Megalonyx jeffersonii (1 individual) have been recovered. One deer skeleton, believed to be a large juvenile, bears antlered deer (O. hemionus), but body size is larger and limb proportions differ. Limited screen washing has yielded microvertebrates including a microtine rodent (1 tooth triangle), cf. Hemionus, and hundreds of bones of Ambystoma tigrinum. The salamander bones represent neotenic, adult and cannibalistic morphs. Gnaw marks on mammoth and mastodon ribs suggest two sizes of carnivores. Beavers (Castor canadensis) are indicated by gnawed wood. At least four fossil horizons are recognized: a lower redivided diatomaceous, a debris flow/coaloid silt; a “yellow” clay; and overlying sedge-peat capped by a thick clay. Changes in sedimentation, fauna, and pollen, track complex climatic changes reflecting a transition from warmer and moister (MIS 5e) to cooler and drier (MIS 5a-d?) conditions. Fossils from different units document varying taphonomic pathways. The basal units have disarticulated, broken and sometimes tumbled-worn remains of bison, deer and mastodon. The peat environment preserves articulated remains of a juvenile mammoth, a juvenile deer and a bison, all lying horizontally. The upper clay also has well preserved mammoth material. All horizons contain salamander remains, some of which occur partially articulated and in high abundance in the pulp cavity of a mastodon tusk.
Mesozoic vertebrate evolution. All of the Daohugou dinosaurs are paravian theropods, and their Mid-Late Jurassic age refutes the "temporal paradox" argument against the theropod origin of birds even on its own terms. The Daohugou mammals include a gliding form and two probable burrowers, one of which was probably also semi-aquatic. This range of adaptive types points to a previously unappreciated ecological diversity among Jurassic mammals. Finally, the pterosaurs include forms that bridge the wide morphological gap between pterodactyloids and previously known non-pterodactyloids.

Poster Session I (Wednesday, November 2)

VERTEBRAL REMAINS OF THE LATE MIOCENE APE HISPANOPITHECUS LAETIATUS (PRIMATES: HOMINIDAE): FUNCTIONAL MORPHOLOGY AND PALEOBIOLOGICAL INFERENCE

SUSANNA, Inés, Instituto de Paleontología, UAB, Barcelona, Spain; ALBA, David, Institut Català de Paleontologia, UAB, Barcelona, Spain; ALMÈCIDA, Sergio, Department of Vertebrate Paleontology, American Museum of Natural History and NYCEP, New York, NY, USA; MOYA-SOLÀ, Salvador, Institut Català de Paleontologia, UAB, Barcelona, Spain

A description and functional interpretation of the vertebral specimens of the late Miocene (9.6 Ma) great ape Hispanopithecus laetius (Primates: Hominidae) from Can Llobateres 2 (Vallès-Penedès Basin, NE Iberian Peninsula) are presented. These specimens include a partial thoracic vertebra, 3 partial lumbar vertebral bodies and 3 partial neural arches of lumbar vertebrae, corresponding to the male partial skeleton IPS18800 (estimated body mass: 39 kg). Despite the retention of some pleiomorphic features shared with paragondykes monkeys and stem, early to middle Miocene hominoids (e.g., relatively long vertebral body with some vertebral wedge), Hispanopithecus displays a set of shared-derived features with extant great apes, which are indicative of upright trunk postures (orthograde bodyplan). The latter include, for the lumbar vertebrae: caudal origin and apparently caudally oriented neural processes, lack of ventral keel, mediallylaterally wide and dorsoventrally shallow vertebral body, and root of transverse process clearly originating from the pedicle with a coplanar orientation; and for the thoracic vertebrae: very dorsally situated costal forae on the vertebral body, and dorsal origin and orientation of transverse process, implying a ventral position of the spinal column relative to the thorax, which can be therefore inferred to have been broad and relatively shallow. The presence of 4 to 5 lumbar vertebrae, as it is common in extant great apes, can be tentatively inferred for H. laetius on the basis of available material. Overall, the vertebral morphology of this taxon agrees well with other postcranial elements, indicating the possession of a modern hominoid-like, orthograde bodyplan. Orthograde features have been also documented in the middle Miocene ape Prierolapithecus catalaunicus from the same basin. Although phylogenetic uncertainties still remain regarding these Miocene European dryopithecins (generally considered to be stem Hominidae or Ponginae), the lack of undoubted orthograde adaptations in the Asian pongin Sivapithecus raises serious doubts on the homology of these features amongst crown hominoids and even between pongines and hominines.

Poster Session II (Thursday, November 3)

JAW MECHANICS OF CROCODILES REVEAL THEIR FAST MASTICATION

SUZUKI, Daisuke, Sapporo Medical University, Sapporo, Japan; HAYASHI, Shoji, University of Bonn, Bonn, Germany; CHIBA, Kentaro, Hokkaido University, Sapporo, Japan; TAYLOR, KA, Kober, University of Calgary, Canada

Anatomical approaches to the jaw mechanics of modern crocodiles can further elucidate the feeding behavior of extinct archosaursaurians. Nevertheless, jaw structure and movement in modern crocodiles are poorly understood. The crocodilian cartilago transiens (CT) in the musculus pterygoideus anterior (MPA) has fibrocartilage body contact on the lateral wing of the pterygoid, and is essential for jaw closure. The CT is indicative of jaw movement because it retains a rough surface on the pterygoid, and is therefore useful in studies involving fossil taxa. Here we investigate the mechanics of the CT in modern crocodilian species and evaluate its functional importance.

Seven specimens of four crocodilian species (four Crocodylus porosus, one C. niloticus, one C. siamensis and one Caiman latirostris) were analyzed using CT scans of open-jaw and closed-jaw positions, and one specimen was studied in four positions: full open, 20° open, 10° open and closed positions. We observed the movement of the CT during jaw closure and calculated the moment arm of the MPA under two different models: CT present and absent. The results revealed that the CT moves anteriorly on the lateral wing of the pterygoid and decreases the MPA moment arm during jaw closure. In both open and closed positions, the moment arm was significantly smaller in the CT present model (28.22±7.99 mm in open and 16.91±3.41 mm in closed positions) than in the CT absent model (34.15±8.87 mm in open and 20.94±5.43 mm in closed positions). In addition, the moment arm in CT present decreased rapidly from full open (approximately 30°) to 20°. As a result, the difference in the moment arm was the largest in the 20°-10° open position from the CT absent model. This study indicates that the MPA is involved in rapid jaw closure by moving the CT anteriorly, instead of strong power generation, especially at the 20°-10° open position. Although fossilization of the CT is unlikely, the rough surface of the fossilized cartilage remnant on the lateral wing of the pterygoid faces the CT. The remnant can be an indicator of the speed/power trade-off structure in jaw mechanics.

Poster Session III (Friday, November 4)

THE MORPHOLOGY AND PHYLOGENETIC POSITION OF ADOCUS/ADOCIDAE AMTGAI, AN ADOCID TURTLE FROM THE LATE CRETACEOUS OF MONGOLIA

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Adocus amtgai was described based on a single incomplete shell from the Late Cretaceous of Mongolia (Amtgai, Eastern Gobi, upper part of the Bainshire Formation, late Turonian– Santonian). Later, this species was placed in a separate genus Adocoides based on preliminary study of the second specimen (almost complete skeleton). Additional preparation and examination of the second specimen allows us to emend the characteristics of A. amtgai: skull: anterior part of skull sharply constricted in preorbital region; temporal emargination large (more than 50% of length), mediolaterally wide and dorsally shallow; anterior border of orbit visible in dorsal view; orbits directed anterolaterally under 30° to long axis of skull; snout profile oblique in lateral view, projected ventrally; maxilla long and in lateral view; cheek emargination deepest in its medial part; shell: nuchal notch weak, formed by nuchal and peripheral 1; six neurals; neural 6 not shortened; two suprapygals; cervical narro and trapezoid, expanded anteriorly; vertebral 5 narrow; pleurals 2–4 narrowed (width about 30% of length); marginals overlapping onto costals beginning with marginal 4; anterior border of plastron straight; length of bridge about 40% of plastron length; width of anterior border of epiplastron more than length of epiplastral symmetry; width of anterior border of gulars more than length of epiplastral symmetry; gulars overlapping onto entoplastron; extragulars shortened (mediolateral borders about 50–70% of length of epiplastral symmetry); humero-pectoral sulcus intersects entoplastron; four inframarginals wide and slightly angle onto peripherals, shell sculptured with small and regular pits; non-shell postcrania: coracoid flat and wide with truncated distal edge; pelves slightly narrowed anteriorly with broad interpubic contact; metacarpal processes long. Inclusion of A. amtgai in the phylogenetic analysis of Adocidae resulted in its position within Adocus clade sister to Adocus aksy, a species from the Late Cretaceous of Uzbekistan.

Poster Session IV (Saturday, November 5)

DEPRESSION OF JAW JOINT IN EARLY EVOLUTION OF CERATOPSIANS

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Ceratopsia was among the dominant herbivorous dinosaur clades in the Cretaceous terrestrial ecosystems of Asia and western North America. Understanding the effectiveness of the masticatory apparatus should help to explain how Ceratopsia achieved ecological success. Recent discoveries of numerous new basal taxa with superbly preserved skulls make it possible to document the early evolution of the ceratopsian masticatory system. In this study, jaw joints of basal ceratopsians were examined to understand the early evolution of the ceratopsian masticatory system in biomechanical aspect. Genoids of basalmost ceratopsians tintong and Chaoyangsauroidea are almost at the same level as the dentary tooth row in lateral or medial view. Although not as lowered as those of ceratopsids, the derived ceratopsians, genoids of psittacosaurids and basal neoceratopsians lie ventral to the level of the tooth row. In a mandibular lever system, the depression of genoid lengths the input lever arm whose

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length is the distance from the glenoid to the apex of the coronoid process. The depression of jaw joint was associated with the caudal displacement of the coronoid process and caudal extension of the tooth row, which allowed shortening of output lever arm length, the distance from the glenoid to the bite point in caudal region of the tooth row. Both elongated input lever arm and shortened output lever arm increase leverage in the mandibular lever system. Depressed jaw joint also makes possible the anteroposterior grinding motion during mastication as in the typical masticatory apparatus of herbivorous mammals with jaw joint dorsal to the level of tooth row, even though the mandible is merely rotating around a fixed transverse axis. This study shows the biomechanical improvement of the masticatory system in the early evolution of Ceratopsia.

Poster Session III (Friday, November 4)

VARIATION IN THE DELTOPECTORAL CREST IN BIRDS
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The shape and orientation of the deltopectoral crest (DPC), the insertion site of the primary wing depressor in birds, are central to our understanding of key aspects of wing function. Optimization of DPC characteristics in phylogenetic analyses reveal that the deltopectoral crest changed orientation relative to the humeral head at least twice on the lineage leading to extant birds. The DPC dominantly deflects anteriorly (or anterodorsally) in most non-avian theropods, then dorsally in basal Mesozoic birds after Archaeopteryx. Changes in the size and shape of the crest are seen associated with this first shift. Finally, anterior deflection is again seen in Aves. Why does DPC orientation switch in these early fliers? Assessments of this character have been limited to a binary character state – anterior or dorsal. However, deciphering its functional role requires more precise angular measures. In this study, we measure the range of variation in DPC angle in extant birds using Aves3D, a database containing 100+ laser-scanned digital models of avian humeri from a broad range of taxa. We calculated inertial properties of each humeral model to provide a consistent reference frame for measuring DPC angle. Angles range from 17 degrees (anterodorsally deflected; 0 degrees = dorsally deflected in line with humeral head long axis) to 79 degrees, indicating broad variation in this character. DPC angle appears to be similar within some clades (e.g. hornbills and penguins) but disparate in others (e.g. falconiformes). Although no extant birds reach the level of dorsal deflection of the DPC in, for example, Confuciusornis, the presence of this range of variation in extant birds suggests combining biomechanical modeling and analyses of the most dorsally deflected extant birds may help explain the evolution of crest angle and its relationship to wing mechanics.

Poster Session I (Wednesday, November 2)

DENTAL MORPHOLOGY OF ALLOSUARIS FRAGILIS (DINOSAURIA: THEROPODA) FROM THE UPPER JURASSIC MORRISON FORMATION OF EASTERN NORTH AMERICA: IS DENTITION MORE INDICATIVE OF TAXONOMY OR FEEDING NICHE?
TESTIN, Jason, South Dakota School of Mines and Technology, Rapid City, SD, USA; TUCKER, Ryan, James Cook University, Townsville, Australia; MIYASHITA, Tetsuto, University of Alberta, Edmonton, AB, Canada; HOLTZ, JR., Thomas, University of Maryland, College Park, MD, USA

Theropod dentition has been used to erect new taxa and define the paleobiogeographic range of known taxa. However, a small number of studies quantitatively describe the dental morphology of well-supported taxa. A detailed morphological study of the dentition of Allosaurus fragilis, one of the best sampled theropods, can lead to a better understanding of the variation in theropod dental morphology as a whole. In-situ dentition was used to set morphometric standards for the dentition of A. fragilis. The procedure is applicable to other theropods. In premaxillary teeth the mesial and distal carinae are convex, whereas the mesial carinae are wider than the distal carinae, which lead to a general “D-shaped” description. Both the maxillary and dentary dentition can be tentatively labeled “J-shaped”, being flatter on the labial surface than the lingual and coming to a point along the distal carinae. As dental morphology may be closely linked to specific feeding behaviors, is it possible that changes in dental morphology could be linked with a shift between feeding niches. Niche-induced morphology may prove to be a more important factor in determining tooth forms than taxonomically diagnostic characters. In addition to dentition of A. fragilis the study includes dental morphology of other large theropod taxa for comparison, including additional Carnosauria (Aceraxonothus and Carnotaurus), Coelurosauria (Tyranosaurus and Gorgosaurus), Megalosauridae (Spinosauridae) and Abelisauridae. Variables include crown base length, crown base width, crown height, and apical length along with a series of morphologically relevant ratios and angles, including the crown base ratio, crown height ratio, crown compression ratio and various angles. This study will lead to a better understanding of theropod dentition and its relationship to feeding behaviors and taxonomic relationships.

Poster Session III (Friday, November 4)

PETROSAL MORPHOLOGY OF THE PROTOSTODIUM CHARTERIOACTYLYC PROTOCERAS CELER
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The status of the subarcuate fossa among protoceratids is disputed, and is of importance because of its potential systematic value in determining character polarity within cetartiodactyls. Computed tomography (CT) scans of the highly derived synthetocerid Syndoceras (USNM 1153) has suggested that protoceratids lacked the deep subarcuate fossa and mastoid fossa seen in Poebrotherium and Iamnus camelliae, and showed a ruminant-like cranio-caudal crest subdividing the dorsalomedial surface of the petrosal into cerebral and cerebel lar faces. The basal protoceratid Leptotragulus (MCZ 5303 and 5304) similarly showed a ruminant-like morphology with a shallow subarcuate fossa and cranio-caudal crest.

The protoceratid Protoceras celer was recently suggested to have instead a deep subarcuate fossa and a relatively flat dorsalomedial surface, comparable to Poebrotherium and the Iamnus camelliae, based upon AMNH-VP 645, an isolated petrosal. A high-resolution computed tomography (CT) scan of the skull of a male P. celer, AMNH-VP 53523, from the Poleside Member of the Bule Fluv., South Dakota, shows the petrosal morphology of this small proto ceratid. This skull shows a shallow, poorly defined subarcuate fossa, and a large crest on the petrosal, subdividing the braincase into distinctive cerebral and cerebellar cavities, similar to Syndoceras and Leptotragulus. The lack of agreement between these two specimens suggests that the identification of AMNH-VP 645 may be erroneous, and that the subarcuate morphology of protoceratids is consistent, but this will require data from additional protoceratid taxa.

