Program and Abstracts

70th Anniversary Meeting
Society of Vertebrate Paleontology
David L. Lawrence Convention Center, East Lobby &
Westin Convention Center Pittsburgh
Pittsburgh, Pennsylvania USA
October 10–13, 2010
SOCIETY OF VERTEBRATE PALEONTOLOGY
October, 2010

ABSTRACTS OF PAPERS

SEVENTIETH ANNIVERSARY MEETING
SOCIETY OF VERTEBRATE PALEONTOLOGY

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY
& WESTIN CONVENTION CENTER PITTSBURGH
PITTSBURGH, PA, USA

OCTOBER 10–13, 2010

HOST COMMITTEE
K. Christopher Beard, Co-Chair; Zhe-Xi Luo, Co-Chair; David Berman, Shundong Bi, Amy Henrici, Leigh Kish, Mark Klingler, Matthew Lamanna, Patrick McShea, Alan Tabrum, John Wible, Ilona Wyers

EXECUTIVE COMMITTEE
Blaire VanValkenburgh, President; Catherine Badgley, Past-President; Philip Currie, Vice-President; Christopher Bell, Secretary; Ted Vlamis, Treasurer; Ana Baez, Member-at-Large; Julia Clarke, Member-at-Large; Kristina Curry Rogers, Member-at-Large

SYMPOSIUM CONVENORS
Mark Clementz, Larisa DeSantis, Robert Fordyce, Casey Holliday, Neil Kelley, William Sanders, Nancy Stevens, Matthew Vickaryous, Lars Werdelin

PROGRAM COMMITTEE
Jonathan Bloch, Co-Chair; Anjali Goswami, Co-Chair; Jason Anderson, Paul Barrett, Kerin Claeson, Kristina Curry Rogers, Ted Daeschler, David Evans, David Fox, Nadia Fröbisch, Jason Head, Christine Janis, Johannes Müller, Emily Rayfield, William Sanders, Bruce Shockey, Mary Silcox, Rebecca Terry
Members and Friends of the Society of Vertebrate Paleontology,

The Section of Vertebrate Paleontology at Carnegie Museum of Natural History is excited to host the 70th Annual Meeting of the Society of Vertebrate Paleontology. From its founding in 1895 right up to the present day, Carnegie Museum of Natural History has played a vital role in the development of vertebrate paleontology in North America. This meeting represents a homecoming for the Society, and it provides us with the opportunity to showcase the museum’s recently renovated Mesozoic gallery, *Dinosaurs in Their Time*.

Pittsburgh is conveniently located in southwestern Pennsylvania, affording easy travel connections by air, rail, and major highways. The city is home to numerous scientific and cultural institutions, as well as several major universities. Autumn visitors to the region can enjoy the fall foliage in the Laurel Highlands, which is home to the museum’s Powdermill Nature Reserve and Frank Lloyd Wright’s architectural masterpiece, Fallingwater.

We look forward to hosting the meeting and seeing you in Pittsburgh!

2010 SVP Host Committee

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**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.)

*Please address any questions about program practices to the Program Committee or to the Executive Committee.*
# 2010 SVP Schedule of Events (subject to change)

All events are held at the David L. Lawrence Convention Center (DLCC), East Lobby, 3rd Floor unless otherwise noted with an **.

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<tr>
<th>Event/Session</th>
<th>Saturday, October 9</th>
<th>Sunday, October 10</th>
<th>Monday, October 11</th>
<th>Tuesday, October 12</th>
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<tbody>
<tr>
<td>Registration Desk</td>
<td>1 pm – 4 pm DLCC, Spirit of Pittsburgh Ballroom Foyer</td>
<td>7 am – 5 pm DLCC, Spirit of Pittsburgh Ballroom Foyer</td>
<td>8 am – 5 pm DLCC, Spirit of Pittsburgh Ballroom Foyer</td>
<td>8 am – 5 pm DLCC, Spirit of Pittsburgh Ballroom Foyer</td>
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### Plenary Session/Welcome
- 7:45 am – 8 am DLCC, Spirit of Pittsburgh Ballroom B
- 8 am – 12:15 pm DLCC, Room 301
- 8 am – 12:15 pm DLCC, Spirit of Pittsburgh Ballroom B
- 8 am – 12:15 pm DLCC, Spirit of Pittsburgh Ballroom B
- 8 am – 12:15 pm DLCC, Spirit of Pittsburgh Ballroom B

### Symposia
- **Advances in Paleocology: Geochemistry, Microwear and Beyond** DLCC, Room 301
- **Physical Drivers and Marine Tetrapod Evolution** DLCC, Room 301
- **Making Connections: The Evolution and Function of Joints in Vertebrates** DLCC, Room 301

### Technical Sessions
- **Romer Session** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session I** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session II** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session III** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session IV** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session V** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session VI** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session VII** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session VIII** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session IX** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session X** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XI** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XII** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XIII** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XIV** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XV** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XVI** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XVII** DLCC, Spirit of Pittsburgh Ballroom B
- **Technical Session XVIII** DLCC, Spirit of Pittsburgh Ballroom B

### Workshops/Educational Events
- **Paleontological Illustration Workshop Session 1** For Pre-Registered Attendees
- **Art Institute of Pittsburgh**

### Poster Sessions
- Poster Session I: 9:30 am – 4:15 pm
- Poster Session II: 9:30 am – 4:15 pm
- Poster Session III: 9:30 am – 4:15 pm
- Poster Session IV: 9:30 am – 4:15 pm

### Exhibit Viewing
- 9:30 am – 6:15 pm DLCC, Spirit of Pittsburgh Ballroom A
- 9:30 am – 6:15 pm DLCC, Spirit of Pittsburgh Ballroom A
- 9:30 am – 6:15 pm DLCC, Spirit of Pittsburgh Ballroom A
- 9:30 am – 6:15 pm DLCC, Spirit of Pittsburgh Ballroom A

### Annual Business Meeting/Open Executive Committee Meeting
- 12:30 pm – 1:30 pm Annual Business Meeting DLCC, Spirit of Pittsburgh Ballroom B
- 12:30 pm – 1:30 pm Open Executive Committee Meeting DLCC, Spirit of Pittsburgh Ballroom B

### Press Event
- 4:15 pm – 5:45 pm **Westin Convention Center Pittsburgh, 2nd Floor, Westmoreland Room**

### Social Events
- 7 pm – 10 pm Welcome Reception **Carnegie Museum of Natural History**
- 8 pm – 10 pm Student Roundtable Forum & Reprint Exchange **Westin Convention Center Pittsburgh, 3rd Floor, Allegheny Ballroom**
- 6:30 pm – 10:30 pm Auction/Reception **Westin Convention Center Pittsburgh, 3rd Floor, Allegheny Ballroom**
- 8 pm – 10 pm Awards Ceremony **Westin Convention Center Pittsburgh, 3rd Floor, Allegheny Ballroom**
- 6:30 pm – 10:30 pm Student Roundtable Forum & Reprint Exchange **Westin Convention Center Pittsburgh, 3rd Floor, Allegheny Ballroom**
- 8 pm – 10 pm After Hours Party **Westin Convention Center Pittsburgh, 3rd Floor**
## 2010 SVP Schedule of Events

All events are held at the David L. Lawrence Convention Center (DLCC), East Lobby, 3rd Floor unless otherwise noted with an **

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<th>Event/Function</th>
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# PROGRAM AT A GLANCE

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<td>Kohn</td>
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<td>Clementz</td>
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<td>DeSantis</td>
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<td>D. Frater</td>
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<td>MacFadden</td>
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<td>M. Jones</td>
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<td>Barron-Orzaz</td>
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8:00 Shabel, A. TRACE ELEMENT COMPOSITION OF BONE IN RELATION TO THE ECOLOGY OF AFRICAN VERTEBRATES

8:15 Secord, R., Krigbaum, J., Bloch, J. STABLE ISOTOPE ECOLOGY OF MODERN AMAZONIAN MAMMALS: IMPLICATIONS FOR RECOGNIZING CLOSED CANOPY HABITATS IN THE FOSSIL RECORD

8:30 Kohn, M. TERRESTRIAL CARBON ISOTOPE PALEOECOLOGY IN A C3 WORLD

8:45 Clementz, M., Miller, E., El-Barkooky, A., Hamdan, M., Gawad, M. STABLE ISOTOPE EVIDENCE OF SEMIAQUATIC HABITS AND DIETARY NICHE DIFFERENCES FOR FOUR SYMPATRIC SPECIES OF ANTHRACOTHERIIDS FROM WADI MOGHRA, EARLY MIocene, EGYPT