E&O Poster Session

APPLICATIONS OF COMPUTED TOMOGRAPHY TO MUSEUM CONSERVATION AND EXHIBITS
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Computed tomography (CT) is frequently discussed in the context of its benefits to paleontological research. However, its applications to conservation and museum exhibits is infrequently discussed. Sharing CT data can provide easier and faster access than shipping loaned specimens, reducing physical stress on specimens. Three-dimensional models can be used in research, exhibits, and hand-on settings in lieu of actual specimens, also reducing handling stress on specimens. Virtual exhibits utilizing CT data, even at low resolution, can show visitors internal structures (such as bone anatomy or virtual endocasts) not always visible in physical specimens. These data can also be integrated into classrooms as an educational supplement. These virtual exhibits can help show visitors and students and internal view to explore beyond just a superficial understanding. The use of computed tomography is useful in areas beyond such as conservation and exhibits.

Poster Session II (Thursday, November 3)

VARIATION IN HINDLIMB MUSCLE ATTACHMENT SITES IN THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) AND IMPLICATIONS FOR PALEOBIOLOGICAL RECONSTRUCTIONS
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The use of the Extant Phyletogenic Bracket (EPB) method has become commonplace for hypotheses of musculature and their attachment sites in extinct archosaurs, particularly dinosaurs. Approximately 30% of the appendicular muscles examined in the Brown kiwi (Apteryx australis mantelli) could be reliably associated with distinct osteological correlates. Despite this, of the numerous reconstructions of archosaurian myology, few studies have quantitatively evaluated variation in the muscle attachment sites in the bracketing extant taxa, or the implications that insertion variability may have upon myological reconstructions in extinct taxa.

The hindlimb musculature of nineteen specimens of Alligator mississippiensis of varying but known size and locomotor histories were dissected and analyzed. Individual muscles with large attachments to the femora and tibiae were measured. The four largest alligators were acquired from the wild at the age of two. The remaining fifteen were raised in the lab and were much smaller despite being of a similar age. Seven muscles with large fleshy attachments to the femur and tibia were measured on both the right and left hindlimbs for comparison. The insertion sites of the following muscles were examined: M. iliobrachialis; M. adductor 1, 2, and 2; and M. caudofemoralis longus. This study includes measurements of M. femorotibialis externus, M. femorotibialis internus and M. tibialis anterior.

High variation was recorded in the majority of muscle attachments between individuals even when adjusting for size. The largest disparity was observed in the origin of M. tibialis anterior. Variation seen in certain muscle attachments suggests that osteological correlates in the appendicular skeleton must be regarded with caution with respect to myological reconstructions. The findings from this study will aid in understanding the interface between soft tissues and their corresponding skeletal structures in extant taxa, with the aim of generating more robust reconstructions of soft tissues in extinct organisms.
Kryptops by small teeth and a short skull length relative to overall body size. However, analysis of similarly to other members of the Abelisauridae, increasing evidence of dietary specialization within this group. Comparative studies of the cranial anatomy of a range of abelisaurid theropods, from basal forms such as Krytops Rugops Majungasaurus, and teeth can be ambiguous. The postcranial elements of these fossilized microfauna are also approximately 17 serrations per cm on each tooth. The most robust teeth were positioned close to the rostral end of the maxilla which, coupled with low crown height and straightened causal edges, would have allowed for powerful puncturing bites.

Abelisaurids lived on the landmass that joined the southern continents, such as Africa and South America, and shared their environment with large carcharodontosaurids and spinosaurids. The existence of this predatory triumvirate may have been the catalyst for such dietary specialization within each group.

Subaqueous tetrapod footmarks and traceways attributed to archosauriform reptiles are present in coastal and fluvial Early-Middle Triassic red beds of the Red Peaks Formation of Wyoming, Moenkopi (Torrey Member) and Ankarah (Mahanayyy Mbr) formations of Utah, and Moenkopi Formation of Arizona (Wupatki Mbr) and New Mexico (Anton Chico Mbr). Footmarks are composed of one, two, or three elongated digit marks preserved in convex hyporelief. One locality in the Moenkopi Formation at Capitol Reef National Park, Utah, exposes two offset traceways containing sequences of 19 and 13 footmarks, respectively. Re-arrangement of these offset traceways reveals alternating pace lengths (9.3 cm), fairly consistent strides (39 cm), a front interpace distance (59 cm) significantly wider than the rear (41 cm), consistent pace angulations for front (33°) and rear (43°) footmarks, and high pes and digitation angles alternating between 62° and 83°. Footmark positions are consistent with a swimming locomotion characterized by synchronized thrusts of the right and left limbs, respectively, followed by a phase before repetition. Because of resistance of the substrate to a full arc of the limb results in posteriorly oriented digits retracting anteriorly to produce posterior overhangs, these overhangs and kick-off scours provide conclusive determination of traceway direction. Swim track surfaces also preserve current crescents that align subequally with traceway directions, demonstrating that the tracermaker swim against the current. Preservation of both manus and pes footmarks shows that all four limbs were used in propulsion. Small interdigit spacing suggests the digits were held together while swimming as opposed to spread at acute angles, like extant crocodilians. Single digit reflecatures ("z-traces") have been interpreted as the tracermaker’s attempt to maintain grip on the substrate by double kicking at the limit of limb extension. My analysis suggests this z-trace morphology and its behavioural implications are unique to these Early-Middle Triassic footmarks, suggesting that these early archosauriforms swim differently from those recorded by later Mesozoic traces.

The evolution of the brain has been studied extensively in mammals, but is less well understood in reptiles, such as dinosaurs, where brain evolution is critical for understanding the patterns and mechanisms associated with brain enlargement in manipotarans and Aves. Here we use computed tomographic (CT) scanning and 3D visualization to reconstruct the endocast of the horned dinosaur Centrosaurus for the first time, and assess patterns of relative brain size within a phylogenetic context. We describe the external morphology of the braincase and the anatomy of the virtual brain endocast, cranial nerves, vasculature and endoosseus labyrinths of the inner ear.

To test the use of micromammalian postcrania in species-level identification, an examination of 14 modern species trapped at the Koanaka Hills locality of Ngamiland Province in northwestern Botswana was undertaken. Results from these analyses indicate that elements such as the femur display genus-specific morphological features. Although features tend to overlap among genera, combinations of characteristics provide distinction among the genera examined. Our analysis also proved useful in differentiating between two species of Gerbillus (G. brantsii and G. leucogaster) that are similar in diet and habitat. An examination of the fossil small mammal femora (early to middle Pleistocene in age) collected from the Bone Cave locality of Koanaka South yielded distinctions consistent with the morphology of the modern taxa, indicating that the postcranial elements provide useful data for micromammal identification.

**SPECIES-LEVEL APOMORPHIES IN SOUTHERN AFRICAN MICROFAUNA: DATA FROM THE POSTCRANIA**

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Species assemblages of small mammals are informative environmental indicators due to their ecological specificity, sensitivity to environmental change, and small habitat ranges. While species composition and relative abundance of these assemblages are useful tools for paleoenvironmental reconstruction, lower level taxonomic identification using mandibles, maxillae, and teeth can be ambiguous. The postcranial elements of these fossilized microfaunal assemblages are often overlooked as potential indicators of taxonomic affinity. In order to test the use of micromammalian postcrania in species-level identification, an examination of 14 fossil species trapped at the Koanaka Hills locality of Ngamiland Province in northwestern Botswana was undertaken. Results from these analyses indicate that elements such as the femur display genus-specific morphological features. Although features tend to overlap among genera, combinations of characteristics provide distinction among the genera examined. Our analysis also proved useful in differentiating between two species of Gerbillus (G. brantsii and G. leucogaster) that are similar in diet and habitat. An examination of the fossil small mammal femora (early to middle Pleistocene in age) collected from the Bone Cave locality of Koanaka South yielded distinctions consistent with the morphology of the modern taxa, indicating that the postcranial elements provide useful data for micromammal identification.
QUANTITATIVE INFERENCE ON MICROVERTEBRATE DEATH ASSEMBLAGES BASED ON RIGHT-LEFT DISPARITY OF SKELETAL PRESERVATION
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When there is no preservational bias against right or left skeletal elements that are mirror images, disparate numbers of right and left elements in a fossil assemblage must result from stochastic and at least partially-independent loss of right and left sides through taphonomic processes. Thus, the cumulative loss of skeletal elements can be simulated based on a simple model of stochastic exponential loss with three parameters: the number of individual organisms in the death assemblage (N0), relative time since the formation of the death assemblage (t), and the decay constant (λ), or the rate at which skeletal elements are lost after the formation of the death assemblage. An important general pattern that emerges from this simulation is that, for a given sum of right and left elements, the probability of more disparate preservation of right and left elements (deviation from the expected 1:1 ratio) increases as N0 or λ increases. Thus, assuming that t is constant for all paired elements of the same taxon derived from the same death assemblage, it should be possible to obtain the combinations of the values of N0 and λ that maximize the fit of the model to empirical data. With this approach, the right-left disparity of skeletal preservation was evaluated for Quaternary microvertebrate assemblages from the San Francisco Bay region. The observed ratios of right and left elements are more constrained (i.e., closer to the 1:1 ratio) than expected from a wide range of values of N0 and λ, suggesting some of the assumptions of the model are violated.

VERTEBRATE MICROFOSSIL ANALYSIS IN THE PALEONTOGICAL SITE OF ‘LO HUECO’ (UPPER CRETACEOUS, CUENCA, SPAIN)
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The site of ‘Lo Hueso’ preserves an extraordinary fossil assemblage, mainly composed of vertebrates, but also includes plants and invertebrates. The fossils are preserved in a stratigraphic succession of versicolour marly mudstone levels, partially cut by a sandy channel structure and two sulphated intervals. Most of the fossils are concentrated in only four of these lithosomes: the sandy channel structure (C), the grey marly mudstone levels (G1 and G2), and the lower part of the second red marly mudstone level (R2). The paleontological material (0.5mm-1cm fraction) obtained from screenwashing and sorting of sediments in the G2 level has been preliminarily studied here, because this lithosome can be considered as one of the most representative of vertebrate richness, abundance and diversity at this site. The G2 level contains fossils that are rarely articulated, randomly scattered, and scarcely or not affected by erosion. The most abundant vertebrate microfossils that appear in this level correspond to fishes, mostly different morphologies of gnathostome scales and numerous teeth. The gnathostome scales are derived from the medium and posterior positions of the body and can be attributed to Lepisosteidae indet., as can numerous teeth and postcranial elements including an atlas. Other teeth and elements can be attributed to different fish groups, such as Pycnodontoidea, Amiidae and possibly Albulidae. Several postcranial elements, mainly diaphyses of lissamphibians, have been collected. A mandibular fragment attributed to a crocodyliform (Crocodylia indet.) and a specimen of a lissamphibian, have been attributed to Triassic archosauromorph (Crocodylidae). Many fewer small pits were evident in the HDR images, and this was true for all four taxa. Many fewer scratches were observed for the two grass-leaf taxa, which previously were characterized by high scratch counts (average scratch counts for C. victoriae previous study = 29.46, this study = 11.05). We believe that these discrepancies are due to differences in microwear per se, but rather that the same features look different when using HDR imaging. Small pits, which have been characterized as “bright” and “shiny” at low magnification, are much less evident in HDR images, as are fine scratches. This highlights the need to use a consistent method when comparing counts of microwear features. As we continue to explore the utility of this new method and add to the extant caviomorph dataset, we expect that the discriminating power of small pits may decline, at least for this group of mammals.

FEATHERING AND ESTIMATING WING LOADING FOR LITHORNITHID BIRDS FROM THE EARLY EOCENE GREEN RIVER FORMATION
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All extant palaeognath birds with the exception of tinamous are flightless. As the sister taxon to the clade including all other Aves, optimization of character states for Palaeognathae are essential to estimating those ancestral to all extant birds (crane clade Aves). New dynamic (HDR) imaging methods have been shown to produce outstanding high-resolution images of enamel microwear. Based on these excellent results and the ease of application, we chose to use this method to expand our microwear dataset previously used for extant caviomorph dietary classification. Since this technique is relatively new, we performed a small consistency study to evaluate whether the microwear features analyzed in our previous study would be consistent using HDR techniques. We reexamined four caviomorph taxa in two dietary categories: Hydrochoerus and Cavius (Caviidae; grass-leaf diet) and Dasyprocta and Cuniculus (Dasyproctidae and Cuniculidae, respectively; fruit-leaf diet).

The image capture segment of the study produced exceptional images with clearly defined microwear features. Nevertheless, our new HDR generated results are not entirely consistent with our previous study. The consistency study showed an increase in features associated with “hard object” feeding in the four taxa, including large pits, large puncture pits, and small puncture pits. Our suggestion is that the increased number of these features is due to the high quality of the HDR image. Many fewer small pits were evident in the HDR images, and this was true for all four taxa. Many fewer scratches were observed for the two grass-leaf taxa, which previously were characterized by high scratch counts (average scratch counts for C. victoriae previous study = 29.46, this study = 11.05). We believe that these discrepancies are due to differences in microwear per se, but rather that the same features look different when using HDR imaging. Small pits, which have been characterized as “bright” and “shiny” at low magnification, are much less evident in HDR images, as are fine scratches. This highlights the need to use a consistent method when comparing counts of microwear features. As we continue to explore the utility of this new method and add to the extant caviomorph dataset, we expect that the discriminating power of small pits may decline, at least for this group of mammals.
The Neogene anthracotheres (Mammalia, Artiodactyla) from the Neogene of central Myanmar have been very poorly understood. Here, we report new dental specimens of the anthracotheres discovered from four Neogene localities in central Myanmar. Based on these new specimens, we recognize four species of anthracotheres in the Neogene of central Myanmar: Microbunodon silistrensis and aff. Sivameryx sp. from the middle Miocene (Pega Beds), and Microbunodon miliensis and Merycopotamus dissimilis from the latest Miocene to Plio-Pleistocene (Irrawaddy Sediments). This study provides the first description of the acetabular anatomy of the American alligator. In addition, we also seek to further elucidate the anatomy of archosaur appendicular joints by providing the first description of the acetabular anatomy of the American alligator. This study provides new insights into joint structure and joint movements in the acetabular joint. Continuing identification and testing of these osteological correlates in fossil archosaurs will greatly enhance our understanding on evolution of locomotor capabilities such as bipedality and limb adduction of fossil archosaurs and other reptiles.

Posters Session II (Thursday, November 3)
A SAUROPOD (DINOSAURIA: SAURISCHIA) BRAINCASE FROM THE LOWER CRETACEOUS OF THE EASTERN GOBI DESERT IN MONGOLIA
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WHAT, IF ANYTHING, IS A 'DWARF' PAREIASAUR? NEW INFORMATION ON PUMILIOCPATEAIRE PICEI
TSUJI, Linda, University of Washington, Seattle, WA, USA; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa; SIDOR, Christian, University of Washington, Seattle, WA, USA

Recent advances in the understanding of pareiasaur taxonomy, phylogeny, and diversity, have greatly reduced the number of valid taxa. A paucity of specimens and their oftentimes unfavorable state of preservation has hampered the recognition of evolutionary patterns within the clade. This is particularly true for the smallest, ‘dwarf’ pareiasaurs from the Cistecephalus Assemblage Zone of the Karoo Basin of South Africa. Two taxa in particular, Nanoparia luciihofoi and Pumilopotamia picei, are the smallest and ostensibly among the most derived pareiasaurs, but are known from only one and two specimens, respectively. The dearth of specimens and knowledge about pareiasaur ontogeny makes it difficult to determine if these are, in fact, distinct taxa or are instead juveniles of the more abundant, large-bodied, contemporaneous taxa.