9:00 Thewissen, J., Sensor, J., Clementz, M., Bajpai, S. TOOTH USE AND DIET ACROSS THE ARTIODACTYL-CETACEAN TRANSITION

9:15 Fox, D. RECONSTRUCTION OF SMALL MAMMAL DIETS DURING THE NEogene EXPANSION OF C4 GRASSES IN THE GREAT PLAINS USING LA-IRMS

9:30 Widga, C. DEFINING THE ECOLOGICAL NICHE OF PROBOSCIDEA AND Bison DURING THE LATE QUATERNARY THROUGH STABLE ISOTOPE ANALYSES (MIDWESTERN NORTH AMERICA)

9:45 Fox-Dobbs, K., Thomas, D., Koch, P. PALEOENVIRONMENTAL AND PALEOECOLOGICAL INTERPRETATIONS OF ISOTOPIC RECORDS DERIVED FROM EASTERN BERINGIAN CARIBOU ANTLERS

10:00 BREAK

10:15 Krigbaum, J. HOLOCENE DIET AND SEASONALITY IN TROPICAL SOUTHEAST ASIA: INTEGRATING ISOTOPIC DATA WITH PALEOClimATE PROXIES

10:30 DeSantis, L., Schubert, B. THE COMBINED USE OF STABLE ISOTOPES AND DENTAL MICROWEAR TEXTURE ANALYSIS TO DECIPHER THE PALEOECOLOGY OF AUSTRALIAN MARSUPIALS

10:45 Scott, R., Merceron, G., Tanju, K., Kostopoulos, D., Serdar, M. DENTAL MICROWEAR TEXTURE ANALYSIS, DENTAL MESOWEAR AND DISTAL LIMb ECOMORPHOLOGY OF THE KALFA (Moldova) Hipparionine Horses: A MULTI-PROXY PALEOECOLOGICAL RECONSTRUCTION

11:00 Rivals, E., Semprebon, G., Solounias, N. ADVANCES IN Ungulate DENTAL WEAR TECHNIQUES REVEAL NEW PATTERNS OF NICHE BREADTH AND EXPANSION THROUGHOUT THE CENOZOIC

11:15 Mihlbacher, M., Beatty, B., Caldera-Siu, A., Chan, D., Lee, R. EXPLORING THE INFLUENCE OF OBSERVER Bias IN DENTAL MICROWEAR ANALYSIS

11:30 Stromberg, C., Dunn, R., Kohn, M., Madden, R., Carlini, A. WAS THE EVOLUTION OF HYPsodonty IN SOUTH AMERICA A RESPONSE TO THE SPREAD OF GRASSLAND VEGETATION?: NEW PHYTOLITH RECORDS FROM GRAN BARRANCA, ARGENTINA

11:45 Chew, A. APPROACHING TRUE DIVERSITY IN FOSSIL COMMUNITIES USING A COMBINATION OF RAREFACTION METHODS AND THE PIE EVENNESS INDEX

12:00 George, C. INCONGRUENT QUATERNARY PALEOECOLOGIC MODELS AND IMPLICATIONS FOR USING MAMMALS TO RECONSTRUCT PAST CLIMATE
SUNDAY MORNING, OCTOBER 10, 2010
TECHNICAL SESSION I

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: David Varricchio, David Evans

8:00  Lee, A., Irmis, R., Wedel, M., Werning, S., Padian, K. THE UNIVERSAL TEMPERATURE DEPENDENCE MODEL FAILS TO PREDICT BODY TEMPERATURES ACCURATELY FOR EXTANT AMNIOTES AND EXTINCT DINOSAURS

8:15  Varricchio, D. A DISTINCT DINOSAUR LIFE HISTORY?

8:30  Georgi, J., Sipla, J., Forster, C. TURNING SEMICIRCULAR CANAL FUNCTION ON ITS HEAD: DINOSAUR DIVERSITY SUGGESTS A NOVEL VESTIBULAR ANALYSIS

8:45  Motani, R., Schmitz, L. PHYLOGENETIC BIAS IN FORM-FUNCTION RELATIONSHIPS AND ITS IMPLICATION TO THE FREQUENCY OF NOCTURNAL DINOSAURS

9:00  Butler, R., Benson, R., Carrano, M., Mannion, P., Upchurch, P. INTERACTIONS BETWEEN SEA LEVEL, SAMPLING AND DINOSAUR DIVERSITY DURING THE MESOZOIC ERA

9:15  Maidment, S., Barrett, P. EVOLUTION OF LOCOMOTOR MUSCULATURE IN ORNITHISCHIANS

9:30  Mallon, J., Anderson, J. AN ASSESSMENT OF DIFFERENTIAL FEEDING SELECTIVITY AMONG THE MEGAHerbIVOROUS DINOSAURS FROM THE DINOSAUR PARK FORMATION (LATE CAMBIAN) OF ALBERTA, CANADA

9:45  Campione, N., Evans, D. CRANIAL MORPHOLOGY AND THE DIVERSITY OF LATE CRETAceous EDMONTOSAURS (ORNITHISCHIA: HADROSAURIDAE) FROM NORTH AMERICA

10:00  BREAK


10:30  Evans, D., Schott, R., Ryan, M., Brown, C., Larson, D. A SANTONIAN-AGED PACHYCEPHALOSAURID FROM NORTH AMERICA AND THE EVOLUTION AND DIVERSITY OF PACHYCEPHALOSAURIDAE

10:45  Schott, R., Evans, D., Goodwin, M., Brown, C., Longrich, N. CRANIAL ONTOGENY IN STEGOCErAS AND THE EVOLUTION OF CRANIAL DOMING AND ORNAMENTATION IN PACHYCEPHALOSAURIDAE (DINOSAURIA: ORNITHISCHIA)

11:00  Arbour, V. A CRETAceOUS ARMOURY: MULTIPLE ANKYLOSAURID TAXA IN THE LATE CRETAceous OF ALBERTA, CANADA AND MONTANA, USA


11:30  Lund, E., Sampson, S., Loewen, M. A NEW BASAL CENTROSAURINE DINOSAUR (ORNITHISCHIA: CERATOPSIDAE) FROM THE UPPER CRETAceous OF UTAH: EVIDENCE OF A PREVIOUSLY UNKNOWN CLADE OF SOUTHERN CENTROSAURINES FROM LARAMIDIA

11:45  Ryan, M., Evans, D., Brown, C., Scott, E., Chiba, K. PALEOBiogeOGRAphIC RANGE OF CENTROSAURUS APERTUs (ORNITHISCHIA: CERATOPSIDAE), WITH IMPLICATIONS FOR LATE CRETAceous DINOSAUR PROVINCIALITY AND EVOLUTION

12:00  Dean-Carpentier, M., Porro, L., Sereno, P. MODELLING AND RECONSTRUCTION OF THE FEEDING BIOMECHANICS OF THE BASAL CERATOPSID PSITACOSAURUS GOBIENSIS AND ITS IMPLICATIONS FOR CERATOPSID EVOLUTION
SUNDAY MORNING, OCTOBER 10, 2010
TECHNICAL SESSION II
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Thomas Martin, Christian Kammerer

8:00  Reisz, R., Fröbisch, J., Berman, D., Henrici, A. NEW PERMO-CARBONIFEROUS CASEID SYNAPSIDS FROM NORTH AMERICA AND EUROPE, AND THEIR EVOLUTIONARY SIGNIFICANCE

8:15  Kuemmell, S., Frey, E. THE ROLLING MODE OF THE ACROPODIUM IN EXTINCT SYNAPSIDA

8:30  Fröbisch, J., Angielczyk, K., Sidor, C. KOMBUISIA (SYNAPSIDA, DICYNODONTIA) FROM THE TRIASSIC OF ANTARCTICA, A REFUGE FROM THE TERRESTRIAL PERMIAN-TRIASSIC MASS EXTINCTION

8:45  Kammerer, C., Angielczyk, K., Fröbisch, J. A COMPREHENSIVE REVISION OF THE DICYNODONT ‘WASTEBASKET GENUS’ DICYNODON (THERAPSIDA: ANOMODONTIA)

9:00  Camp, J. A GEOMETRIC MORPHOMETRIC ASSESSMENT OF GONDWANANLYSTROSAURUS AND THEIR RELATION TO LAURASIAN FORMS

9:15  Botha-Brink, J., Smith, R. BONE HISTOLOGY OF CARNIVORE COPROLITES FROM THE UPPER PERMIAN SOUTH AFRICAN KAROO BASIN

9:30  Huttenlocker, A., Botha-Brink, J., Sidor, C. BONE HISTOLOGY AND GROWTH IN THE PERMO-TRIASSIC THEROCEPHALIAN MOSCHORHINUS KITCHINGI (SYNAPSIDA: THERAPSIDA) FROM THE KAROO BASIN OF SOUTH AFRICA