In 2005, a new pareiasaur specimen was collected from the southern slopes of the Skip Mountain in the Beaufort West District, South Africa, a locality assigned to the lowermost Cistecephalus Assemblage Zone. SAM-PK-K10498 consists of an articulated cranial and anterior skeleton with a large number of articulated osteoderms, which are closely associated with flattened dorsal ribs. The specimen was prepared from both dorsal and ventral aspects, and is notable for its small size (skull length approximately 20 cm) and exceptional preservation. SAM-PK-K10498 is assigned to Pumilopotamia picei, as the taxon is currently defined. Despite the fact that it is as large as the other known specimens of Pumilopotamia, the specimen shows signs of immaturity: the epiphyses of the humerus are incompletely ossified, the angular boss is modest, the cranial sculpturing is attenuated, and the neurocentral sutures are incompletely fused. The new material indicates that the smallest pareiasaur taxon may not be such a ‘dwarf’ after all, and emphasizes the need to develop an ontogenetic framework within which other small pareiasaur specimens can be understood.

Posters Session II (Thursday, November 3)
NEBRASKA’S HIGHWAY PALEONTOLOGY PROGRAM: 50 YEARS OF LIFE IN THE PAST LANE
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Whenever the surface is disrupted in Nebraska, whether it is digging the foundation for a home or building a highway, there is a distinct possibility that fossils will be uncovered. Large, heavy earth-moving equipment can irreparably damage fragile bones yet many of these prehistoric remains would remain buried for millennia without construction. Without coordinated mitigation efforts, vast amounts of information critical to the interpretation of climate and life history in North America would be lost.

Nebraska has been a leader in fossil mitigation efforts for more than 50 years. The Nebraska Department of Roads (NDOR) has long been cognizant of its impact on these non-renewable resources having included a section on paleontological discoveries in their 1937 specifications for highway construction. In 1960, Nebraska created the nation’s first full-time program devoted to fossil recovery on road construction projects. This cooperative effort between the University of Nebraska State Museum (UNSM) and NDOR prevents the destruction of unique, irreplaceable scientific resources. Backed by state and federal legislation, the Highway Paleontology Program has collected approximately 200,000 fossil vertebrate specimens, including 20 holotypes, from more than 150 localities in the past five decades.

UNSM works closely with contractors and NDOR personnel in all phases of construction to preserve the state’s rich prehistoric past without stopping or delaying construction. Early notification of pending projects allows for field surveys and test excavations prior to construction. Pre-construction meetings and on-site training inform the contractor and NDOR staff of potentially fossiliferous areas and what to look for during excavation. If fossil remains are discovered, contractors continue working but shift their operations to temporarily avoid paleontologically sensitive areas. After construction is completed, NDOR will provide complete to re-open localities for additional study. This highly successful inter-agency partnership preserves specimens that would be destroyed thereby enhancing our scientific knowledge of the paleoflora and fauna in our state.
The derived placement of *S. djadochaensis* highlights its importance in understanding the suite of character changes taking place at the origin of Eusuchia and “modern” crocodylians. However, the morphology of the remaining 9 species have largely been unexamined and their phylogenetic placement and impact on more derived eusuchian relationships remain uncertain. Many of the named species of *Shamosuchus* show striking differences in size and cranial morphology. Furthermore, many are based on partial remains of skulls suggesting that the true species diversity is overestimated and the assumed monophyly of *Shamosuchus* is perhaps unwarranted. Our firsthand reexamination of the known *Shamosuchus* specimens reveal that only *S. djadochaensis*, *S. gradilifrons* and *S. ancestralis* represent valid species. We included these additional *Shamosuchus* species in a maximum parsimony analysis utilizing an expanded phylogenetic dataset focused on elucidating neosuchian and early eusuchian relationships. *Shamosuchus* species share a number of derived characters including a distinct depression on the dorsal surface of the squamosal together with a corresponding flared posterior process of the squamosal, a prominent crest on the lateral surface of the jugal, and an open craniocaudal canal. These results suggest the presence of a diverse *Shamosuchus* clade present in eastern Asia during the Cretaceous which exhibited a remarkable diversity in cranial shape and morphology.

Poster Session IV (Saturday, November 5)

**A NEW SPECIES OF PACHYRHINOSAUR (CERATOPSIDAE: CENTRASORUAINE) FROM THE LOWER MAASTRICHTIAN OF THE NORTH SLOPE OF ALASKA**

TYKOSKI, Ronald, Museum of Nature and Science, Dallas, Dallas, TX, USA; FIORILLO, Anthony, Museum of Nature and Science, Dallas, Dallas, TX, USA

The Maastrichtian portion of the Prince Creek Formation of Alaska’s North Slope has yielded several remarkably rich dinosaur-bearing localities. One of these sites, the Kikak-Tegoskeek Quarry (69-70Ma) has produced a variety of taxa but is a monodominant bournemouth centrosaurine ceratopsian and remains from at least nine individuals. Fragmentary cranial specimens first collected from the site bear enlarged nasal bosses that justified early assignment of the material to *Pachyrhinosaurus* sp. Collections from the site in 2006 and 2007 included more complete cranial material that has revealed additional data. A recently prepared partial skull shares similarities with both *Pachyrhinosaurus canadensis* and *Pachyrhinosaurus lakustai*, but also has features, such as a rostral comb and a nasal boss that nearly contacts the supraorbital bones, that are present in one but not the other of these species. Pieces of partials from two individuals each bear an ornamental horn in a position not expressed in the two known *Pachyrhinosaurus* species. Indeed, the location and morphology of this parietal horn is currently unique among ceratopsids. This unusual frill apomorphy and the combination of other features in the skull support recognition of the Arctic taxon as a new species. Further, there is a substantial temporal gap between the Kikak-Tegoskeek Quarry specimens and other previously described pachyrhinosaurines. A phylogenetic analysis that includes recently recognized centrosaurine taxa and additional characters that test pachyrhinosaur relationships finds the new species is the sister-taxon of *P. canadensis* to the exclusion of *P. lakustai* and the other centrosaurines.

Technical Session XIX (Saturday, November 5, 1:45 pm)

**A NEW PROTOCETID WHALE FROM THE MIDDLE EOCENE OF MISSISSIPPI**

UIHEN, Mark, George Mason University, Fairfax, VA, USA

A new protocetid whale was recently discovered in eastern Mississippi that represents a new species similar to *Nathichostis jonesi*. The specimen includes three thoracic, three lumbar, one sacral and eleven caudal vertebrae, the right innominate, the proximal right femur, and one pedal (?) phalanx. The specimen was discovered along the southwest bank of the Chickasawhay River, south of Quitman, Mississippi. It was found in a mix of mud and carbonate typical of the Archusa Marl Member of the Cook Mountain Formation, which is early Bartonian (late middle Eocene) in age. The comparable vertebrae in the specimen are very similar in overall morphology to those of *Nathichostis jonesi*, but are about 20% larger in linear dimensions. The size and morphology of the innominate and the proximal femur indicate that the hind limbs of this new animal were relatively as large or larger than those of animals such as *Rodhocetus* and *Maiacetus*. The innominate is similar in size and morphology to that of *Georgiacetus*, but unlike *Georgiacetus*, this specimen displays a large auricular surface on the ilium for attachment to the single sacral vertebra. This specimen greatly enhances our knowledge of the hind limb morphology of North American protocetids given its significant difference from the detached innominate of *Georgiacetus*, and the much reduced innominate of *Eocetus wardii*.
plete skull roof, braincase, cervical centrum, humerus, metacarpal or metatarsal, plastron, pygal, left costal 3, right costal 4, left peripherals 5 through 7, right peripherals 8 and 7, and indeterminate carapace fragments. Remains of Bothremys include the fused dentaries, nuchal scute, left peripheral one, and indeterminate carapace fragments. The new speci-
mens of Taphrosaurus and the fact that the central part of this pleurodiran, including the morphology of its lower jaw, thus far only the second mandible discovered for the entire genus. As for Taphrosaurus congolensis, the lower jaw of T. salcatus presents a broad, flat mandibular triturating surface without deep pits that is narrow posteriorly and has low lingui-
grade ridges, the processus coronoides is low, and the fossa meckeli is widely open ventrally. New insights from this specimen into lower jaw morphology for the genus Taphrosaurus include lack of a splenic, fused rather than sutured dentary symphysis, posterior process of the dentary widely exposed laterally, foramen nervi auricolotemporalis present, narrow coronoid exposure in lateral view, anterior portion of the fossa meckeli enclosed by a long angular-pretarticulate contact, and a long, posteriorly-placed processes retroarticularis. These fossils were discovered in the basal Damian-stage Main Fossiliferous Layer (MFL) of the Hornersstown Formation. The Cretaceous Navesink and Cretaceous-Paleocene Hornerstown glauconitic greensands demonstrate that at this time southern New Jersey comprised a low sedimentation rate and low energy shallow marine setting. Abundant biarticulation is likely responsible for disarticulation and low sedimentation rate is reflected in the partial nature of these and most MFL specimens. Generalised Procrustes superimposition was performed on the raw coordinates and allometry residuals, and analyses of variance (ANOVA) and post-hoc Tukey honestly significant differ-
ences (HSD) tests performed on the PC scores.

For both \( m_{temporalis} \) and \( m_{masseter} \), PCA differentiates between known dietary niches in extant Ursidae. ANOVA indicates that the most important food item in the diet has a highly significant effect on PCs 1 and 2. Post-hoc Tukey HSD tests indicate that \( U. \) *spelaecus* forms a homogeneous subset with folivorous bears on PC 1. Differences in the results between \( m_{temporalis} \) and \( m_{masseter} \) are seen primarily in the position of the extant spectacled bear \( T. \) ornatus, probably due to the influence of its premaxillotestic fossa on the morphology of its masseteric fossa. These results suggest that \( U. \) *spelaecus* was herbivorous, rather than omnivorous. And, the usefulness of separately analysing the function of individual muscles is demonstrated.

Technical Session I (Wednesday, November 2, 10:30 am)

**QUANTIFYING THE POSTURE OF QUADRUPEDAL DINOSAURS: A MORPHOMETRIC APPROACH**

VANBUREN, Collin, Western Illinois University, Macomb, IL, USA; BONNAN, Matthew, Western Illinois University, Macomb, IL, USA

Although the hindlimb of dinosaurs was fully erect, the forelimb posture of quadrupedal dinosaurs has been a subject of heated debate in vertebrate paleontology. It has been sug-
gested that dinosaurs, unlike their archosaur relatives, had an erect forelimb posture, similar to therian mammals. While previous studies explored trends in dinosaur posture, quantifying forelimb posture has remained relatively unexplored. We focused on quantifying the shape of the radius, a long bone that closely correlates with forelimb posture. We tested the hypoth-
thesis that radius shape in dinosaurs should not be significantly different from that of therian mammals if their forelimbs were held erect. Over 380 mammal, sauropod, and dinosaur radii were photographed, and measured to quantify radius morphology. Linear di-
ensions, radial head photographs, and long axis photographs were captured for each radius specimen and traditional and shape analysis software tested these variables for significant differences among the taxa. Our results indicate there is a significant difference in radius shape between dinosaur and mammal radii, but, surprisingly, no significant difference was reported for radius shape between dinosaurs and sauropods with non-erect forelimb posture. We find it significant that ceratopsians, a clade often depicted as rhino-like galloppers, showed a significant difference with therian mammal radii and most resembled non-erect sauropods. Sauropodomorphs, in contrast, had a radius shape significantly different from both therian mammals and non-erect sauropods, suggesting that their forelimb posture, if fully erect, did not resemble that of therian mammals.

Overall, our data suggest that, unlike therian mammals, quadrupedal dinosaurs had less erect forelimbs. We find our results significant given that they suggest previous models of quadrupedal dinosaur locomotion based on therian forelimb posture must be re-evaluated. Ultimately, we suggest that mammal forelimb posture and function are not a good proxy for dinosaur locomotion.

**3D MORPHOMETRIC ANALYSIS OF INTERSPECIFIC VARIATION IN ODONTOCETE PETROSALS**

VARADIAN, Elizabeth, New York College of Osteopathic Medicine, Old Westbury, NY, USA; BEATTY, Brian, New York College of Osteopathic Medicine, Old Westbury, NY, USA; GEISLER, Jonathan, New York College of Osteopathic Medicine, Old Westbury, NY, USA

Odontocete ear regions are diverse in their morphology and because of their density and isolation from the rest of their skulls to minimize acoustic interference, often prehistorically isolated and separated from craniodental remains. Their distinctive morphology has been useful in cetacean systematics, yet the lack of understanding of their variation along with the complexity of their shapes, has made it difficult to qualitatively assess the characters derived from them. To quantitatively explore this question, 14 landmarks were digitized in 3D using a GZ Microscribe for 22 petrosals of 9 modern species: Monodon monoceros, Delphinus delphis, Tursiops truncatus, Pontoporia blainvillei, Iniia geoffrensis, Globicephala melas, Kaguga brevicauda, and Orcinus orca. Though PCA 1 and 2 do not always differentiate species, they clearly identify families Iniidae; Iniidae, Pototoporidae, and Kogadidae; Delphinidae. Discriminant Function Analysis indicated specific landmark variables can discriminate family groups (\( p = 0.05 \)): Del-
phinidae (\( p = 0.000 \)), Monodontidae (\( p = 0.000 \)), Iniidae (\( p = 0.015 \)), Potoroporidae (\( p = 0.002 \)), Kogadidae (\( p = 0.000 \)), Delphinidae (\( p = 0.003 \)), Orcinus orca (\( p = 0.001 \)). Landmark data could not distinguish Globicephalinae (\( p = 0.14 \)). The landmarks involved in the greatest amount of variation in standardized canonical discriminant function coefficients differed between groups. Landmark points 5 ( apex of ventrolateral tuberosity), 6 (posterior process margin), 2 (fenestra ovalis), 4 (ventrolateral tuberosity), 3 ( center of malleolar fossa), 1 (fenestra ro-
tunda), and 7 (posterior process margin bulla facet opposite Ant. process VL angle between growth lines) demonstrated the greatest discriminating ability within groups in decreasing order. With greater sampling of modern taxa, we hope to enhance the ability to differentiate genera. Trials using this information to identify Pliocene odontocete periotics from South Carolina indicate that this may not only be useful in recognizing Neogene odontocetes more quantitatively, but also in identifying trends of periodict evolution that will help tease out characters of these groups that can help us better recognize relationships between problem-
atical fossil odontocetes, particularly early Delphininoa and Platanistoida.
THE STATUS OF MORPHOLOGICAL AND DEVELOPMENTAL EVIDENCE ON DIGIT IDENTITY IN THE HAND OF ANURA

VARGAS, Alexander, Universidad de Chile, Santiago, Chile; SOTO-ACUÑA, Sergio, Universidad de Chile; CARRION, Brian; CHAVEZ, Camila, Universidad de Chile, Santiago, Chile; OSSA-FUENTES, Luis, Universidad de Chile, Santiago, Chile

The digits of the tetradactyl hand of living Anura are often labeled I,II,III and IV. A digit-like structure anterior to the digits is named the "prepollex", assuming the most anterior digit is comparable to the thumb. However, the developmental pattern of cartilage formation shows the digits develop in positions that become II,III,IV and V in amniotes. Hometrical frameshifts of digit identity are documented in limb development and have been proposed for a similar mismatch in the bird wing. To assess this possibility, we examined morphological evidence on amphibian digit identity. Three main groups of crown tetrapods are generally recognized: The Reptilomorpha (leading to amniotes), the Lepospondyl (of debated affinities), and the Temnospondyl, widely considered the ancestors of Anura. The earliest known hands of temnospondyls already exhibit a tetradactyl hand with a Phalangeal Formula (PF) of 2-2-3-3 as in modern Anura. Lepospondyls often had four or three digits with PF 2-3-4-3 or 2-3-3, but *Uncombridus* presents a pentadactyl hand with PF 2-3-7(2)-3-2. The PF of lepospondyls closely resembles that of early Reptilomorpha, who had a pentadactyl hand with PF 2-3-4-5-4. The closest known outgroup to crown tetrapods in which a hand is known is *Tulerpeton*, a hexadactyl stem tetrapod with PF 2-3-4-5-4-3. *Tulerpeton* supports the notion that a reptiliform-like PF 2-3-4-5-4 was present in the first pentadactyl crown tetrapods, such that the hand of temnospondyls is derived. The available morphological data does not document how the PF 2-2-3-3 of Temnospondyls evolved from PF 2-3-4-5-4. The two more anterior digits are biphalangeal, so this trait is not linked to digit I identity. We conclude that morphological evidence is inconsistent equivocal in support of either I.II.III or II.II.IV-V identification. It is therefore premature to consider a possible homeotic frameshift. Unlike the case of the bird wing, expression of HoxD11 is present in the most anterior interdigit of the anuran hand, supporting a II, III,IV, V identification. More fossil hands from early crown tetrapods are necessary to solve the issue.