10:00 BREAK

10:15 Ruf, I., Luo, Z., Martin, T. CT SCANNING ANALYSIS OF THE BASICRANIUM AND THE INNER EAR OF HALDANODON EXSPECTATUS (DOCODONTA, MAMMALIA)

10:30 Martin, T., Nowotny, M., Fischer, M. NEW DATA ON TOOTH REPLACEMENT IN THE LATE JURASSIC DOCODONT MAMMAL HALDANODON EXSPECTATUS

10:45 Gaetano, L., Rougier, G. NEW SPECIMENS AND PHYLOGENETIC RELATIONSHIPS OF THE SOUTH AMERICAN JURASSIC TRICONODONT ARGENTOCONODON FARIASORUM

11:00 Parsons, W., Parsons, K., Sues, H. AN UNUSUAL LARGE NEW MAMMALIAFORM FROM THE LOWER CRETACEOUS CLOVERLY FORMATION OF MONTANA

11:15 Lazzari, V., Schultz, J., Taftreau, P., Martin, T. MASTICATORY MOVEMENTS TRIGGER CUSP MORPHOLOGY IN MAMMALIAMORPHS WITH RODENT-LIKE DENTITIONS

11:30 Chen, M., Luo, Z. NEW STUDY OF THE CRETACEOUS MAMMAL AKIDOLESTES WITH ITS IMPLICATIONS FOR EARLY THERIAN MAMMAL POSTCRANIAL EVOLUTION

11:45 Goswami, A., Prasad, G., Upchurch, P., Boyer, D., Seiffert, E. THE PHYLOGENETIC AFFINITIES OF THE ENIGMATIC MAMMAL DECCANOLESTES FROM THE LATE CRETACEOUS OF INDIA AND IMPLICATIONS FOR EUOTHERIAN MAMMAL EVOLUTION

12:00 Schultz, J., Martin, T. 3D-ANALYSIS OF FUNCTIONAL SURFACES IN THE PRE-TRIBOSPHENIC DENTITION
### SUNDAY AFTERNOON, OCTOBER 10, 2010
#### TECHNICAL SESSION III
**DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301**
**MODERATORS: Brian Kraatz, Jonathan Bloch**

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<td>1:45</td>
<td>Hooker, J., Russell, D.</td>
<td>EUROPEAN EARLY PALEOGENE LOUISININES: HIGH DIVERSITY AND ENIGMATIC RELATIONSHIPS</td>
</tr>
<tr>
<td>2:00</td>
<td>Kraatz, B., Meng, J., Wang, Y., Li, C.</td>
<td>MIMOTONID TARSAL BONES FROM THE EOCENE OF CHINA AND THE EVOLUTION OF LOCOMOTION IN Duplicidentata</td>
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<tr>
<td>2:15</td>
<td>Sallam, H., Seiffert, E., Bouer, D., Simons, E.</td>
<td>POSTCRANIAL MORPHOLOGY OF AN ANOMALUROID RODENT FROM THE LATE EOCENE EGYPT</td>
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<td>2:30</td>
<td>Manz, C., Bloch, J., Boyer, D.</td>
<td>TARSAL BONES OF NORTH AMERICAN PALEOGENE LEPTACODON (MAMMALIA, EULIPOTYPHLA?) AND EVIDENCE FOR SCANSORIALITY IN NYCTITHERIIDAE</td>
</tr>
<tr>
<td>2:45</td>
<td>Fox, R., Scott, C.</td>
<td>A NEW, EARLY PUERCAN (EARLIEST PALEOCENE) SPECIES OF PURGATORIUS (PLESIADAPIFORMES, PRIMATES) FROM SASKATCHEWAN, CANADA</td>
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<td>3:00</td>
<td>Woodruff, E., Ruta, M., Bloch, J., Benton, M.</td>
<td>DISPARITY AND EVOLUTIONARY NOVELTY IN TWO PALEOGENE PRIMATE RADIATIONS</td>
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<td>3:15</td>
<td>Nachman, B., Beard, K., Anemone, R.</td>
<td>NEW PRIMATES (OMOMYIDAE) FROM THE GREAT DIVIDE BASIN, WYOMING</td>
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<td>3:30</td>
<td>Gingerich, P., Franzen, J., Habersetzer, J., Hurum, J., Smith, B.</td>
<td>SYSTEMATIC POSITION OF THE EOCENE PRIMATE DARWINIUS MASILLAE</td>
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<td>3:45</td>
<td>Bloch, J., Randall, Z., Silcox, M., Chester, S., Boyer, D.</td>
<td>DISTAL PHALANGES OF EOCENE NORTH AMERICAN NOTHARCTINES (MAMMALIA, PRIMATES): IMPLICATIONS FOR PRIMATE AND ANTHROPOID ORIGINS</td>
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<td>4:00</td>
<td>Zalmout, I., Ali, M., MacLatchy, L., Sanders, W., Gingerich, P.</td>
<td>CRANIUM OF A NEW OLIGOCENE PRIMATE FROM SAUDI ARABIA AND THE DIVERGENCE OF APES AND OLD WORLD MONKEYS</td>
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### SUNDAY AFTERNOON, OCTOBER 10, 2010
#### TECHNICAL SESSION IV
**DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B**
**MODERATORS: Jack Conrad, Michelle Lawing**

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<tr>
<td>1:45</td>
<td>Vietti, L., Rogers, R., Fox, D.</td>
<td>PRELIMINARY DESIGNATION OF MARINE TETRAPOD TAPHOFACIES</td>
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<tr>
<td>2:00</td>
<td>Ji, C., Jiang, D., Motani, R., Hao, W., Sun, Z.</td>
<td>PHYLOGENETIC ANALYSIS OF SHASTASAURIDAE ILLUMINATED BY GUIZHOUICHTHYOSAURUS FROM CHINA INDICATES A POSSIBLE PATHWAY OF THE MIGRATION OF THIS FAMILY</td>
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<td>2:30</td>
<td>Liu, J., Rieppel, O., Jiang, D., Aitchison, J., Zhang, Q.</td>
<td>A SMALL PACHYPELGAURAS FROM THE LOWER MIDDLE TRIASSIC OF SW CHINA WITH COMMENTS ON THE PHYLOGENY OF EOSAUROPTERYGIA</td>
</tr>
<tr>
<td>2:45</td>
<td>Sato, T., Wu, X.</td>
<td>BRAINCASE OF A POLYCOTYLID PLESIOSAUR (REPTILIA: SAUROPTERYGIA) FROM THE UPPER CRETACEOUS OF MANITOBA, CANADA</td>
</tr>
<tr>
<td>3:00</td>
<td>Jones, M., Curtis, N., O’Higgins, P., Fagan, M., Evans, S.</td>
<td>CRANIAL JOINTS IN SPHENODON (RHYNCHOCEPHALIA) AND ITS FOSSIL RELATIVES WITH IMPLICATIONS FOR LEPIDOSAUR SKULL MECHANICS</td>
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TECHNICAL SESSION IV (continued)

3:30 Yi, H., Norell, M. NEW MATERIALS OF ESTESIA MONGOLIENSIS (REPTILIA: SQUAMATA) FROM THE LATE CRETACEOUS OF MONGOLIA CAST DOUBT ON THE MONOPHYLY OF THE MONSTERSAURIA

3:45 Conrad, J., Sidor, C. A FOSSIL JESUS LIZARD (SQUAMATA, CORYTOPHANIDAE) FROM THE EOCENE OF NORTH AMERICA

4:00 Lawing, A., Polly, P. MODELLING EFFECTS OF PLEISTOCENE CLIMATE CYCLES ON SPECIES’ DISTRIBUTIONS: IMPLICATIONS FOR THE NEAR FUTURE

SUNDAY AFTERNOON, OCTOBER 10, 2010
TECHNICAL SESSION V
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Larry Flynn, Bruce MacFadden

1:45 Samuels, J., Janis, C. IMPACTS OF CENOZOIC CLIMATE AND HABITAT CHANGES ON RODENT COMMUNITIES

2:00 Flynn, L. Z-113

2:15 Calede, J., Hopkins, S. MICROWEAR, DIET AND FOSSORIALITY IN MIOCENE RODENTS FROM THE GREAT BASIN

2:30 Fraser, D., Theodor, J. UNGULATE DIETS REVEAL PATTERNS OF NORTH AMERICAN GRASSLAND EXPANSION DURING THE LATE MIOCENE

2:45 MacFadden, B. MIOCENE MAMMALS OF PANAMA: TROPICAL REFUGIUM OR CRADLE OF BIODIVERSITY?

3:00 Campbell, K., Prothero, D., Romero-Pittman, L., Hertel, F., Rivera, N. AMAZONIAN MAGNETOSTRATIGRAPHY: DATING THE FIRST PULSE OF THE GREAT AMERICAN FAUNAL INTERCHANGE

3:15 Bibi, F. MIO-PLIOCENE FAUNAL EXCHANGES BETWEEN EURASIA AND AFRICA: THE RECORD OF RARE BOVID TAXA

3:30 Deng, T., Hou, S. A DENSELY CONCENTRATED EARLY PLIOCENE MAMMALIAN FAUNA FROM THE LINXIA BASIN IN GANSU, CHINA


4:00 Barron-Ortiz, C., Theodor, J. NORTH AMERICAN LATE PLEISTOCENE EQUIDS (MAMMALIA, PERISSODACTYLA): A GEOMETRIC MORPHOMETRIC STUDY OF THE UPPER PREMOLARS

SUNDAY AFTERNOON, OCTOBER 10, 2010
POSTER SESSION I
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM A

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

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

1 Fillmore, D., Lucas, S., Simpson, E., Szajna, M. AN EXAMPLE OF UNDICHTNA, THE FISH SWIMMING TRACE, FROM THE DEVONIAN CATSKILL FORMATION, EASTERN PENNSYLVANIA

2 Scott, B., Wendruff, A., Wilson, M. MORPHOLOGY AND ASPECT RATIO OF THE TAIL OF THE LOWER DEVONIAN OSTEOSTRACAN SUPERCILIASPIS GABRIELSEI

3 Potvin-Leduc, D., Cloutier, R., Landing, E., VanAller Hernick, L., Mannolini, F. NEW CHONDRICHTHYAN MICROREMAINS FROM NEW YORK, USA: INSIGHTS INTO MIDDLE-LATE DEVONIAN CHONDRICHTHYAN GLOBAL DISPERSION
SUNDAY AFTERNOON, OCTOBER 10, 2010
POSTER SESSION I (continued)

4 Andermann Jr., R., Grogan, E., Lund, R. PECTORAL GIRLLE AND FIN SEXUAL DIMORPHISM IN THE HOLOCEPHALAN HARPAGOFOUTUTOR VOLSELLORHINUS FROM THE BEAR GULCH LIMESTONE OF MONTANA (HEATH FORMATION, BIG SNOWY GROUP, SERPUKHOVIAN) WITH COMMENTS ON CHONDRENCHELYS PROBLEMATIC.A

5 Elliott, D., Hodnett, J., Olsen, T. CTENACANTHIFORM SHARKS FROM THE PERMIAN KAIBAB FORMATION, NORTHERN ARIZONA

6 Fischer, J., Voigt, S., Buchwitz, M., Schneider, J. THE TRIASSIC MASYGEN LAKE ENVIRONMENT — A SHARK NURSERY GROUND?

7 Hamm, S. A NEW GENUS OF PTYCHODONTID SHARK FROM THE ALBIAN OF TEXAS AND ITS PHYLOGENETIC PLACEMENT WITHIN PTYCHDONTIDAE

8 Sankey, J. NUMEROUS SHARKS FROM LATEST CRETACEOUS UPPERMOST HELL CREEK FORMATION, NORTH DAKOTA: SEA LEVEL RISE DUE TO THE LATE MAASTRICHTIAN GREENHOUSE EVENT?

9 Cook, T., Newbrey, M., Murray, A., Wilson, M., Shimada, K. ESTIMATED AGE AND SIZE OF THE LATE CRETACEOUS SHARK ARCHAEOLAMNA KOPINGENSIS

10 Popov, E. THE DIVERSITY AND NOMENCLATURAL REVISION OF THE HOLOCEPHALIAN FISHES (CHIMAERIFORMES) FROM THE HORNERSTOWN FORMATION (K/T TRANSITION) OF NEW JERSEY, USA

11 Tulu, Y. BIOGEOGRAPHY OF THE LATE CRETACEOUS CHONDRICHTHYAN FAUNA FROM THE JUDITH RIVER FORMATION (CAMPANIAN), MONTANA: WHEN TO USE GENERIC LEVEL DATA OVER SPECIES LEVEL DATA IN PARSIMONY ANALYSIS OF ENDEMICY

12 Tanoue, K., Shimada, K., Rigsby, C., Nicholas, A. JAW MECHANICS IN LAMNIFORM SHARKS AND ITS EVOLUTIONARY IMPLICATIONS

13 DeMar, Jr., D., Wilson, G. AMPHIBIANS INDICATE ECOSYSTEM INSTABILITY PRIOR TO AND AFTER THE K-PG BOUNDARY: FOSSIL EVIDENCE FROM GARFIELD COUNTY, NE MONTANA

14 Folie, A., Smith, R., Smith, T. AMPHIBIAN DIVERSITY FROM THE EARLY OLIGOCENE BORGLOON FORMATION AT BOUTERSEM, BELGIUM

15 Ikeda, T., Saegusa, H., Handa, K. A FOSSIL ANURAN FROM THE LOWER CRETACEOUS SASAYAMA GROUP OF HYOGO PREFECTURE, SW JAPAN

16 Ruta, M., Bolt, J. MAXIMUM PARSIMONY AND BAYESIAN INFERENCE ANALYSES OF PALAEOZOIC TEMNOSPONDYL: SUPPORT FOR A CLADE OF HETEROCHRONIC TAXA AND RAPID CHARACTER EXHAUSTION IN EARLY DIVERGING BRANCHES

17 Madalena, K., Zeigler, K., Sumida, S. PRELIMINARY REPORT OF NORIAN TRIASSIC AGE VERTEBRATE FAUNA FROM LANDS BELONGING TO THE PUEBLO OF JEMEZ, NORTH CENTRAL NEW MEXICO, INCLUDING AN UNUSUALLY LARGE TEMNYSPODYL METOPOSAURID AMPHIBIAN

18 Gardner, N., Holliday, C., Zhu, H., O’Keefe, F. BRAINCASE ANATOMY OF THE BASAL DIAPSID YOUNGINA CAPENSIS FROM HIGH-RESOLUTION X-RAY CT SCANNING

19 Mazierski, D., Reisz, R. A NEW, NEARLY COMPLETE SPECIMEN OF PETROLACOSAURUS KANSENSIS (DIAPSID: ARAEOSCELIDAE) THE EARLIEST KNOWN DIAPSID FROM THE UPPER PENNSYLVANIAN OF KANSAS

20 Buchwitz, M., Witzmann, F., Kogan, I., Voigt, S. CHRONIOSUCHIANS AS CROCODILE MIMICS

21 Modesto, S. THE POSTCRANIAL SKELETON OF THE AQUATIC PARAREPTILE MESOSAURUS TENUIDENS FROM THE GONDWANAN PERMIAN
MacDougall, M., Modesto, S. NEW INFORMATION ON THE SKULL OF THE EARLY TRIASSIC PARAREPTILE SAUROPAIREION ANOPLUS

Heckert, A. BIOSTRATIGRAPHIC SIGNIFICANCE AND REDESCRIPTION OF THE ENIGMATIC VERTEBRATE COLOGNATHUS OBSCURUS FROM THE UPPER TRIASSIC CHINLE GROUP, SOUTHWESTERN U.S.A.