DENTAL MICROWEAR AND THE EVOLUTION OF CHEWING IN CERATOPSISAN DINOSAURS

VARRIALE, Frank, Johns Hopkins University, Baltimore, MD, USA

Ceratopsians (horned dinosaurs) are remarkable for their derived masticatory system. This clade diversified during the angiosperm radiation, but there is little evidence linking their chewing adaptations to the evolution of flowering plants. Although the morphology and lever-arm mechanics of the masticatory apparatus have been well-documented, an understanding of the mandibular movements involved in ceratopsian chewing has remained elusive.

In order to address this issue, dental microwear striations were examined in 16 ceratopsian and 2 pachycephalosaur (sister to Ceratopsia) genera. Lack of preservation in some specimens prevented use of microwear in reconstructing mastication; however, a correlation between microwear pattern and facet architecture allowed additional reconstruction of chewing styles in 3 genera for which microwear was not preserved.

Microwear reveals an evolutionary sequence of four chewing styles within Ceratopsia. Contrary previous hypotheses, orthal mastication was not present in Neoceratopsia but limited to basal ceratopsian *Einiosaurus* and the sister clade Pachycephalosauria. Occlusal wear facets with rectilinear striations inclined ~60° to the denticle apical axis support reconstruction of clinolineal chewing as a synapomorphy of the recent common ancestor of Chaoynosaurs and all subsequent ceratopsians. Palinal mastication in neoceratopsians exclusive of Ceratopsia is indicated by curvilinear striations that begin at the distal and mesial edges of dentary and maxillary teeth respectively and curve through an arc of ~60° to end in a mesial orientation. Furthermore, all teeth are with a labial (horizontal) shelf are palinal chewers. Orthopalinal chewing, diagnostic of Ceratopsia, is inferred from vertical, apicobasally oriented facets with rectilinear scratches oriented at 15-45° to the apical axis. Among herbivorous dinosaurs, palinal chewing with a mandibular orbit is unique to ceratop- sians. Ceratopsians with palinal chewing replaced those with clinoline chewing ~110 Ma. Palinal chewing first appears ~125mya in Palaeotherioidea, and is therefore premature to consider a possible homeotic frameshift. Unlike the case of the bird wing, expression of HoxD11 is present in the most anterior interdigit of the anuran hand, supporting a II, III,IV, V identification. More fossil hands from early crown tetrapods are necessary to solve the issue.

BASELINE LEVELS OF ALPHA AND BETA DIVERSITY IN VERTEBRATE MICROFOSSIL ASSEMBLAGES

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Understanding how patterns of species diversity change over geologic time scales is one of the ultimate questions of palaeoecology. However, not all patterns or changes may be significant, and testing these without any context may give misleading results. Modern ecosystems can show a large magnitude of variation in species diversity and abundance simply due to random, normal events, and this variation would be expected to also be present in fossil assemblages. We measured rates of ecological change using a data set of fossil microfossil assemblages. These sites are from a relatively small area (Dinosaur Provincial Park, Alberta, Canada) from a stratigraphically well resolved and temporarily restricted portion of the Dinosaur Park Formation. Within this spatially restricted region, species should not have experienced any geographic barriers to dispersal, and so any ecological difference in species composition between contemporaneous sites should be due to normal ecological variability. Overall, there was a reasonable amount of turnover between sites, even those that were very close stratigraphically and spatially. However, within site species diversity through the section did not vary greatly. There was a detectable and significant pattern of turnover between the lower and upper sites, as had previously been found, possibly due to a rise in water levels of the interior sea during the interval. Although alpha diversity appears to be relatively stable for a single region, species composition can vary greatly between sites; however, significant ecological patterns in the sites can still be found. When looking at patterns of beta diversity between fossil sites, it is important to recognize that observed turnover is the interaction we observe between actual effects and random chance, and a high level of turnover may not actually be due to any ecological pattern.
Pyrite framboids are often found associated with marine vertebrate fossil material. Framboïds are frequently interpreted as products of sulfide generated by sulfate-reducing bacteria present on the degrading bone. Alternative interpretations exist, however, that attribute framboid pyrite to changes in post-burial pore water geochemistry late in a fossil’s diagenetic history. Here, we provide further evidence that pyrite framboids are microbially derived based on their appearance on submerged bone surfaces during laboratory experiments. Three-dimensionally de-fleshed domestic goat rib sections were placed in marine water and sediments from the Pacific margin of Costa Rica (1000-1025m depth) and were incubated at 10°C for 6 months. Two weeks after emplacement, bone surfaces were densely colonized by putative mats forming sulfate-reducers (dark in color) and sulfide-oxidizers (light in color). The sediment around the bone became concentrically stained with proximal dark and distal red colored zones. Oxygen and pH profiles of sediment near bone show steep geochemical gradients at the bacterial mat when compared with surrounding conditions, indicating an anoxic and acidic microenvironment. These conditions are consistent with microbial activity observed at natural whale falls. SEM analyses of bones removed after 3 weeks and 6 months of microbial exposure show a notable change in bone surface texture and an increase in framboid density. Framboids on bones removed after 3 weeks range in size from 4 to 10 microns. Framboid density is higher on bone surfaces facing the sediment compared to the water-exposed sides (50cm2 vs. 10cm2, respectively). Framboids found on bones exposed for 6 months are similar in size and are notably denser.

Our results suggest that framboidal pyrite is microbially mediated and begins to form on bone surfaces very early (~3 weeks or less) in the diagenetic process. Because framboid densities increase with microbe exposure time, they have potential to act as a sea-floor exposure time proxy, aid in time-averaging interpretations, and act as indicators of a sulfophilic community.

**USE OF LINEAR MORPHOMETRY TO DEFINE DIAGNOSTIC MORPHOLOGICAL VARIATION IN THE APPENDICULAR SKELETON OF ANHANGUERIidae AND TAPEJARiidae PTEROSAURs (PTEROSAURIA, PTERODACTyLOIDEA)**

VILA NOVA, Bruno, Universidade de Sao Paulo, Ribeirao Preto, Brazil; SAYAO, Juliana, Universidade Federal de Pernambuco, Vitoria de Santo Antao, Brazil

The Pterosauria is the best known tetrapod group recorded in the Lower Cretaceous Arapixe Basin (northeast of Brazil), and belong to two major groups: Anhangueridae and Tapejaridae. These can be promptly identified based on skull synapomorphies, but few specimens are composed of cranial and post cranial remains. Incomplete specimens, including only post cranial parts, are more common, with limb bones sometimes crushed during burial, but still useful for identification. In this context, linear morphometric data obtained from the literature and measurements of specimens were analyzed using a Principal Components Analysis (PCA) to identify exclusive features of both the Anhangueriidae and Tapejaridae. Six Anhangueridae and seven Tapejaridae were measured: Anhanguera piscator, Anhanguea santanae, “Anhangua” sp.; Arantesaurus castilhoi, two Anhangueriidae sp. indet.; Sinopterus dorgi, and six Tapejaridae sp. indet. A variation of at least 10% in each ratio was employed to separate both groups and the relationships between the humerus (hu), wing metacarpal (mcIV), first phalanx of the wing digit (ph1d4), femur (fem), and tibia (tib) were considered as sufficient to diagnose partial remains of Aratipe pterosaurs. The PCA shows that each clade has different, non-overlapping scores for the studied ratios, which allow for precise inferences. The data show that anhanguerids have a mcIV/hu ratio of 1.00, and ph1d4/hu ratio of 0.6. In tapejarids, the wing metacarpal is larger (mcIV/hu ratio ~ 1.5), and there is a reduction in the length of the phalanges towards the wing end (ph1d4/hu ratio ~ 0.6). Specific bone ratios for the identification of anhanguerids and tapejarids were identified, indicating a faster way to diagnose fragmentary bones.

**GIANT FOSSIL SOFT-SHELLED TURTLES OF NORTH AMERICA**

VITEK, Natasha, Beverly University, Minnesota, MN, USA

Axestemys byssina, a large, potentially paedomorphic soft-shelled turtle (Trionychidae), and a number of other giant trionychids have been described from the Campanian to Eocene of North America, but no rigorous analysis has been undertaken to investigate their relationships. Because these trionychids are so unusual and occupy such a broad temporal range (70-46 myr), their study provides new insights into patterns of trionychid evolution. This project set out to use all material previously assigned to “Axestemys” as well as previously undescribed material to develop a concept of Axestemys that is meaningful in both a systematic and taxonomic context. Axestemys, after reanalysis, contains 5 species, two of which remain unnamed. The taxon name ‘Axestemys’ is best defined phylogenetically as a stem-based clade rather than a character-based clade, because many characters are not consistently present throughout the clade. All members of Axestemys reach a gigantic size that is today found only in a few tropical trionychid species that independently evolved gigantism. The presence of Axestemys in North America indicates both a warmer climate and a higher trionychid diversity and disparity comparable to those found in tropical climates today. For example, the most diverse region on earth today contains four species of trionychids with bony carapaces ranging from 22 to 74 cm long. The Eocene Bridger Formation, in comparison, contains at least four trionychid species 21 to 97 cm long, in addition to 19 other named species, which still require reanalysis. Based on this work, it is hypothesized that further study of North American trionychids, such as those in the Bridger Formation, will reveal a diversity and disparity higher than any place on Earth today.
discriminate between different magnitudes of feather bending stiffness within extant birds. Primary feather length explains 68% of variance, reflecting its critical role in flight.

The feather rachises of Archaeopteryx and Confuciusornis are much narrower than extant birds and primary feather length of Archaeopteryx is extremely short. Adding fossil measurement data to DFA shows that Archaeopteryx, Confuciusornis and non-avian theropods with feathered arms do not overlap with extant birds. This strongly suggests that the bending stiffness of their primary feathers was different to extant birds and provides further evidence for distinctive flight styles and likely limited flight ability in Archaeopteryx and Confuciusornis.
A NEW PANTOLAMBiid PANTODONT (MAMMALIA) FROM THE PALEOCENE OF SOUTH CHINA: AN IMMIGRANT TO THE ‘EAST OF EDEN’ FROM NORTH AMERICA

WANG, Yuanqing, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; TONG, Yong-Sheng, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; YE, Jie, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LI, Qian, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Asian Paleocene mammalian faunas have been considered to be endemic for a long time. Several waves of intercontinental dispersal between North America and Asia during this period mainly involved the migration of Asian forms into North America, especially in the early stage. However, a pantolambid pantodont, represented by a pair of lower jaws from the Paleocene of southern China provides evidence for an example of migration in the opposite direction. The specimen came from the Zhuguiqen Mt. (correlative to Ti1) of the Nongshang Fm. in the Nanxiong Basin, Guangdong. It is clearly distinguishable from all of the known Asian pantodonts, but shares the following features with the North American pantolambids: lower canine moderately enlarged, subcircular in cross section; talons of p2–4 very small and not basined; molar trigonids distinctly higher than talonids; talonid of m3 elongate anteroposteriorly, with a distinct hypoconulid forming a sharp angle at the posterior margin. Based on external morphology, the specimen was ascribed to metatarsal IV of either an ornithomimosaur or a tyrannosaurid and bears a flat extensor surface, posteriorly extended lateral condyle, triangular lateral collateral fossa, distinct median angle near the metaphysis, and a larger lateral condyle relative to the medial condyle. Histological analysis showed that the bone is composed of fibro-lamellar matrix with laminar, plexiform and reticulibranch patterns, as observed in various long bones of lower latitude ornithomimosauridae. In contrast, the long bones of tyrannosaurids generally exhibit the lamellar pattern. Taken together, morphological and histological comparisons suggest that the Asian specimen is from an ornithomimosaur. Despite this taxonomic designation, the structure of growth lines was shown to be variable among taxa. The growth lines in the Alaskan specimens are primarily composed of annuli, which imply seasonal retardation of growth, while lines of arrested growth (LAGs) were observed, for instance, in metatarsals of Gallimimus and Struthiomimus. Interestingly, LAGs were reported previously in a southern high latitude ornithomimosaurs and these were interpreted as adaptations for polar conditions. The results here suggest somatic growth in ornithomimosaurids varies greatly and that their relevance to environmental adaptation needs a more comprehensive examination.

POSTER SESSION VII (Thursday, November 3, 2:45 pm)

BONE HISTOLOGY OF AN ALASKAN ORNITHOMIMOSAUR: IMPLICATIONS FOR POLAR DINOSAURIAN PHYSIOLOGY

WATANABE, Junya, Department of Geology and Mineralogy, Kyoto University, Kyoto, Japan

Assessing ontogenetic age of fossil specimens is an essential step in paleontological studies including taxonomy, faunal studies and evolution. Studies in bird fossils, such as evolution of flightlessness as heterochrony, would be improved by a reliable and practical ageing method. “Textural ageing” has been proposed as a practical method, in which surface texture of a long bone is examined to age the specimen. However, only several studies were taken to describe ontogenic changes of surface texture of long bones in birds, so fundamental data are lacking for establishment of textural ageing as a reliable method. The fact that little is reported on ontogenetic change in the morphology of skeletal materials in birds also hampers establishment of ageing methods. So here ontogenetic changes of morphology and surface texture are described in an ontogenetic series comprised of about 20 individuals of the Gray Heron Ardea cinerea.

Ardea cinerea is a common heron in the Palearctic Area, whose ecology has been well documented. Skeletal materials are dissected out from collected carcasses, treated with dilute hydrochloric acid to remove soft tissues and dried. Three ontogenetic stages are recognized: chick, juvenile, and adult. Chicks are birds before leaving nests, collected at a breeding colony of A. cinerea in Kyoto, Japan, and arranged as increasing body mass. Juveniles are birds that are under 1-year old and after leaving nests, which can be separated from adults with its plumage, and arranged with the date of death. Adults are here defined as birds 1-year old and older and not arranged.

In general, chick bones are characterized by cartilaginous epiphysis, faint osteological landmarks, and longitudinal grooves and pits on surface; juvenile bones are characterized by ossified though porous epiphysis, osteological landmarks with obscure contours, and smaller and shallower pits on surface; and adult bones are characterized by ossified epiphysis with little pores, obvious osteological landmarks, and smooth surface. These diagnoses may be useful as a simple ageing method.