Hao, W., Jiang, D., Rieppel, O., Motani, R., Tintori, A. NEW SPECIMEN OF THE TERRESTRIAL REPTILE MACROCENEMUS FROM THE LATEST LADINIAN XINGYI-FUYUAN MARINE REPTILE LEVEL, SOUTHWESTERN CHINA

Bennett, S. INCONGRUENCE BETWEEN MORPHOLOGICAL DATA PARTITIONS: AN EXAMPLE FROM THE FOSSIL RECORD OF THE ARCHOSAUROMORPHA

Voigt, S., Schneider, J., Saber, H., Klein, H., Hminna, A. COMPLEX TETRAPOD BURROWS FROM THE TRIASSIC TIMEZGADIOUINE FORMATION (ARGANA BASIN, WESTERN HIGH ATLAS, MOROCCO)

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Larson, D., Brinkman, D., Morin, J. LATE CRETACEOUS CANADIAN SPECIMENS OF FAMILY SOLEMYIDIDA (TESTUDINES) WITH SPECIAL MENTION OF A NEW GENUS AND SPECIES

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Hirayama, R., Shikano, K., Sonoda, T. OLIGOCENE MALAYEMYS AND MIOCENE GEOEMYDA (GEEMYDIDAE; TESTUDINES) FROM JAPAN

Georgalis, G., Kear, B. NEW RECORDS OF FOSSIL TURTLES FROM GREECE

Vitek, N. CHARACTER REINTERPRETATION AND FOSSIL SOFT-SHELLED TURTLE TAXA (TRIONYCHIDAE) WORK TOGETHER TO RECOVER NEW RELATIONSHIPS

Rubilar-Rogers, D. NEW LOCALITY WITH DINOSAUR TRACKS FROM THE LATE JURASSIC OF THE ATACAMA DESERT, NORTHERN CHILE

Coria, R., Currie, P., Koppelhus, E., Braun, A., Cerda, I. FIRST RECORD OF A VALANGINIAN (EARLY CRETACEOUS) DINOSAUR ASSOCIATION FROM SOUTH AMERICA

Shibata, M., Azuma, Y. NEW DINOSAURS FROM THE LOWER CRETACEOUS KITADANI FORMATION OF THE TETORI GROUP, FUKUI, CENTRAL JAPAN

de Santisteban, C., Santos-Cubedo, A., Suñer, M., Poza, B. DINOSAUR FOSSIL SITES INSIDE INCISED CHANNELS. AN EXAMPLE FROM THE ARCILLAS DE MORELLA FORMATION (LOWER CRETACEOUS, SPAIN)

Lynch, E., Novak, B., Bridges, T. EVIDENCE OF A BACTERIAL ORIGIN FOR DINOSAUR “BLOOD VESSELS” FROM UPPER CRETACEOUS DINOSAUR BONE

Fiorillo, A., Adams, T., Kobayashi, Y. A NEW DINOSAUR ICHNOFAUNA FROM THE LATE CRETACEOUS OF WRANGELL-ST. ELIAS NATIONAL PARK AND PRESERVE, ALASKA

Kong, D., Lim, J., Kim, T., Kim, K. DISCOVERY OF A LARGE REPTILIAN TRACKWAY FROM THE CRETACEOUS JINDONG FORMATION OF GOSEONG COUNTY, KOREA

Stout, J., Boardman, G. MORPHOLOGY AND SYSTEMATICS OF DINOSAUR EGGSHELLS AND THE IDENTIFICATION OF PROBLEMATIC OOSPECIES

Porter, W., Witmer, L. VASCULATURE AND DINOSAUR PHYSIOLOGY: VASCULAR PATTERNS IN EXTANT DIAPSIDS
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43  Trevethan, I., Scannella, J. A MORPHOMETRIC ANALYSIS OF CRANIAL SEXUAL VARIATION IN THE EXTANT PHYLOGENETIC BRACKET OF THE DINOSAURIA: IMPLICATIONS FOR FOSSIL STUDIES

44  Padian, K., Horner, J., Fowler, D., Scannella, J. HOW A SYNERGY OF SPECIES RECOGNITION AND SOCIAL SIGNALING EXPLAINS CRANIAL ANATOMY AND ONTOGENY IN SEVERAL GROUPS OF DINOSAURS

45  Falkingham, P., Margetts, L., Manning, P. MUDDYING THE WATER: TRACK FEATURES TYPICAL OF LIMB KINEMATICS FORMED THROUGH NORMAL SUBSTRATE DEFORMATION, AS SHOWN BYFINITE ELEMENT ANALYSIS EXPERIMENTATION

46  Habib, M. 10,000 MILES: MAXIMUM RANGE AND SOARING EFFICIENCY OF AZHDARCHID PTEROSAURS

47  Rodrigues, T., Kellner, A. REAPPRAISAL OF BASAL PTEROSAUR RELATIONSHIPS THROUGH THE REDUCED CONSENSUS METHOD

48  Sumida, S., Pelletier, V. PARTIAL BODY RECONSTRUCTION OF THE BASAL PELYCOSAURIAN-GRADE SYNAPSID OEDALEOPS


50  Hawthorn, J., Scott, D., Reisz, R. CRANIAL ANATOMY OF OPHIACODON UNIFORMIS: NEW INSIGHTS FROM AN EXCEPTIONALLY PRESERVED SPECIMEN USING COMPUTED TOMOGRAPHY

51  Harris, S., Lucas, S., Spielmann, J. POSTCRANIAL ANATOMY OF OPHIACODON NAVAJOVICUS (EUPELYCOSAURIA: OPHIACODONTIDA), FROM THE UPPER PENNSYLVANIAN OF CANYON DEL COBRE, NEW MEXICO

52  Spindler, F., Schneider, J., Voigt, S. TAPHONOMIC ANALYSIS OF THE SKELETAL AGGREGATION OF PANTEOSAURUS (SPHENACODONTIA, EUPELYCOSAURIA)

53  Wong Ken, N., Reisz, R., May, W. A NEW VARANOPID SYNAPSID FROM THE LOWER PERMIAN OF OKLAHOMA, WITH EVIDENCE OF HYPERCARNIVORY

54  Scott, K., Sumida, S. PLACEMENT OF THE PERMO-CARBONIFEROUS BOUNDARY IN THE HALGAIITO FORMATION, CUTLER GROUP, SOUTHEASTERN UTAH

55  Krainer, K., Lucas, S., Harris, S., Spielmann, J., Rinehart, L. VERTEBRATE PALEONTOLOGY, BIOSTRATIGRAPHY AND BIOCHRONOLOGY OF THE PENNSYLVANIAN-PERMIAN CUTLER GROUP, CANYON DEL COBRE, NORTHERN NEW MEXICO

56  Martens, T., Berman, D., Henrici, A., Sumida, S. THE BROMACKER HORIZON - THE MOST IMPORTANT SEQUENCE OF STRATA OF LOWER PERMIAN TERRESTRIAL VERTEBRATE FOSSILS OUTSIDE OF NORTH AMERICA

57  Weinbaum, J., Martz, J. A NEW VERTEBRATE FOSSIL LOCALITY IN THE UPPER TRIASSIC CHINLE FORMATION OF NORTHEASTERN ARIZONA

58  Gold, M. BIOSTRATIGRAPHIC CORRELATION OF A NEW TRIASSIC FOSSIL LOCALITY WITHIN THE GETTYSBURG BASIN, MARYLAND

59  Martz, J., Parker, W. UNDERSTANDING AND UTILIZING DETAILED BIOSTRATIGRAPHIC DATA TO CHARACTERIZE LATE TRIASSIC FAUNAL CHANGE: EXAMPLES FROM WESTERN NORTH AMERICA

60  Carpenter, K. TAPHONOMY OF THE DOUGLASS QUARRY, DINOSAUR NATIONAL MONUMENT, UTAH

61  O’Connor, P., Sertich, J., Sallam, H., Seiffert, E. RECONNAISSANCE PALEONTOLOGY IN THE LATE CRETACEOUS OF DAKHLA AND KHARGA OASES, WESTERN DESERT, EGYPT
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63 Nagrodski, M., Shimada, K., Schumacher, B. FOSSIL MARINE VERTEBRATES FROM THE UPPER CRETACEOUS HARTLAND SHALE IN SOUTHEASTERN COLORADO

64 Gates, T., Makovicky, P., Rieppel, O. MICROVERTEBRATE FAUNA FROM THE MAASTRICHTIAN (LATE CRETACEOUS) “SUE” QUARRY: IMPLICATIONS FOR MICROSITE ORIGINATION AND FINE-SCALED HELL CREEK FORMATION BIODIVERSITY


66 Ullmann, P., Varricchio, D., Knell, M., Lacovara, K. TAPHONOMY AND TAXONOMY OF A VERTEBRATE MICROSITE IN THE CRETACEOUS BLACKLEAF FORMATION IN SOUTHWEST MONTANA

67 Crane, C., Rigsby, C., Culver, S., Russell, D. VERTEBRATE FAUNAL ANALYSIS OF THE LATE CRETACEOUS BLACK CREEK GROUP, BLAEDEN COUNTY, NORTH CAROLINA

68 Callahan, W., Johnson, R., Mehling, C. A NEW VERTEBRATE ASSEMBLAGE FROM THE LATE CRETACEOUS (MAASTRICHTIAN) NEW EGYPT FORMATION OF NEW JERSEY

69 Kaye, T., Martin, L., Burnham, D., Gong, E. MULTISPECTRAL IMAGING AND ANALYSIS OF A LIAONING “MYSTERY SPECIMEN”

70 Cumbaa, S., Shimada, K., Cook, T. MID-CENOMANIAN VERTEBRATE FAUNAS OF THE NORTH AMERICAN WESTERN INTERIOR SEAWAY

71 Egerton, V., Williams, C., Lacovara, K. CLIMATIC AND FLORAL LATITUDINAL GRADIENTS BETWEEN LATE CRETACEOUS SOUTH AMERICA AND ANTARCTICA: PALEOBIOGEOGRAPHICAL IMPLICATIONS FOR SOUTHERNMOST GONDWANA

72 Peyrot, D., Barroso-Barcenilla, F., Berreteaga, A., Cambra-Moo, O. FIRST PALYNOLOGICAL DATA AND INTERPRETATION OF “LO HUECO” VERTEBRATE SITE (UPPER CRETACEOUS, CUENCA, SPAIN)

73 Rogers, R., Krause, D. NEW INSIGHTS INTO THE GEOLOGICAL CONTEXT OF THE LATE CRETACEOUS VERTEBRATE ASSEMBLAGE FROM THE MAEV ARANO FORMATION, MAHAJANGA BASIN, MADAGASCAR


75 González-Acebrón, L., Barroso-Barcenilla, F., Cambra-Moo, O., Carenas, B. DIAGENETIC OVERVIEW ON VERTEBRATE FOSSILS FROM THE SANDY CHANNEL OF “LO HUECO” SITE (UPPER CRETACEOUS, SPAIN)

76 Ikegami, N. TAPHONOMY AND SEDIMENTOLOGY OF A BONEBED FROM THE UPPER CRETACEOUS MIFUNE GROUP IN KYUSHU, JAPAN

77 Meyers, V., Rowland, S. COMPARISON OF TWO PLIOcene (BLANCA) VERTEBRATE FOSSIL ASSEMBLAGES: PANACA LOCAL FAUNA (LINCOLN COUNTY, NEVADA) AND HAGERMAN LOCAL FAUNA (TWIN FALLS COUNTY, IDAHO)

78 Randall, K., Gensler, P. A PRELIMINARY REPORT ON A BLANCA MICRO MAMMAL ASSEMBLAGE FROM THE OTAY RANCH VILLAGE 2 NORTH HOUSING DEVELOPMENT PROJECT, SAN DIEGO FORMATION, CHULA VISTA, CALIFORNIA

79 Reed, D., Geraads, D. A NEW PLIO-PLEISTOCENE MICROMAMMAL ASSEMBLAGE FROM HADAR A.L. 894, AFAR ETHIOPIA

80 Seymour, K. PAWS FOR THOUGHT: THE LATE PLEISTOCENE FOSSIL VERTEBRATES FROM THE TALARA TAR SEEPS, PERU, AND CORRALITO, ECUADOR
SUNDAY AFTERNOON, OCTOBER 10, 2010
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81 Atwater, A., Davis, E. TOPOGRAPHIC CHANGE AND PLIO-PLEISTOCENE BETA DIVERSITY OF THE NORTH AMERICAN GREAT BASIN AND GREAT PLAINS
82 Hakala, S., Bobe, R. LATERAL AND TEMPORAL DISTRIBUTION OF MAMMALIAN FAUNA FROM EARLY PLEISTOCENE KOOBI FORA FORMATION, EAST TURKANA
83 Milideo, L. ACTUALISTIC TAPHONOMY OF COLD AND TEMperate CLIMATES: APPLICATIONS FOR PLEISTOCENE PALEONTOLOGY
84 Slepkov, R., Kovarovic, K., McNulty, K. REFINING ECOLOGICAL DIVERSITY ANALYSIS IN A PALEOECOLOGICAL RECONSTRUCTION OF OLDUVAI GORGE BED II
85 France, C., Kaufman, A. TROPHIC RELATIONSHIPS BETWEEN LATE PLEISTOCENE MAMMALS FROM AUCILLA RIVER, FLORIDA: EVIDENCE FROM NITROGEN AND CARBON STABLE ISOTOPES
86 Garrett, N., Fox, D., McNulty, K., Tryon, C., Peppe, D. ISOTOPE PALEOECOLOGY OF THE PLEISTOCENE WASIRIYA BEDS OF RUSINGA ISLAND, KENYA
87 Jass, C., Burns, J., Milot, P. RELATIVE ABUNDANCE OF LATE PLEISTOCENE MEGafauna IN CENTRAL ALBERTA, CANADA
88 Tamma, K., Ramakrishnan, U. TEMPORAL VARIABILITY IN THE COMPOSITION OF A FOSSIL SMALL MAMMAL ASSEMBLAGE FROM SOUTH INDIA
89 Pons-Monjo, G., Furió, M., Moyà-Solà, S. THE UNUSUAL PELVIC CONSTRUCTION OF THE INSULAR SHREW NESIOTITES HIDALGO (SORICIDAE, MAMMALIA) FROM MALLORCA (BALEARIC ISLANDS, SPAIN)
90 Arney, I., Lewis, P., Thies, M. THE UTILITY OF POSTCRANIAL ELEMENTS IN DIAGNOSING SOUTHERN AFRICAN MICROFAUNA
91 Rowland, S. AGE PROFILE OF COLUMBIAN MAMMOTHS FROM THE TULE SPRINGS FOSSIL BEDS, UPPER LAS VEGAS WASH, NEVADA
92 Patterson, D., Mead, A. NEW SKELETAL REMAINS OF MAMMUTHUS COLUMBI FROM COASTAL GEORGIA
93 Smith, K., Fisher, D. SEXUAL DIMORPHISM IN TUSKS OF AMERICAN MASTODONS (MAMMUT AMERICANUM) AND AFRICAN ELEPHANTS (LOXODONTA AFRICANA, LOXODONTA CYCLOTIS): A MULTIVARIATE COMPARISON
94 Green, J. USING TUSK MICROWEAR TO RECONSTRUCT FEEDING BEHAVIOR IN EXTINCT PROBOSCIDEANS (MAMMALIA)
95 Peek, S., Clementz, M. THE EFFECT OF DIAGENESIS ON SR/CA AND BA/CA RATIOS OF TOOTH ENAMEL
96 Schmitt, E., Schubert, B., Ungar, P., Scott, J. ANALYSIS OF THE BONE CRUSHING BEHAVIOR OF CANIS DIRUS USING DENTAL MICROWEAR TEXTURE ANALYSIS

MONDAY MORNING, OCTOBER 11, 2010
SYMPOSIUM: PHYSICAL DRIVERS AND MARINE TETRAPOD EVOLUTION
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301
MODERATORS: Robert Fordyce, Neil Kelley

8:00 Fordyce, R., Marx, F., Aguirre-Fernández, G. PHYSICAL TRENDS, RHYTHMS AND ABERRATIONS IN THE WORLD OF MARINE TETRAPODS: THE CASE OF PLATANISTOID AND DELPHINOID DOLPHINS
8:15 Kelley, N., Motani, R., Jiang, D., Rieppel, O. GLOBAL GEOCHEMICAL CONTEXT OF EARLY MESOZOIC MARINE REPTILE EVOLUTION

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MONDAY MORNING, OCTOBER 11, 2010
SYMPOSIUM: PHYSICAL DRIVERS AND MARINE TETRAPOD EVOLUTION (continued)

8:30 Rieppel, O. THE DIVERSIFICATION AND DECLINE OF SAUROPTERYGIA IN THE TRIASSIC WESTERN TETHYS

8:45 Fischer, V. RECONSIDERING THE EXTINCTION OF ICHTHYOSAURS

9:00 Polcyn, M. SENSORY ADAPTATIONS IN MOSASAURS


9:30 Parham, J., Joyce, W. PHYSICAL DRIVERS AND THE ORIGINS, EVOLUTION AND DIVERSITY OF MARINE TURTLES

9:45 Hinic-Frlog, S., Rowe, G., Rybczynski, N. SKELETAL SPECIALIZATIONS FOR LOCOMOTION IN AQUATIC BIRDS: PHYLOGENETIC AND PHYSICAL ASPECTS

10:00 BREAK

10:15 Ando, T. FLIGHTLESS WING-PROPELLED DIVERS: SOUTHERN PROSPERITY VS. NORTHERN EXTINCTIONS

10:30 Beatty, B., Mihlbachler, M. DENTAL MICROWEAR OF MODERN AND FOSSIL SIRENIA REFLECTS CHANGES IN THE PHYSICAL ENVIRONMENT IN THE NEOGENE OF FLORIDA