Further studies, including comparison among various taxa, are needed for establishment of a more reliable ageing method.

E&D POSTER SESSION

DEVELOPMENT AND BENEFITS OF STUDENT ORGANIZATION LED OUTREACH PROGRAMS: TWO CASE STUDIES FROM THE UNIVERSITY OF NORTH DAKOTA AND SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

WEILER, Matthew, University of North Dakota, Grand Forks, ND, USA; SCHUMAKER, Karew, University of North Dakota, Grand Forks, ND, USA

The benefits of science based outreach activities for young audiences have long been known. In student organization led outreach activities, valuable experience is gained both by the participants and the “experts” on topics that they have little training in. Another way to increase student participation in paleontology is through large scale community based outreach dependent on the schools, such as children’s activities fairs, events for National Earth Science Week, community open houses, and assisting Boy Scouts. Volunteers, both undergraduate and graduate students, gain beneficial experience in public speaking and communicating effectively to a wide range of audiences. Cooperation between undergraduate and graduate students of Vertebrate Paleontology
promotes mentoring and leadership. Development and critical evaluation of new activities is useful for volunteers with career goals related to teaching. Operation of an outreach program does not come without some cost, the most tangible of these is funding for supplies. Funding for supplies can be obtained through student organization funding committees and the host department. A less easily determined cost is the number of hours that are needed to keep the programs operational. Recognition for student volunteers by the department, university, or board of higher education is a way for students to display their talents. These merits can be included on resumes and job or graduate school applications. If programs are operated successfully they can have wide ranging benefits for students, teachers, and volunteers.

Symposium 1 (Wednesday, November 2, 12:00 pm)
UNDERSTANDING THE IMPLICATIONS OF LATE-STAGE LIMB AND GIRDLE DEVELOPMENT ON MAMMALIAN LIMB/GIRDLE EVOLUTION—ADDITION OF A FEW MONOTREMES REALLY HELPS
WEISBECKER, Vera, University of Queensland, Brisbane, Australia
Late stages of limb development — e.g. the formation of cartilage (chondrification) or bone (ossification) — effectively summarize a complex cascade of preceding developmental events, and are also sufficiently close to the completion of skeletal development to provide insights into the interaction between developmental change and the evolution of adult limb diversity, which is notoriously difficult to trace in the fossil record. Here, I showcase the usefulness of investigating late-stage limb development by presenting ossification sequences of monotreme limbs. Ossification sequences were determined through X-rays and Computed Tomography of 9 echidnas and 4 platypus of different ages, representing the first data on monotreme limb development ever acquired. Monotremes display a striking reversal of the generally highly conserved proximo-distal direction of tetrapod limb development, as humerus and femur ossify after radius/ulna and tibia/fibula. This pattern resembles only the similarly adapted European moles among all tetrapods, providing intriguing clues on the relationship between adaptation and limb development in mammals. The fact that humeri and femora both ossify late in monotremes and moles suggests a strong influence of serial homology on the evolution of mammalian limb development. Although monotremes are the only mammals that retain cartilages in the shoulder girdle, cartilaginous ossification onset is later than in other amniotes. This suggests that the developmental basis for to coracoid loss already existed in the ancestor of extant mammals. Monotreme limb development resembles that of placental. It does not follow the marsupial pattern of strong forelimb vs. weak hind limb development, which has been suggested to relate to the low forelimb diversity of marsupials compared to placentals. This is contrary to the common notion that monotremes and marsupials represent the developmental mode of late synapsids. Rather, the marsupial developmental mode and coincident diversity constraints appear to represent a derived pattern tied to their unusual reproduction, which did not characterize the evolution of limb diversity in derived synapsids.

Poster Session III (Friday, November 4)
NEW APPROACHES IN UNDERSTANDING THE SYSTEMATICS OF LEPTAUCHENINAE OREODONTS (ARDHADACTYLA: MERYCIDEONODONTIDAE) AND IMPLICATIONS OF A NEW STRATIGRAPHIC OCCURRENCE OF SESSIA IN THE HIGH PLAINS
WELSH, Ed, South Dakota School of Mines and Technology, Rapid City, SD, USA
Oreodonts (Family: Merycoidodontidae) have undergone several degrees of taxonomic turbulence through over 100 years of study. Leptauchenine oreodonts originally included one genus and three species. Recent revision has reduced this to seven genera and 34 species. In response, contemporary researchers have reorganized taxa into two genera and four species, similar to the taxonomic diversity expressed in the original description. Much confusion has stemmed from these analyses including the use of characters resulting from post-mortem deformation in descriptions for expansive taxonomy as well as vague descriptions for condensed taxonomy.

A new approach in understanding Leptauchenine systematics incorporates the use of the Cephalic Index (CI). CI is useful in modern anthropological studies to observe skull morphology delineating ontogenetic age, sex, and race in a population. Specimens of Leptauchenia and Sesia from the University of Nebraska State Museum (UNSM), South Dakota School of Mines and Technology Museum of Geology (SDSM), and Badlands National Park (BADL) were subjected to CI analysis coupled with morphologic comparisons of skulls. One outlier in this study included Limenetus platycopis, which has been referred to as the predecessor to the subfamily by numerous authors. CI displays trends of dolichocephaly (long face) to brachycephaly (short face) in respective order of Limenetus, Sesia, and Leptauchenia. Specimens of juvenile to adult Leptauchenia decora from the BADD collection also display a trend of brachycephaly through ontogeny. This approach, along with morphological characters, provides a useful method of identifying taxonomically confusing specimens.

These methods were applied in validating the identification of SDSM 3210, Leptauchenia nitida (=Sesia nitida), from the Whitney Member of the Brule Formation in South Dakota. This study, included with the new specimen of Sesia from the Brule Formation, has provided a new stratigraphic range extension for the genus Sesia and new insights on biostatigraphy, biogeography, and morphologic development within the subfamily Leptaucheninæ.

Technical Session I (Wednesday, November 2, 8:30 am)
ARCHOSAUROMORPH BONE HISTOLOGY REVEALS EARLY EVOLUTION OF ELEVATED GROWTH AND METABOLIC RATES
WERNING, Sarah, University of California, Berkeley, CA, USA; IRMSI, Randall, University of Utah and Utah Museum of Natural History, Salt Lake City, UT, USA; SMITH, Nathan, The Field Museum, Chicago, IL, USA; TURNER, Alan, Stony Brook University, Stony Brook, NY, USA; PADIAN, Kevin, University of California Museum of Paleontology and University of California, Berkeley, CA, USA
Bone histology has established that birds, dinosaurs, and pterosaurs grew at much higher rates and had much higher metabolic rates compared to extinct crocodilians and other reptiles, but it remains uncertain when these features evolved, temporally and phylogenetically. The study of key fossil taxa allows us to track changes in growth rate and its underlying metabolism through deep time and in taxa whose character states are not represented among living animals. We expanded the histological database of archosaurs and their ancestors to include archosauromorph, pseudosuchian, and dinosaurian archosaur taxa. Our study differs from previous works in its approach, phylogenetic breadth, and level of taxonomic sampling, but also in that we used apomorphy-based identifications for all specimens and sampled the same location on homologous elements from individuals of comparable ontogenetic stage. This allowed more rigorous control over factors affecting interpretations of histology and growth dynamics (e.g., differences in ontogeny or biomechanics). We then mapped characters relevant to growth and metabolism (e.g., osteocyte density, collagen organization, osteonal development, and vascularity) on a recent phylogeny of archosauromorph reptiles to assess where particular adaptations of growth dynamics first evolved, focusing on the lineages leading to Archosauromorpha, Crocodylomorpha, Dinosauria, and Theropoda. Many histological features associated with high growth and metabolic rates in living birds evolved much earlier than the common ancestor of birds and pterosaurs, and several aspects of the accelerated growth syndrome did not evolve simultaneously. Most of these character changes accumulated in a short segment in the archosaur tree before the end of the Early Triassic. Therefore, many physiological features related to high growth and metabolic rates of living birds evolved not in dinosaurs or the common ancestor of Ornithodira, but before the most recent common ancestor of crocodiles and dinosaurs.

First Late Triassic Vertebrate Localities in the Owl Rock Member, Upper Chinle Formation, Petrified Forest National Park, AZ
WHATLEY, Robin, Columbia College Chicago, Chicago, IL, USA; BEHRENSMEYER, Anna, Smithsonian Institute, Washington, DC, USA; AMARAL, William, Emeritus, Harvard University, Cambridge, MA, USA; PARKER, William, Petrified Forest National Park, Petrified Forest, AZ, USA; DOMEISCHEL, Jenna, Columbia College Chicago, Chicago, IL, USA
Systematic surveys in the Upper Chinle Formation in 2009-10 resulted in the discovery of over 50 new vertebrate localities, including the first fossils from the Owl Rock Member in the Petrified Forest National Park (PEFO) and additional sites in the upper part of the Petrified Forest Member. Fossils were recovered in the PEFO Wilderness Area (with the aid of pack horses and Navajo wranglers) from three main levels: the upper Petrified Forest Member; a series of intersecting channel fills and paleosols in the lower Owl Rock Member informally named the Pastel Bed Complex; and a conglomeratic mudclast unit above a prominent calcite near the top of the Owl Rock Member. As in older deposits in the PEFO, in situ preserved skeletal material and in the Upper Petrified Forest Member and in overlying channel deposits at the base of the Owl Rock Member. Fossiliferous channel fills and paleosols of the Pastel Bed Complex near the base of the Owl Rock contain juvenile phyosaur teeth and actinopterygian teeth and scales. We also recovered large metopsaur cranial elements, associated small metopsosaurid material, cf. Apachesthesaurus, aetosaur cervical armor and osteoderms, and a partial archosauriform skeleton with upper and lower heterodont jaw elements, limbs and vertebrae. The latter find resulted from controlled lateral surveys (“Bone Walks”) to locate fossil-producing sites along specific stratigraphic levels. PEFO localities higher in the Owl Rock Member typically yield microvertebrates, or larger isolated fragmentary bones in float or in situ. Fossil wood and root casts are abundant at the base but rare in upper portions of the Owl Rock. Gastropods and the unionid Antediplodon are most abundant low in the section. The hybodontid shark Reticulodus tyritis, a common component of the Ward Terrace Owl Rock assemblage, is rare or absent. The fauna and taxonomy of the Owl Rock Member changed through time as the depositional setting of the lower strata shifted from large-scale fluvial channel and floodplain environments to a low gradient alluvial plain with seasonal ponds, small-scale channels, and carbonate-rich soils near the top of the member.

Symposium 4 (Friday, November 4, 9:15 am)
NON-BIOTIC CONTROLS OF PERMO-TRIASSIC TETRAPOD DIVERSITY: IMPLICATIONS FOR UNDERSTANDING THE END-PERMIAN EXTINCTION ON LAND
WHITESIDE, Jessica, Brown University, Providence, RI, USA; IRMSI, Randall, Utah Museum of Natural History, Salt Lake City, UT, USA
The end-Permian mass extinction is arguably the largest extinction event in the Phanerozoic, yet its effects on land remain poorly understood. Though many studies of the first and last appearances of taxa demonstrate that non-marine vertebrates suffered an extinction, few
studies have investigated paleoecological metrics that would provide insight into diversity dynamics during and after this extinction. The interpretation of these diversity patterns is complex because a number of non-biotic factors bias these data.

To elucidate the effects of the extinction on non-marine vertebrates, we analyzed raw and sample-standardized richness, evenness, and relative abundance for a specimen-level dataset of Late Permian-Middle Triassic southern African tetrapods identified to genus. These data demonstrate a major drop in richness and evenness across Permio-Triassic boundary, in addition to permanent changes in relative abundance of several clades; full recovery does not occur until the Middle Triassic. Rarefaction of the data does not appreciably change richness patterns. We also investigated the effects of outcrop area sampled for each temporal bin; there is a moderate but significant correlation with raw and rarefied richness values, and outcrop area has an extremely strong correlation with the number of specimens per temporal bin. The temporal length of each bin only has a weak relationship to richness values. The effect of outdated or erroneous taxonomy for specimens is difficult to quantify. Although it does affect our diversity estimates, taxonomic issues are down-weighted by rarefaction, and this error appears to be spread relatively randomly across the dataset. Non-biotic controls like taxonomy and geologic bias (i.e., available outcrop) do influence Permio-Triassic tetrapod diversity estimates; however, the main conclusion that non-marine vertebrates were severely affected by the end-Permian mass extinction, and that these effects lasted for millions of years, is still supported.

Technical Session IX (Friday, November 4, 11:30 pm)

FOSSIL SNAKES AND CLIMATE CHANGE: CORRELATING THE NEOCENE COLUBRID SNAKE RADIATION TO GLOBAL CLIMATIC CHANGES

WILLIAMS, Michael, Natural History Museum of Los Angeles County, Los Angeles, CA, USA

The North American colubrid radiation represents one of the most dramatic examples of large-scale, long-duration faunal turnovers. It occurred over a period of approximately 17 million years and resulted in the almost complete obliteration of the North American boids (boid snakes, or the asp species) and the diversification of modern colubrids (approximately 102 species). To determine the extent to which climate played a role in the radiation, colubrid and boid snake abundances were plotted for the past 30 million years, with numbers of colubrids expressed as a percentage of the total colubrid and boid fauna. In addition, a composite stratigraphic section for North American snakes was constructed using chronological data for individual lineages. These data revealed a number of similarities between the spread of colubrid snakes and global climatic alterations as evidenced by the δ13C record. Two significant increases in colubrid percentages correspond to major global climatic warming periods, while a significant decrease equates to a decline in global temperatures. The first increase in colubrid abundance occurred during the Late Oligocene warming 27 million years ago, and the second major increase took place during the warming period leading up to the Middle Miocene Climatic Optimum. During this time, there were more species of snakes in North America than any other time within the Miocene. Following the Miocene Climatic Optimum, percentages of colubrid snakes decreased as climate began to deteriorate, and four boid and three colubrid taxa went extinct. In the late Hemphillian, four snake taxa went extinct and five taxa originated. This occurred at the point where global climate was on its final decrease from relatively warm conditions during the Late Miocene and Early Pliocene to the climatic regime with permanent polar ice caps seen presently.

Poster Session III (Friday, November 4)

A LONG-TERM TERRESTRIAL RECORD OF EARLY PALEOCENE CLIMATE AND ECOSYSTEM CHANGE IN THE SAN JUAN BASIN, NEW MEXICO

WILLIAMSON, Thomas, New Mexico Museum of Natural History & Science, Albuquerque, NM, USA; PEPE, Daniel, Baylor University, Waco, TX, USA; SECORD, Ross, University of Nebraska, Lincoln, NE, USA; BRUSATTE, Stephen, American Museum of Natural History, New York, NY, USA; WEIL, Anne, Oklahoma State University, Tulsa, OK, USA

The Nacimiento Formation in the San Juan Basin contains one of the most complete, diverse, and longest record of early Paleocene mammal evolution known anywhere in the world, spanning nearly four million years from 65.5-62.0 Ma. It documents the early Paleocene radiation of eutherian mammals following the end-Cretaceous mass extinction, a period of critical importance in the evolution of mammals. We are developing a regional climate record for the early Paleocene using fossil leaves and stable isotopes from mammal teeth collected from the Nacimiento Formation that will be integrated with a detailed record of mammal succession.