10:45 Kohno, N. ENVIRONMENTAL CHANGES AND EVOLUTIONARY DIVERSIFICATION OF PINNIPEDS

11:00 Davis, E., Pyenson, N. USING THE HIGH FIDELITY OF CETACEAN STRANDINGS TO REVEAL THE SPATIOTEMPORAL SCALES OF CETACEAN MACROECOLOGY


11:30 Fitzgerald, E. EVOLUTION AND EXTINCTION OF RIVER DOLPHINS (CETACEA: PLATANISTOIDEA) IN CENTRAL AUSTRALIA

11:45 Marx, F., Fordyce, R. LEVIATHANS SPORTING ON THE FOAMING WAVES - AN INTEGRATED VIEW OF BALEEN WHALE DIVERSITY, DISPARITY AND EVOLUTIONARY RELATIONSHIPS

12:00 Pyenson, N., Lindberg, D. WHAT HAPPENED TO GRAY WHALES DURING THE PLEISTOCENE? RECONSTRUCTING THE ECOLOGICAL IMPACT OF SEA-LEVEL CHANGE ON CRITICAL BENTHIC FEEDING HABITATS IN THE NORTH PACIFIC OCEAN

MONDAY MORNING, OCTOBER 11, 2010
ROMER PRIZE SESSION

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: David Fox, Leon Claessens

8:00 Cooper, L. THE EVOLUTION AND DEVELOPMENT OF HYPERPHALANGY AND HYDROFOILS IN CETACEANS

8:15 Crowley, B. COMPETITIVE RELEASE OR ECOLOGICAL RETREAT: ECOLOGICAL RAMIFICATIONS OF EXTINCTION AND HABITAT TRANSFORMATION FOR MADAGASCAR’S LEMURS

8:30 de Boef Miara, M. THE EFFECTS OF PHYLOGENY, FUNCTION AND PHYSIOLOGY ON BONE MICROSTRUCTURE

8:45 Fowler, D. ANAGENESIS AND LONG-TERM MORPHOLOGIC TRENDS IN CHASMOCAURINAE (DINOSAURIA: CERATOPSIDAE) REVEALED BY A NEW HIGH-RESOLUTION CHRONOSTRATIGRAPHIC FRAMEWORK, ONTOGENETIC ANALYSIS AND DESCRIPTION OF TWO NEW TAXA

9:00 Gignac, P. TOOTH PRESSURES, NICHE OCCUPATION AND THE EVOLUTION OF THE CRANIAL ECOMORPHOLOGY OF CROCODYLIANS
MONDAY MORNING, OCTOBER 11, 2010
ROMER PRIZE SESSION (continued)

9:15  Hirasawa, T. THE EVOLUTION OF RIBCAGE ANATOMY AND BREATHING FUNCTION IN THE MESOZOIC THEROPODS

9:30  Marjanović, D. AGE AND RELATIONSHIPS OF THE MODERN AMPHIBIANS (TETRAPODA: SALIENTIA, CAUDATA, GYMNOPHIONA, ALBANERPETONTIDAE)

9:45  McGuire, J. INTERPRETING RECENT SMALL-MAMMAL RANGE SHIFTS IN YOSEMITE IN LIGHT OF THE QUATERNARY FOSSIL RECORD

10:00  BREAK

10:15  Ololi, J. DEVELOPMENTAL FEATURES OF MICROSAURS (LEPOSPONDYLI), AND CONSEQUENCES FOR THE EVOLUTION OF DEVELOPMENT AND PHYLOGENETIC RELATIONSHIPS WITHIN TETRAPODA

10:30  Sadleir, R. SEASONALITY AS A POTENTIAL SOURCE OF VARIATION IN ALLIGATOR CRANIAL EVOLUTION

10:45  Scannella, J. TRICERATOPS: A MODEL ORGANISM FOR DECIPHERING DINOSAUR HETEROCHRONY

11:00  Schachner, E. EVOLUTION OF THE DINOSAURIFORM RESPIRATORY SYSTEM: NEW EVIDENCE FROM THE POSTCRANIAL AXIAL SKELETON

11:15  Spaulding, M. PHYLOGENY OF THE CARNIVORAMORPHA, WITH IMPLICATIONS FOR LOCOMOTOR RECONSTRUCTION

11:30  Thomas, D. EVOLUTION OF HEAT RETENTION IN PENGUINS

11:45  Wheatley, P. EVOLUTION OF SALT-WATER TOLERANCE IN THE CROCODYLIA AND RELATED CROCODYLOMORPHS: NEW INSIGHTS FROM STABLE ISOTOPES

12:00  Wilhelm, B. OSTEOLOGICAL EVIDENCE FOR A TAIL FIN IN CRYPTOCELEIDOID PLESIOSAURS AND THE ROLE OF THE TAIL IN PLESIOSAUR LOCOMOTION

MONDAY MORNING, OCTOBER 11, 2010
PREPARATORS’ SESSION

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Kyle Davies, William Simpson

8:00  Potapova, O., Agenbroad, L., Wilkins, W. FROM THE BONEBED TO THE BASEMENT: COLLECTION PROCEDURES AT THE MAMMOTH SITE OF HOT SPRINGS, SOUTH DAKOTA

8:15  Fry, R., Main, D. MAPPING AND RECORDING THE EXCAVATION OF A MID-CRETACEOUS CROCODILE (ARCHOSAURIA: GONIOPHOLIDAE) AT AN URBAN DIG UTILIZING A CARTESIAN MAPPING SYSTEM

8:30  Benton, R., Weiler, M., Thompson, W. LONG TERM DOCUMENTATION OF THE CONATA PICNIC GROUND SITE (BIG PIG DIG) BADLANDS NATIONAL PARK, SOUTH DAKOTA

8:45  Smith, M. CSI KIMBERLY: FOSSIL CRIME SCENE INVESTIGATION PRIOR TO THE ESTABLISHMENT OF THE PALEONTOLOGICAL RESOURCES PROTECTION ACT

9:00  Brown, G. BONE BANDAGES: A CONSERVATIONALLY-SOUND REPAIR TECHNIQUE FOR BROKEN BONES HAVING LIMITED CONTACT SURFACE AREA

9:15  Shinya, A. USE OF RIGID, SEMI-RIGID AND TRANSPARENT CRADLES FOR PREPARATION AND LONG TERM STORAGE OF DELICATE SPECIMENS

9:30  Keyser, W., Kroehler, P., Jabo, S. CONTINUED IMPROVEMENTS IN THE USE OF ARCHIVAL MATERIALS FOR THE PADDED PLASTER JACKET STORAGE METHOD: WHAT WE HAVE LEARNED IN TWENTY YEARS

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MONDAY MORNING, OCTOBER 11, 2010
PREPARATORS’ SESSION (continued)

9:45  Nelsen, T., Grasso, J., Haulton, K., Gensler, P. ADDRESSING A CRITICAL NEED WITHIN THE COLLECTIONS AT HAGERMAN FOSSIL BEDS NATIONAL MONUMENT: REFINED AND IMPROVED TECHNIQUES AND MATERIALS FOR THE PRODUCTION OF MULTI-SIZE, CLAM SHELL SPECIMEN CRADLES

10:00  BREAK

10:15  Carlson, K., Smilg, J., DeClerk, B., Yates, C., Berger, L. CT IMAGING OF FOSSIL-BEARING CALCIFIED CLASTIC SEDIMENTS FROM THE MALAPA SITE, SOUTH-AFRICA—ADVANCES IN DISCOVERY, IDENTIFICATION AND PREPARATION OF FOSSIL HOMININS AND FAUNA

10:30  Andersen, A., Lichko, J., Jones, M., Larson, P. HOW TO MOLD AND CAST A MUMMY DINOSAUR

10:45  Keillor, T., Sereno, P., Masek, R. RANGE OF MOVEMENT IN A NOASAURID FORELIMB: IN SITU DATA AND JOINT RECONSTRUCTION

11:00  Davies, K., Cifelli, R., Davis, B., Gordon, C. A SIMPLE MICROVERTEBRATE MOLDING AND CASTING TECHNIQUE: A 20-YEAR RETROSPECTIVE

11:15  Van Beek, C. PREPARATION OF MICRO-FEATURES OF EOCENE GREEN RIVER SPECIMENS: METHODS AND MATERIALS

11:30  Shaw, T., Nydegger, L. CREATION OF A LARGE SCALE INTERPRETIVE TRACKWAY DISPLAY

11:45  Chure, D. RACING AGAINST DISASTER: THE DEMOLITION, REHABILITATION AND RECONSTRUCTION OF THE Quarry VISITOR CENTER, CARNEGIE Quarry, DINOSAUR NATIONAL MONUMENT