We find that the Nacimiento Formation is an active in-situ dig site. The Mammoth Site Site of Hot Springs, South Dakota represents a highly fossiliferous Late Quaternary deposit formed from the collapse of bedrock forming sinkhole approximately 26,000 years ago. The sinkhole was a thermal pond fed by artesian spring water which was slowly in-filled over the course of about 350-700 years. Over 80 different Pleistocene taxa are currently known here, and behavioral shifts from the Pleistocene provide a minimum number of 59 individuals. Since 1976, the Mammoth Site has been maintained as an active in-situ dig site and functions as an immersive exhibit for visitors. Curation and preparation are necessary tasks for this collection in order to maintain its scientific and public value. Currently over 5,000 specimens have been discovered, with over 1,500 remaining in-situ.

Currently, the exposed specimens are the responsibility of Mammoth Site curatorial staff. Specific threats to the collection include: fluctuating environmental conditions (such as air temperature, relative humidity and light), consolidant degradation, accidental anthropogenic modification and natural disasters. Bonebed procedures at the Mammoth Site have been constantly modified in light of new advances in fossil conservation strategies to address these threats. Temperature, relative humidity and light have been controlled through the use of mass air humidifiers, inhibiting agents of deterioration. Consolidants have been changed following industry standards, going from the initial consolidant, Glyptal, to the current standards, Butvar and Acrylic. Solvents for removing thick or peeling consolidants are addressed, specifically for the use of ethanol on the Glyptal consolidant. Additionally the tools used for excavation and repair have been expanded from simple hand tools to include plastic and pneumatic instruments. Cataloguing and cartography are addressed through the use of a robotic total station and ArcGIS.
PACIFIC DIVORCE AND BIOGEOGRAPHIC HISTORY OF THE TITANOSAUR SAUROPOD ALAMOSAURUS SANJUANENSIS FROM THE LATEST CRETACEOUS OF NORTH AMERICA

Reposition fossil floral records made using leaf margin analysis suggest a cooling trend within C28n 2 that may correspond to the Puercan—Torroneján boundary event. Stable isotope data from the tooth enamel of two closely related periptichids (archaic ungulate mammals), Car- sioticus cayxius (Puercan) and P. carinates (Torroneján), show an increase in δ18O values and a corresponding increase in δ13C values prior to the To2-To3 boundary. These preliminary data suggest a transient interval of warming, with the cooling phase of the interval corresponding to a high rate of extinction at the To2-To3 boundary. These results suggest that early Paleocene fluctuations in climate may have had significant impacts on mammalian evolution in western North America during the early phase of the Paleocene mammal radiation. Future work to refine the early Paleocene climate record and mammalian succession in the San Juan Basin will include isotopic analysis of foraminiferal assemblages, bulk organic carbon, and additional mammal teeth, and further development of the paleobotanical and micromammal records through additional collecting.

Technical Session VII (Thursday, November 3, 2:15 pm)

MAMMALIAN DENTAL COMPLEXITY ACROSS THE CRETACEOUS—PALEOGENE BOUNDARY WITH IMPLICATIONS FOR ECOLOGICAL RECOVERY AND EXPANSION

WILSON, Gregory, University of Washington, Seattle, WA, USA

Following the Cretaceous—Paleogene (K–Pg) mass extinction and associated collapse of dinosaur-dominated terrestrial ecosystems, an early Paleocene biotic recovery ensued that transitioned into an unrivaled evolutionary radiation of mammals. Studies of this critical interval, particularly those with a quantitative ecomorphological perspective, are fundamental to understanding evolutionary and ecological dynamics of recoveries and radiations, but are currently lacking. Most studies of post-K–Pg mammals have focused on their taxonomic diversity. We quantified mammalian dental complexity across the K–Pg boundary by measuring the orientation patch count (OPC) of mammalian tooth rows (premolars and molars of multituberculates, molars of thearians) from Lanzan and early Paleocene faunas of northeastern Montana. We used OPC as a proxy for diet based on its demonstrated relationship to diet in a variety of modern taxa (carnivores, rodents, bats).

Lancian multituberculates show a wide range of OPC values, corresponding to values among modern insectivores, omnivores, and herbivores. Lancian theridiatheres and eutherians have a narrower range of OPC values, which are on average lower than those of multituberculates and correspond to modern insectivores and animal-dominated omnivores. Early Paleocene multituberculates show a range of OPC values that is similar to their Lancian counterparts, whereas early Paleocene eutherians, driven by an influx of archaic unglulates, have a wider range of OPC values than their Lancian counterparts; some have OPC values corresponding to plant-dominated omnivores. Our results suggest that despite major faunal turnover across the K–Pg boundary via extinction, speciation, and immigration, the range of feeding ecologies of multituberculates was relatively unchanged during this interval. In contrast, eutherians expanded their range of feeding ecologies to include a greater plant component immediately across the K–Pg boundary.

Technical Session XI (Friday, November 4, 4:00 pm)

THE VALIDITY AND PALEOBIOGEOGRAPHIC HISTORY OF THE TITANOSAUR SAUROPOD ALAMOSAURUS SANJUANENSIS FROM THE LATEST CRETACEOUS OF NORTH AMERICA

WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA; B’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA

Alamosaurus sanjuanensis is the only named sauropod from the Late Cretaceous of North America. Alamosaurus appears in the fossil record after a ‘sauropod hiatus’ of about 30 million years, during which sauropod fossils from North America are unknown. The validity, constituency, and paleobiogeographic history of Alamosaurus are contentious because of its single-bone holotype (a scapula), lack of critical evaluation of its hypodigm, and sampling issues, respectively. Alamosaurus has been incorporated into several cladistic and paleobiogeographic studies, which have assumed its validity and constituency for heuristic purposes. Our first-hand observations of the holotype of A. sanjuanensis and a broad sampling of other titanosaurs allow us to diagnose it with a combination of features, including: two processes at the ventral edge of the base of the scapular blade, an asymmetrically concave medial margin of the scapular blade, and a scapular blade with distinct expansion on the ventral side only. These features and the absence of substantial differences allow confident referral of several more anatomically complete specimens to A. sanjuanensis, which in turn expands its diagnosis. This augmented hypodigm includes dorsal ribs, a nearly complete caudal vertebra series with chevrons, a complete pectoral girdle and forelimb, and ischia. A cladistic analysis incorporating relevant taxa indicates that Alamosaurus is a derived titanosaur most closely related to latest Cretaceous Asian or Gondwanan taxa. These results provide strong support for the hypothesis that Alamosaurus was an immigrant rather than a late-surviving member of a lineage of Early Cretaceous North American sauropods.

Poster Session I (Wednesday, November 2)

THE FEEDING ECOLOGY OF CRETACEOUS AND MODERN PURSUING BIRDS

WILSON, Laura, University of Colorado at Boulder, Boulder, CO, USA

Hesperornithiform birds are inferred to have been foot-propelled pursuit divers based on functional morphology, with a short, laterally rotated, robust femur, long tibiotarsus, and compressed feet with long toes. The geographic range of North American hesperornithiforms during the Late Cretaceous from the Arctic to Arkansas shows a stark contrast to that of extant pursuit divers, whose ranges are limited to colder high latitude and upwelling waters. Based on modern pursuit divers, water temperature is thought to be a primary factor limiting geographic distribution, as it gives an advantage to endothermic predators over ectothermic prey. However, greenhouse conditions during the Late Cretaceous and the apparent success of hesperornithiforms in the temperate waters of the Western Interior Seaway refute this hypothesis. Osteohistological patterns from high and mid latitude hesperornithiforms indicate these birds were physiologically similar to modern birds, with rapid, sustained growth. Consequently, it is unlikely that there were major physiological differences between hesperornithiforms and extant pursuit divers. In the absence of a physiological explanation for differences in geographic ranges, two possibilities may account for the occurrence of hesperornithiforms in warm waters: (1) these birds pursued prey for which dive success was not dependent on thermoregulatory response to low temperatures; (2) differences in Late Cretaceous marine ecosystem structure meant reduced competitive and predation pressure on hesperornithiforms, resulting in an expanded geographic range. The dominance of marine reptiles in Cretaceous systems versus marine mammals in modern systems may explain some of these ecological differences. Overall, the hesperornithiform presence in temperate waters implies marine ecosystem structuring, rather than temperature, influences the geographic ranges of pursuit divers. This hypothesis has important implications for understanding not only hesperornithiform ecology along the Western Interior Seaway but also the fauna of the Late Cretaceous and modern marine ecosystems.

Symposium I (Wednesday, November 2, 8:00 am)

COMPARATIVE MORPHOLOGY AND SUGGESTED HOMOLOGIES OF PAIRED FINS IN JAWLESS AND EARLY JAWED VERTEBRATES

WILSON, Mark, University of Alberta, Edmonton, AB, Canada

The origin of jawed vertebrates (Gnathostomata) is one of the greatest events in vertebrate evolution yet it remains among the least well understood. Among the many features of gnathostomes with possible precursors in jawless (agnathan) vertebrates are paired fins. At one time, morphologists assumed that paired fins evolved in concert with jaws, teeth, and a variety of other predatory adaptations including hypaxial vs epaxial musculature, heterocercal tail, stomach, large eyes, and third semicircular canal. We now know that many of these features pre-date the origin of jaws, while others perhaps followed later. Prior to the origin of jaws, paired fin-like structures occurred in many species of vertebrates including anaspids, thelodonts, and osteostracans. These early, often rudimentary paired fins were at one time assumed to be remnants of apaired ventralateral fin field that was to become divided into pectoral and pelvic portions. However, I argue that the early paired fins can be homologized either with pectoral or with pelvic fins. A few taxa likely had both. Anagnath cladest lost either pectoral fins (furcacaudiforms) or pelvic fins (osteostacans, perhaps some thelodonts) that were present in their ancestors. In early gnathostomes, paired fins take on a remarkable variety of forms, with and without leading-edge spines and/or series of spines. Certain early fossil gnathostomes demonstrate that pectoral and pelvic fins differed in morphology and position; others show that one or the other pair could be elaborated or reduced, sometimes even lost. Apparently they were not anterior and posterior expressions of the same developmental field. The evidence from morphology supports the idea that paired fins preceded the origin of jaws, that the two kinds of fins were under somewhat different selection pressures, and that they were in distinct developmental compartments under largely separate fields of genetic expression.

Technical Session I (Wednesday November 2, 8:00 am)

BEYOND EUROPASAURUS: THE LATE JURASSIC VERTEBRATE ASSEMBLAGE OF THE LANGENBERG QUARRY IN OKER/GERMANY

WINGS, Oliver, Museum f Naturkunde Berlin, Berlin, Germany

The marine deposits of the Langenberg quarry near Oker (Lower Saxony, northern Germany) are among the most important Mesozoic vertebrate fossil localities in Europe. The biostratigraphically well dated sediments range from late Oxfordian to late Kimmersidian in age. The beds were tilted to a near vertical, slightly overturned position during the Harz Mountains orogeny in the Paleogene. The dominant lithologies are carbonates that may be impure and grade into marls. Sediment composition and invertebrate faunal content record changes in water depth and salinity, but there is no evidence of subaerial exposure. Paleogeoographically, the Langenberg quarry is located in the Lower Saxon Basin that was surrounded by several large islands, the source of the clastic components in the sediment. Surprisingly, at least the beds 56, 73, and 83 have yielded terrestrial vertebrates that were washed into the sea from a nearby island, while most other beds contain a partially or purely marine fauna. The finds offer unique insights in the Late Jurassic terrestrial island fauna of northern Germany. The most spectacular finds include different ontogenetic stages of the sauropod dinosaure Euopasaurus holgeri, which evolved into a dwarf form on the island. Exquisitely preserved material of non-dinosaurian vertebrates has also been found and
consists of three-dimensional pterosaur remains including the articulated skeleton of a small
sauropod, the first from the Kimmeridgian of Germany, as well as articulated skeletons of
the small atroposaurid crocodyliform Theriosuchus which also lived on the island. Abun-
dant and diverse turtle material (including several skulls) comprise cf. Thalassemys, Plesto-
chelys, and at least one possible chelonian from Okelbara. In addition to many reptilian teeth a diverse fish fauna represented mainly by isolated teeth of marine chondrichthyans and osteichthyans. Current research activity is concentrated on the sedi-
mentology, microfacies, and taphonomy of the Langenberg Quarry as well as the taxonomy and paleoecology of the island fauna and the paleobiogeographic and ecological controls of island dwelling in dinosaurs.

Poster Session III (Friday, November 4)

NO GRASS TODAY: DIETARY RECONSTRUCTION AND DENTAL EVOLUTION OF THE BALEARIC CAVE GOAT MYOTRAGUS (PLIO-HOLOCENE, SPAIN)
WINKLER, Daniela, Biocenter Grindel and Zoological Museum, Hamburg, Germany;
KAISER, Thomas M., Biocenter Grindel and Zoological Museum, Hamburg, Germany;
WINKLER, Daniela, Biocenter Grindel and Zoological Museum, Hamburg, Germany;
SCHULZ, Ellen, Biocenter Grindel and Zoological Museum, Hamburg, Germany

The immediate interface between mammals and the environment are teeth, thus these are an excellent study object when questions of foraging efficiency and functional optimization are considered. Dental adaptations directly reflect demands of forage and environment. The dwarf bovid genus Myotragus forms a Pliocene-Holocene chronospecies endemic to Majorca island (Mediterranean Sea). Myotragus is comprised of six successively dwarfing species (M. palombi, M. peggelenae, M. antiquus, M. kopperi, M. batei and M. balearicus) with unknown ancestor. We apply 3D occlusal topography and microtexture analysis (Scale-Sensitive Fractal Analysis (SSFA) and Dental Areal Surface Texture Analysis (DASTA)) on the upper second molar to reconstruct the diet and quantify small scale morphological adap-
tations. Furthermore, we test for geographical dietary segregation in separated populations of the M. balearicus. Occlusal surface models and high resolution surface texture models of dental facets are generated and analysed. The older Myotragus species, M. peggelenae, M. kopperi and M. batei have significantly higher enamel/dentin ratios than the younger M. balearicus. This suggests a gradual evolutionary decrease of the dentin/enamel ratio. Length and surface of inner enamel ridges decreases within the Myotragus lineage. SSFA revealed decreasing surface complexity from M. peggelenae over M. kopperi and M. batei to M. balearicus. This is interpreted as to reflect the dietary shift from graze-dominated to browse-
dominated diets. The maximum height of surface textures and the material volume (DASTA) decrease within the succession. This signature is indicating a dominance of soft and tough food items like browse in M. balearicus, while brittle and hard forage maintains a more elevated profile in the three older species. Within the two local populations of M. baleari-
cus, no difference in occlusal topography or microtextature was found. Our results reflect an adaptation to energetic restrictions of an insular environment and reveal that either a dietary shift took place in the lineage or Myotragus successively adapted to increased intraspecific competition and expanded its dietary range.

Romer Prize/Technical Session 5 (Thursday, November 3, 9:15 am)

AN INTRA-SKELETAL BONE MICROANALYSIS OF ALLIGATOR MISSISSIPPIENSIS AND ITS APPLICATION TO NON-AVIAN DINOSAUR OSTEOSTOMOLGY
WOODWARD, Holly, Museum of the Rockies, Montana State University, Bozeman, MT, USA

Bone microanalyses of extinct vertebrates allow for more informed hypotheses regard-
ing the growth and aging of extinct taxa and for more meaningful comparisons of growth dynamics across related groups. Here, an osteohistologic analysis of eight paired pectoral and appendicular elements from three juvenile Alligator mississippiensis assesses growth mark consistency and tissue type variation within extant archosaurian individuals. Results demonstrate that: 1) every bone from an individual forms the same number of growth marks in each element; 2) the femur, humerus, and tibia have the highest absolute growth rates; 3) as is typical for alligators, the periodic growth of the two captive individuals was much higher than that of the wild individual, suggesting ecophenotypic plasticity. These results were used to infer aspects of non-avian dinosaur growth in a sample of 18 femora and tibiae from basal ornithopods from polar Australia, and 46 tibiae from the hadrosaurid Maiasaura peeblesorum, the latter being the largest single element, monospecific dinosaur analysis to date. Despite likely having the highest appendicular absolute growth rates, rapid tibia and fe-
mur mineral deposition occurred for only 2-3 growth cycles in the basal ornithopods before slowing, whereas every Maiasaura tibia exhibited high growth rates throughout ontogeny. Interestingly, some similarly sized basal ornithopod tibiae and femora vary in the number of growth marks present. If every growth mark is recorded in every element, the discrepancy may indicate that several taxa are represented in the sample or that eco-phenotypic plasticity caused differing growth rates due to external stresses. In contrast, growth marks of similar circumference from different individuals of Maiasaura represent the same period of growth suspension, indicating the more derived hadrosaurid possibly lacked marked eco-phenotypic plasticity. These results emphasize the need for more osteohistologic studies on extant taxa, benefiting paleobiology by enabling stronger extinct taxon growth hypotheses.

Technical Session II (Wednesday, November 2, 3:00 pm)

A NEW ARCHOSAUR (DIAPSIDA: ARCHOSAURIFORMES) FROM THE MARINE TRIASSIC OF CHINA
WU, Xiao-chun, Canadian Museum of Nature, Ottawa, ON, Canada; LI, Chun, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; ZHAO, Li-jun, Zhejiang Museum of Natural History, Hangzhou, China; SATO, Tamaki, Tokyo Gakugei University, Tokyo, Japan; WANG, Li-ting, Geological Survey of Guizhou Province, Guiyang, China

A new Middle Triassic archosauromorph was recently collected from the Zhuganpo Member (Ladin-
ian) of the Falang Formation, eastern Yunnan Province, China. It is represented by a nearly complete skeleton and mainly characterized by a snout more than twice longer than the rest of the skull, the postdorsal processes of the premaxilla extending posteriorly well beyond the external naris, the presence of three sacral vertebrae, the pronoto-costal anterior process/ hook of the coracoid terminated by a dorsal/lateral process, the ischium with a boot-like distal foot, metatarsal IV the longest, and the anteriorly notched cervical osteoderms. The new archosauromorph is a crocodylomorph that lived on the basis of the crocodilean-nasal tarsal joint and other features. This is the second crocosenian taxon known from the Triassic marine deposits in

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China. The postcranial skeleton of the new taxon demonstrates few anatomical modifications toward an aquatic way of life when compared with *Qianosuchus*, the first Chinese marine archosaur from the Middle Triassic (Anisian) of the same area. However, the large and relatively posteriorly positioned external nares, the ornamented roof bones of the skull, and the fish remains of the stomach content suggest that the new archosaur may have adapted for an aquatic lifestyle although to a less degree than *Qianosuchus*. Our primary analysis is based on 53 archosaurs and 188 characters derived from an existing data matrix confirms the crurotarsus status of *Qianosuchus* and suggests a sister-group relationship between it and the new form within the Rauisuchioidea but with a low bootstrap support value. The discovery of the second archosaur further underscores the affinity of the semi-terrestrial vertebrate faunas between the eastern and western regions along the northern coastline of the Tethys during the Middle Triassic.

Poster Session IV (Saturday, November 5)

**A NEW RECORD OF STEGODON IN TAIWAN AND ITS BIOGEOGRAPHICAL IMPLICATIONS**

WU, Yun-Hsin, Department of Geology, National Museum of Natural Science, TAIWAN, Taichung City, Taiwan, ROC; CHANG, Chun-Hsiang, Department of Geology, National Museum of Natural Science, TAIWAN, Taichung City, Taiwan, ROC; WEI, Kuo-Yen, Department of Geosciences, National Taiwan University, TAIWAN, Taipei City, Taiwan, ROC

As a continental island connecting East and Southeast Asia, Taiwan has been in a critical position to understand the biogeographic history of species in Western Pacific area. Stegodon, an extinct Proboscidian member which was widespread in East and Southeast Asia during Miocene to Pleistocene, represents the dispersal history of macromammal traveling between landmasses and islands. A Middle Pleistocene Stegodon specimen found in the Tongtshan Formation of Taiwan may shed a light on this aspect. This specimen anatomically resembles *S. miensis* in Japan and *S. elephantoides* in southern China and Myanmar, yet shows more primitive characteristics than both of the species. Nevertheless, the sediment carrying this specimen is much younger than the youngest record of *S. miensis* of 2.9 Ma and relatively young to the living period of *S. elephantoides*, which is late Pliocene to middle Pleistocene. While *S. miensis* and *S. elephantoides* are both derived from *S. sanjusi*, a primitive species thriving in northern China during Miocene to Pliocene, this specimen sets a new record in Taiwan to imply another derivative of *S. sanjusi* spreading to this island and preserving the primitive characteristics during the isolation caused by risen sea level in interglacial period.

Technical Session XIV (Saturday, November 5, 11:30 am)

**A NEW EUMANIRAPTORAN PHYLOGENY AND ITS IMPLICATIONS FOR AVIALAN ORIGINS**

XU, Xing, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ZHANG, Fucheng, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; O’CONNOR, Jingmai, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Recent discoveries of basal oviraptorosaurs, basal avialans, basal dromaeosaurs, and basal troodontids have provided significant new information on eumaniraptoran phylogeny, but the full impact of this information has yet to be fully appreciated. Morphological comparisons among basal members of these groups reveal surprising similarities between basal oviraptorosaurs and basal avialans other than *Archaeopteryx* on the one hand, and between *Archaeopteryx* and basal deinonychosaurians on the other. A numerical phylogenetic analysis incorporating data from these new discoveries removes the *Archaeopterygidae* (consisting of *Archaeopteryx* and two eumaniraptorans from the Jurassic of China) from the Avialae and places it at the base of the Deinonychosauria. Salient synapomorphies shared by *Archaeopteryx* and other deinonychosaurians include an enlarged promaxillary fenestra, a longitudinal groove that widens posteriorly on the lateral surface of the dentary, a shortened mid-shaft, a highly shortened ischium with a distally located obturator process and a posteriorly located ilium, a phalanx IV-2 that has a rigid articulation with IV-1, a pubis with a lateral expansion at the mid-shaft, a highly shortened ischium with a distally located obturator process and a posteriorly located ilium, a pubis with an expanded lateral expansion at the mid-shaft, and a highly extensible pedal digit II. This challenges the long-held view that the iconic *Archaeopteryx* is a central taxon for understanding the transition to birds, and instead indicates that *Archaeopteryx* offers important information about the early evolution of deinonychosaurians. The new phylogeny reveals an interesting structural and functional differentiation between basal deinonychosaurians: basal theropods exhibit a more primitive cranial and carnivorous diet. This new phylogeny has significant implications for avian origins, and for related issues such as the origin and early evolution of feathers and flight.

Poster Session I (Wednesday, November 2)

**MESOWEAR ANALYSIS OF EXTANT JAPANESE SIKA DEER (CERVUS NIPPON) IN DIFFERENT HABITATS AND SEXES**

YAMADA, Eisuke, Kagoshima University, Kagoshima, Japan; NAKAYA, Hideo, Kagoshima University, Kagoshima, Japan

Dental mesowear of Sika deer (*Cervus nippon*, Cervidae) in Japan was analyzed to evaluate intraspecific differences in their diet. Four wild populations from different habitats were compared. Hierarchical cluster analysis (HCA) divided them into two dietary categories. The data set of one population was significantly different from the others. The deer in south and west Japan were classified as browsers, and the deer in north and east Japan were grouped as mixed feeders. The dietary classifications of the four populations were supported by ecological studies about them. Japanese Sika deer have been known to be able to switch their eating habits based on the surrounding vegetation environment. The deer show a browsing diet in evergreen broad-leaved forests. On the other hand, the deer mainly rely on grazing diet in deciduous broad-leaved forests or grasslands. Furthermore, foraging separation of the sexes within the same population was investigated. The mesowear variables indicated that male deer had a more abrasive diet (i.e., fibrous food). HCA classified the males as grazers and the females as browsers. The body size differences between the sexes likely play an important role in the contrasting results. Metabolic demands for energy and nutrients have been pointed out as a cause of sexual segregation in foraging behavior. The gastrocnic hypothesis predicts that large males consume abundant fibrous forages because of high digestive capacity, while females demand high nutrient food, especially during gestation and lactation. The results of this study are consistent with this hypothesis.

Thus, we conclude that mesowear analysis indicated dietary differences in different populations of the same species of Japanese Sika deer. Further studies of other extant ungulates are necessary before analyzing fossil populations.

Poster Session IV (Saturday, November 5)

**SANDBEON DIAGENESIS AS A PROXY INDICATOR OF PORE FLUID GEOCHEMISTRY: IMPLICATIONS FOR FOSSILIZATION OF VERTEBRATE SKELETAL MATERIAL IN THE HELL CREEK FORMATION (UPPER CRETACEOUS), EASTERN MONTANA**

YAMAMURA, Daigo, Montana State University, Bozeman, Bozeman, MT, USA; SCHMIDT, James, Montana State University, Bozeman, Bozeman, MT, USA

Enclosing sandstone matrix is often invoked as an entombing medium, facilitating preservation of vertebrate skeletal material by isolation from contact with pore fluids. We employed optical petrography, x-ray diffraction, and scanning electron microscopy analysis of a fossil-rich sandstone in the Hell Creek Formation to document pore fluid geochemistry during diagenesis and examine the role of sandstone matrix as an entombing agent. Excavated skeletal material includes a large hadrosaur humerus and rib, femur fragments (unknown dinosaur), a chasmosaur femur, and various small bones and fragments (turtle, crocodile). Presence of fine-grained ripple cross-laminated (Sr) and massive muddy sandstone (Sm), abundant coal stringers, and overlying and underlaying floodplain mudrocks indicate a low-energy crevasse-splay origin. This overbank sequence directly overlies a trough-cross-stratified sandstone (So), up-fingding fluvial channel sandstone. Both sandstones are feldspathic litharenites.

The channel sandstone shows evidence of secondary porosity development through acidic pore fluid migration including feldspar grain skeletonization, oversaturated pores containing complete grain dissolution, suspended exploded-grain fabrics in biotite indicating dissolution of early calcite cement, and porosity values >50 percent. The bone-bearing crevasse-splay sandstone contains skeletonized and altered (feldspar to clay) feldspar grains, also indicating migration of acidic pore fluids, and later chlorite cement precipitation. Enclosed bones show minimal evidence of alteration; they are surrounded by a concretionary zone of calcite and iron oxide cement characterized by isopachous calcite rims on detrital grains indicating meteooric phreatic or vadose calcite precipitation.

Presence of well-preserved bone in sandstone extensively altered by acidic fluids suggests that early calcification of surrounding calcite (concretion growth) enhanced bone preservation, chemically buffering it from the later corrosive effects of acidic pore waters. This indicates that early calcite precipitation (concretionary entombment) is an important factor in vertebrate skeletal preservation in sandstones.

Poster Session III (Friday, November 4)

**MAMMALIAN OXYGEN ISOTOPE VALUES AS AN INDICATOR OF REGIONAL CLIMATIC DIFFERENCES IN THE PLEISTOCENE NORTH AMERICA**

YANN, Lindsey, Vanderbilt University, Nashville, TN, USA; HAUPT, Ryan, Vanderbilt University, Nashville, TN, USA; DESANTIS, Larisa, Vanderbilt University, Nashville, TN, USA; ROMER, Jennifer, Vanderbilt University, Nashville, TN, USA; CORAPI, Sarah, Vanderbilt University, Nashville, TN, USA

Geochron tools such as stable isotope analyses have the potential to clarify paleoclimatic and dietary information. Specifically, oxygen isotopes can be used to assess relative aridity and/or temperature, with greater δ18O values occurring in hotter and/or drier regions. Here, we compiled a database of stable isotope values obtained from mammalian tooth enamel to quantify regional climatic differences between the southeastern and southwestern US during the Pleistocene. By selecting only fossil localities containing proboscideans (i.e., evaporation sensitive taxa), we subsequently calculated the difference between average δ18O values of a given taxon and the average proboscidean value to calculate an offset value that can further identify evaporation sensitivity. Taxa including antilocaprids, camels, cervids, and equids were identified as evaporation sensitive, in contrast to boids, tapirs, tapirids, and proboscideans (elephantids, gomphotheres, mammutids). Comparisons of evaporation sensitive and insensitive taxa between regions demonstrates greater δ18O values in the southeastern US overall and between like sensitivity categories while offset values were greater in the southwestern US in evaporation sensitive taxa. These data suggest cooler and drier conditions during the Pleistocene in the southwestern US as compared to the likely warmer and drier conditions during the Pleistocene in the southeastern US.
wetter southeastern US. Furthermore, 613C values were greater in the southwestern US in all categories and overall; however, there is no correlation between 613C values and 618O values. Thus, while C4 recourses may have been more abundant in the southwest, environmental sensitivity does not appear to be related to dietary feeding strategies. Collectively, this meta-analysis helps clarify regional climatic differences and identifies taxa that may be useful for quantifying changes in aridity over time.

Technical Session X (Friday, November 4, 8:45 am)
THE FIRST DENTALLY ASSOCIATED SKELETON OF PLAGIOMETRAE (MAMMALIA, ?DERMOPTERA) FROM THE LATE PALEOCENE OF WYOMING YAPUNCI, D. J., CUNY Graduate Center, New York, NY, USA; BOYER, Doug, Brooklyn College/CUNY, New York, NY, USA; SECORD, Ross, University of Nebraska, Lincoln, NE, USA; BLOCH, Jonathan, University of Florida, Gainesville, FL, USA

It has long been recognized that Paleocene-Eocene plagiometids have derived dentitions similar to extant flying lemurs. These affinities have led to their classification within Dermo- ptera, although discoveries of a plagiometid basioccipitum and teeth of Eocene dermopterans in Asia seem to contradict this relationship. Here we describe the first dentally associated plagiometid postcrania recovered from the late Tiffanian of the Bighorn Basin, Wyoming, which allow for a reassessment of plagiometid phylogenetic affinities and provide insight into their positional behavior. A reconstruction of the pes of cf. Plagiometra zalmouti is inconsistent with committed arboreality, contrary to expectations for primitive dermopterans, both in the morphology of the astragali and calcaneus, as well as in the stout proportions of the intermediate phalanges. The astragalus has an asymmetrical grooved trochlea with a shallow medial border and a proximodistally restricted sustentacular facet. The calcaneus also exhibits a distally fused tibia-fibula, elongate metatarsals on rays II-IV with cylindrical distal condyles, and shallow, straight-shafted claws. This suite of features limits the rotational capacity of the foot, but allows for powerful plantarflexion and extension, suggesting a more terrestrial lifestyle. Principal component analysis of measurements on the astragali and calcaneus indicate that the pes of P. zalmouti is most similar to the extinct Cryptotepos (Nydjterideridae, Eulipotyphla), while intermediate phalans elongation ratios reveal that P. zalmouti was most similar to extant terrestrial scarnatorial such as Tupaiia and Sciurus. Cladistic analysis of 240 characters coded for 36 taxa aligns cf. P. zalmouti (and Nydjerideridae) with eulipotyphans such as Suncus and Erinaceus. On functional morphological and cladistic grounds we consider Plagiometidae to be more likely allied with larausiatheres than dermopterans or other eutherians.

Technical Session XI (Wednesday, November 2, 2:45 pm)
FUNCTIONAL MORPHOLOGY OF THE LOWER JAW IN THE CHORISTODERA (REPTILIA: DIAPSIDA) INDICATES DIET DIVERSION BETWEEN ECOMORPHS
YI, Hong-yu, American Museum of Natural History, New York, NY, USA

Choristoderes are top predators in the fresh water ecosystems of the Mesozoic and Cenozoic of Laurasia. They are the only diapsid group that became extinct well after surviving the K-T extinction. Choristoderes reached the highest diversity and disparity in the Cretaceous, with three distinct ecomorphs: a long-snout form that is comparable with living gavials in snout shape, a short-snout form that is similar to living crocodiles, and a long-neck form that is unique in freshwater diapsids. Their widely varying body plans indicate ecological partitioning for different ecomorphs, although direct evidence (e.g., gut contents) is lacking. This study provides the first quantitative comparison of choristodarian lower jaw mechanics, aimed at an evaluation of dietary divergence between ecomorphs. Five choristodarian genera are measured for mechanical advantage (MA, force property) and velocity advantage (VA, speed property), based on reconstruction of musculature attachment in the lower jaw. Four extant fish-eating reptiles are also measured for comparison. The result shows that the long-snout ecomorph, including Champsosaurus and the Late Cretaceous and Paleocene of North America, has a high VA for jaw closing. The long-neck ecomorph, including Hypalosa- surus from the Early Cretaceous of Asia, approaches the closing VA of Champsosaurus, but has a much smaller skull for small prey. The short-snout ecomorph includes the crocodile-like Sinoedosaurus and small lizard-sized Monjurosuchus, and is generally characterized by a strong jaw with high closing MA. Comparison of choristodarian lower jaw mechanics to that of extant reptiles shows that Champsosaurus and Hypalosaurus have a VA similar to living piscivorous reptiles (gavials). The short-snout ecomorph has an MA similar to living alligators, indicating their ability to prey on middle to large sized vertebrates. Furthermore, the difference of maximum MA and VA values for jaw closing between the short-snout ecomorph and the other two ecomorphs is statistically significant. Quantitative assessment supports dietary divergence in choristoderes, and indicates the importance of ecological adaptation in species diversification for choristoderes.

Poster Session IV (Saturday, November 5)

Basal hadrosauriform dinosaurs from the early cretaceous Mazongshan area of gansu province, northwestern china
YO, Hai-Lu, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; LI, Da-Qing, Gansu Geological Museum, Lanzhou, China

Xuvalong yuehui is the latest reported basal hadrosauriform dinosaur from the Early Cretaceous Mazongshan area of northwestern Gansu Province of northwestern China. The specimen is based on an articulated specimen including a complete cranium, almost complete axial skeleton, and complete pelvic girdle. Xuvalong is among the most basal members of hadrosauriform dinosaurs, and distinguished by its unique lower jaw in having a V-shaped rostral end of the dentary in lateral view and a mandibular articulur surface which levels with mid-height of the dentary ramsus, as well as an enlarged and downturned prepubic process.

Jintasaurus is recovered from the same horizon as Xuvalong in the Yujingzi Basin of Mazongshan area. It is represented by an articulated posterior portion of the skull and is unique in having an extremely long, pendant and crescentic paroccipital process with its ventral tip projecting far beyond the ventral level of the occipital condyle. Phylogenetic analysis recovers Jintasaurus as the sister-taxon to Hadrosauridea (Hadrosauridea includes Bactrosaurus johnsoni, Parasaurolophus walkeri, their most recent common ancestor and all descendants), more derived than other Early Cretaceous hadrosauriforms and Protostegidae from the early Late Cretaceous of North America. The co-occurrence of two basal hadrosauriforms, together with a third (Equiabthus) from the Xinmipu Group in nearby Gong countryCode, indicates a rich diversity and abundance of basal hadrosauriforms in the Mazongshan area of northwestern China, and further supports the hypothesis of an Asian origin of hadrosauroids.

Poster Session II (Thursday, November 3)
A SAURODONTID FISH FROM THE LATE CRETACEOUS OF DAKHLA OASIS, WESTERN DESERT, EGYPT
YOUSEF, Mohamed, Mansoura University, Mansoura, Egypt; SALLAM, Hesham, Mansoura University, Mansoura, Egypt; FRIENDMAN, Matt, University of Oxford, Oxford, United Kingdom; O’CONNOR, Patrick, Ohio University, Athens, OH, USA; SERTICH, Joseph, Denver Museum of Nature and Science, Denver, CO, USA

Field exploration efforts in Upper Cretaceous deposits in southern Egypt have recovered representatives of most major vertebrate clades, including dinosaurs, pterosaurs, turtles, marine reptiles, crocodyliforms, and sarcopterygian and osteichthyean fishes. Among the latter is a remarkable saurodontid fish consisting of a nearly complete skull with an articulated and dissociated series of vertebrae, numerous articulated costal elements, and a pectoral fin. The specimen was recovered from marine calcareous shale of the late Campanian Duwi Formation exposed near Dakha Oasis, Western Desert, Egypt.

Although severely flattened, the specimen is very well preserved. The edentulous unpaired predentary bone, a neomorphic ossification projecting from the lower jaw and extending beyond the anterior margin of the upper jaw, is not preserved. However, the anterior surface of the dentary bears an articulation for this midline bone. Computed tomography reveals that the teeth are cylindrical, short and thin, forming a single series on the lower and upper jaws, consistent with what is known in other saurodontal fishes. Moreover, there is a small foramen/ossa positioned near the base of each tooth along the lingual surface of the tooth-bearing elements. This feature, along with the presence of a predentary bone, represents saurodontid synapomorphies. The teeth also are deep rooted with short crowns, characters not seen in saurodontid fishes.

The Egyptian specimen is an exceptionally large saurodontid. Its predicted body length is estimated as ca. 3.5 m, based on cranial proportionals of more completely known saurodontids. Sauroidontidae, a family of the stem-teleost Ichthyodectiformes, is presently known only from Upper Cretaceous deposits of North America, Europe, and Asia. The clade is currently represented by three established genera, Saurorhabdus, Sauroidon, and Protosau- rodon, all of which are best known from material collected in North America. Thus, the speci mens reported herein represents the first record of Sauroidontidae from Africa.

Poster Session III (Friday, November 4)
The deciduous dentition of didymictis (viverravidae) and the first appearance of hyaenodontidae
ZACK, Shawn, University of Arizona, College of Medicine-Phoenix, Phoenix, AZ, USA

Mammalian deciduous premolars differ from their permanent counterparts in small but predictable ways that can nevertheless obscure relationships. As a result, deciduous premolars of fossil mammals are frequently misidentified as permanent teeth of different, often unrelated taxa. This is particularly true of members of Carnivoromorpha, due to the fact that DP4 has an elongate mesialty shearing crest, while its permanent equivalent, M1, lacks a metastyle. To avoid such confusion, it is critical that deciduous dentitions be documented when possible, particularly those of carnivoromorphs.

Among extinct, basal members of Carnivoramorpha, deciduous dentitions of one family, Viverravidae, have not been described. Viverravid deciduous premolars are reported for the first time, based on material referable to Didymictis protenus from the early Eocene Willwood Formation of Wyoming. Several specimens preserve deciduous teeth of D. protenus in association with elements of the permanent dentition, permitting confident identification. Elements of the deciduous dentition of Didymictis are smaller, lower crowned, less trans
verse, and with weaker development of the principal cusps than their permanent equivalents. As in members of the carnivore crown group, DP4 has a well-developed metastylist, which is lacking on M1.

These new specimens permit a re-evaluation of two Paleocene taxa of controversial affinity, and weak evidence for larger magnitudes of mass increases versus decreases in Therizinosauria, and weak evidence for larger magnitudes of mass increases versus decreases in Therizinosaurus and Ornithomimosaurus as determined by Wilcoxon signed rank tests on ancestral descendant pairs values. Such a pattern minimally substantiates that increasing mass is not a universal trend among noncarnivorous theropods. Furthermore, our results demonstrate that either ecological and/or taphonomic factors exerted a more pronounced influence on body-size evolution in theropods than has been previously presumed or omnivorous/herbivorous coelurosaurians engaged in alternative strategies for increasing dietary efficiency.

Here we reconstruct the evolution of body mass in the major omnivorous/herbivorous coelurosaurian subclades (Therizinosauria, Ornithomimosauria, Oviraptorosauria, and Alvarezsauroidea) using linear, squared change parsimony. Our analyses fail to recover a significant phylogenetic trend of increasing mass in any of these clades using a generalized least squares approach, despite an apparent increase in mean mass over time in Therizinosauria, and weak evidence for larger magnitudes of mass increases versus decreases in Therizinosaurus and Ornithomimosaurus as determined by Wilcoxon signed rank tests on ancestral descendant pairs values. Such a pattern minimally substantiates that increasing mass is not a universal trend among noncarnivorous theropods. Furthermore, our results demonstrate that either ecological and/or taphonomic factors exerted a more pronounced influence over body-size evolution in theropods than has been previously presumed or omnivorous/herbivorous coelurosaurians engaged in alternative strategies for increasing dietary efficiency.

Loricatan pseudosuchians (previously known as “rausuchians”) typically consist of poorly understood fragmentary remains known worldwide from the Middle Triassic to the end of the Triassic. Renewed interest and the discovery of more complete specimens recently revolutionized our understanding of the relationships of archosaurs, the origin of Crocodylomorpha, and the paleobiology of these animals. Heptasuchus clarki was the first formally recognized North American “rausuchian” and was collected from a poorly sampled and disparately fossiliferous sequence of Triassic strata in North America. The H. clarki type locality occurs within a sequence of red beds above the Alcova Limestone and Crow Mountain formations within the upper Chugwater Group which is exposed along the trend of the Casper Arch flanking the S.E. Big Horn Mountains. The age of the type locality is poorly constrained, but is likely similar to or just older than that of the Pope Formation assemblage from the western portion of Wyoming. The holotype consists of associated cranial elements found in situ, and the paratypes consist of cranial and postcranial that are referable to the same taxon. Thus, about 50% of the osteology of the taxon is preserved. All of the pseudosuchian elements collected at the locality appear to belong to Heptasuchus and the taxon is not a chimera as previously hypothesized. Heptasuchus is distinct from all other archosaurs by the presence of large, posteriorly directed flanges on the parasphenoid and a distinct, orbit-overhanging postfrontal. Our phylogenetic hypothesis posits a sister-taxon relationship between Heptasuchus and the Ladinian-aged Batrachotomus from Germany within Loricata. These two taxa share a minimum of six discrete character states and further support the hypothesis that crocodylomorphs are loricatans. A minimum of four individuals of Heptasuchus are present at the type locality suggesting that a group of individuals died together. Moreover, aggregations of loricatans (e.g., Heptasuchus, Batrachotomus, Decuriasuchus, Pseudosuchus) are common suggesting that these animals may have lived in groups.

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tions even with well developed postero-labial wear facet. The wear pattern on m1 shows that during retraction, the lower dentition only slid for a short distance against the upper dentition. The extensive wear facet on both P4 and p4, and the relatively high crown of P4 shows that shearing played an important role in the masticatory cycle of *Mesodon*.

Technical Session I (Wednesday, November 2, 12:00 pm)

**LONG BONE HISTOLOGY AND GROWTH PATTERNS OF PSITTACOSAURUS LUIJATUNENSI S (CERATOPSIS: PSITTACOSAURI DAE)**

ZHAO, Qi, University of Bristol, Bristol, United Kingdom; BENTON, Michael, University of Bristol, Bristol, United Kingdom; HIAYASHI, Shoji, Steinmann Institut für Geologie, Mineralogie und Paläontologie, University of Bonn, Bonn, Germany; SANDER, P., Martin, Steinmann Institut für Geologie, Mineralogie und Paläontologie, University of Bonn, Bonn, Germany; XU, Xing, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

*Psittacosaurus*, the most species-rich dinosaurian genus, contains more than 12 species, although some of them are potentially invalid. In this study, eight individuals of *Psittacosaurus luijatunensis* from the Jehol Biota of China were histologically sampled, resulting in 16 thin-sections taken from the middle shafts of tibiae, humeri, and femora. The sample, spanning a growth series from hatching to adult developmental stages, was examined for life history and longevity estimates based on diaphyseal growth line counts and other features of histology. We recognized four histologic ontogenetic stages, i.e., hatching, juvenile, sub-adult, and adult. None of the specimens were fully grown, however. Radial vascular canals were found in the humeri of the hatching stage (less than one year old), compared with only longitudinal vascular canals in femora. This suggests that the humeri grew faster than the femora in this stage, possibly indicating that *Psittacosaurus* was quadrupedal as a hatching. Four individuals in our study were from a cluster of six small *Psittacosaurus* individuals, which was reported in 2007. The largest individual in the cluster was three years old while the others were two years old, indicating that this cluster contained offspring from two different egg clutches. The cluster thus represents the remains of a mixed-age herd as previously hypothesized. Compared with the growth stages of *Psittacosaurus mongoliensis*, different growth patterns were found in *P. luijatunensis*, especially in the juvenile stage. Longitudinally vascularized canals formed half of the growth zones from ages three to four in the femora of *P. luijatunensis*, but none were found in *P. mongoliensis* at this age, indicating inter-species differences in bone histoology in *Psittacosaurus*. Thin sections of the tibia and humerus from *Hongshansaurus houi* were also analyzed in this study and compared with *P. luijatunensis*. The similar growth patterns suggest that *H. houi* may be a synonym of *Psittacosaurus luijatunensis*.

Technical Session XVI (Saturday, November 5, 8:30 am)

**NEW CHARACTER DIAGNOSIS YIELDS NOVEL PERSPECTIVES ON THE INTERRELATIONSHIPS OF MAJOR GNATHOSTOME GROUPS**

ZHU, Min, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; YU, Xiaobo, Kean University, Union, NJ, USA; QU, Qingming, Uppsala University, Uppsala, Sweden

Phylogenetic analysis based on new character diagnosis (including revised character formulations and codings) provides novel perspectives for reconstructing the interrelationship of major gnathostome groups (Placodermi, Acanthodii, Chondrichthyes and Osteichthyes). Characters previously used to unite *Acanthodes* and the Osteichthyes (e.g. the trophic basicranial morphology, the ascending basipterygoid pilla pierced by internal carotid), and characters previously used to assign the *Psarolepis* - *Guiyu* clade to the Sarcopterygii (e.g. the intracranial joint, the unconstricted cranial notochord), have been re-evaluated. Comparison between the *Psarolepis* - *Guiyu* clade and stem osteichthyan *Ligulalepis*, especially in neurocranial features (e.g. the postorbital pilla, the spiracular groove lying in front of lateral commissure) leads to revised codings and suggests that the *Psarolepis* - *Guiyu* clade might have a more basal position than previously thought. In addition, new findings of Silurian placoderms further challenge the view that a fundamental difference of dermal bone pattern exists between placoderms and osteichthysans. The resulting new character-by-taxon matrix yields topologies suggesting that 1) *Acanthodes* may be a stem chondrichthyan rather than a stem osteichthyan; 2) the *Psarolepis* - *Guiyu* clade may be stem osteichthysans rather than stem sarcopterygians; and 3) placoderms remain paraphyletic at the base of jawed vertebrates. Accordingly, the phylogenetic gap between placoderms and osteichthysans now appears to be less substantial than implied by previous phylogenies. With acanthodians as stem chondrichthysans and the *Psarolepis* - *Guiyu* clade as basal osteichthysans, new scenarios of gnathostome character evolution can be proposed, and observed morphological resemblances between placoderms and osteichthysans (e.g. similarities in dermal and endoskeletal girdle components between placoderms and the *Psarolepis* - *Guiyu* clade) can be explained more parsimoniously in this new light.
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