12:00  Brown, M., Rowe, T. DESIGNING THE MODERN PREPARATION LAB: INTEGRATING NEW TECHNOLOGIES

MONDAY AFTERNOON, OCTOBER 11, 2010
TECHNICAL SESSION VI

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301
MODERATORS: Wighart von Koenigswald, Nancy Simmons

1:45  Smith, T., de Ploëg, G., Métais, G., Eric, D., Floréal, S. FIRST MODERN MAMMALS FROM THE LATEST PALEOCENE OF EUROPE

2:00  Wang, Y., Tong, Y., Li, Q. UPDATED ASIAN PALEOCENE MAMMALIAN BIOCHRONOLOGY AND ITS IMPLICATIONS TO INTERCONTINENTAL FAUNAL INTERCHANGE

2:15  Giallombardo, A., ATol Mammal Morphology Team POSTCANINE TEETH HOMOLOGIES IN MAMMALIA

2:30  von Koenigswald, W. THREE MAJOR ASPECTS DESCRIBING THE DIVERSITY OF HYPSODONTY IN MAMMALIAN DENTITIONS

2:45  Christensen, H. CONVERGENT MICRWARE PATTERNS IN EXTANT METATHERIAN AND Eutherian Herbivores: A Proxy for the Analysis of Mammalian Diet in the Latest Cretaceous and Early Paleocene

3:00  Engels, S., von Koenigswald, W., Martin, T. CHANGES IN MOLAR FUNCTIONAL MORPHOLOGY OF EARLY HIPPOMORPHA

3:15  Kilbourne, B. THE SCALING OF LIMB ROTATIONAL INERTIA IN CURSORIAL MAMMALS: A PRECURSOR TO MODELING LIMB INERTIA IN EXTINCT TAXA

3:30  Schmitz, L., Price, S. INFLUENCE OF BODY MASS ON THE EVOLUTION OF DIET ACTIVITY PATTERN IN HERBIVOROUS MAMMALS AND IMPLICATIONS FOR PALEOBIOLOGY

3:45  Rodgers, J., Rodgers, M. ROTATIONAL AND NAVIGATIONAL VESTIBULAR SENSITIVITY DIRECTIONS IN THERIAN MAMMALS

4:00  Simmons, N., Seymour, K., Habersetzer, J., Gunnell, G. INFERRING ECHOLOCATION IN ANCIENT BATS
MONDAY AFTERNOON, OCTOBER 11, 2010
TECHNICAL SESSION VII
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: Sarah Werning, Jason Head

1:45  Werning, S., Irmis, R. RECONSTRUCTING THE ONTOGENY OF THE TRIASSIC BASAL ARCHOSAUROMORPH TRILOPHOSAURUS USING BONE HISTOLOGY AND LIMB BONE MORPHOMETRICS

2:00  Wu, X., Ji, Q., Cheng, Y. CRETACEOUS CHORISTODERAN REPTILES GAVE BIRTH TO LIVE YOUNG

2:15  Milner, A., Milner, A. ONTOGENY AND PHYLOGENY IN PROCOLOPHONIDS - EVIDENCE FROM A NEW LEPTOPLEURONINE FROM THE MIDDLE TRIASSIC OTTER SANDSTONE OF SIDMOUTH, DEVON

2:30  Lyson, T., Bhullar, B., Bever, G., Joyce, W., Gauthier, J. VERTICAL SPLIT OF THE TURTLE SHOULDER GIRDLE PUSHES THE LIMITS OF MUSCULAR SCAFFOLD HOMOLOGY

2:45  ElShafie, S. A COMPLETE SKULL AND SKELETON OF A LONG-NECKED PLEURODIRE (PLEURODIRA: ARARIPEMYDIDAE) FROM NIGER

3:00  Head, J. CLIMATIC REGULATION OF MAXIMUM BODY SIZE IN POIKILOTHERMIC VERTEBRATES: AN EMPIRICAL TEST USING THE CRETACEOUS AND PALEOGENE RECORD OF NORTH AMERICAN TRIONYCHID TURTLES

3:15  Hill, R., Sertich, J., Roberts, E., O'Leary, M. FOSSIL CROCODYLIFORMS AND TURTLES FROM THE EARLY CRETACEOUS OF NORTHEASTERN MALI

3:30  Smith, D., Sanders, R., Parker, W., Cavaughna, J. THE ENDOCRANIUM, INNER EAR AND PNEUMATIC STRUCTURE OF THE UPPER TRIASSIC PHYTOSAUR PSEUDOPALATUS PRISTINUS

3:45  Wilberg, E. THE PHYLOGENETIC POSITION OF THALATTOSUCHIA (CROCODYLOMORPHA) AND THE IMPORTANCE OF OUTGROUP CHOICE

4:00  Dufaeau, D., Witmer, L. OPPORTUNISM, ACOUSTICS AND MASS: EXAPTATION AND PATTERNS OF MIDDLE-EAR EXPANSION IN ARCHOSAURIA

MONDAY AFTERNOON, OCTOBER 11, 2010
TECHNICAL SESSION VIII
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Michael Cotes, John Long

1:45  MacKenzie, L. UNCOVERING THE TAPHONOMY OF THE CHENGJIANG BIOTA USING GEOCHEMISTRY AND SEDIMENTOLOGY

2:00  Jones, D., Evans, A. FUNCTIONAL MORPHOLOGY OF THE EARLIEST VERTEBRATE FEEDING STRUCTURES

2:15  Brazeau, M., Friedman, M. PHYLOGENETIC EXPERIMENTS ON CURRENT SCENARIOS OF EARLY GNATHOSTOME EVOLUTION

2:30  Coates, M., Davis, S. ABOUT THE EARS: ACANTHODES RE-EXAMINED AND GNATHOSTOME ORIGIN RE-ANALYZED

2:45  Blais, S., MacKenzie, L., Wilson, M. TOOTH-LIKE LIP AND CHEEK SCALES IN EARLY GNATHOSTOMES FROM THE MACKENZIE MOUNTAINS, NORTHWEST TERRITORIES, CANADA

3:00  Jerve, A. MODES OF GNATHOSTOME FIN SPINE DEVELOPMENT INFERRED FROM THREE-DIMENSIONAL HISTOLOGY

3:15  Long, J., Trinajstic, K., Young, G., Johanson, Z. PLACODERM COPULATION AND VIVIPARITY: IMPLICATIONS FOR PELVIC GIRDLE DEVELOPMENT

3:30  Zhu, M., Zhao, W., Jia, L. PLACODERM JAW BONES FROM THE XIAOXIANG FAUNA (LUDLOW, SILURIAN) AND THE DENTITION OF EARLY GNATHOSTOMES

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MONDAY AFTERNOON, OCTOBER 11, 2010
TECHNICAL SESSION VIII (continued)

3:45  Carr, R.  PLACODERM REPRODUCTIVE STRATEGIES

4:00  Cloutier, R., Potvin-Leduc, D., Landing, E., Stein, W., VanAller Hernick, L.  A NEW DEVONIAN FISH LAGERSTATTEN FROM NEW YORK STATE: TAPHONOMY, PALEOENVIRONMENT AND PALEODIVERSITY

MONDAY AFTERNOON, OCTOBER 11, 2010
POSTER SESSION II
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM A

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

1  Pellegrini, R., Jehle, A., Grandstaff, B., Albright, S., Parris, D.  BEESWAX AS A REMEDIAL TREATMENT FOR PYRITE DISEASE

2  Davidson, A.  POLYTOPLAFLUOROETHYLENE (PLUMBER’S) TAPE, TISSUE AND PLASTER BANDAGE USED AS A REMOVABLE SUPPORT FOR FOSSIL PREPARATION

3  Fox, M.  USING DIFFERENT MOLECULAR WEIGHTS OF CARBOWAX

4  Finlayson, H., Temme IV, T., Gray, D.  BLOCK 124: A LOOK INTO THE HISTORY OF A 100-YEAR-OLD FIELD JACKET FROM THE CARNEGIE QUARRY, DINOSAUR NATIONAL MONUMENT, UT

5  Santucci, V., Kenworthy, J., Tweet, J., Woods, J.  INVENTORY AND MONITORING OF VERTEBRATE PALEONTOLOGICAL RESOURCES FROM NATIONAL PARK SERVICE AREAS

6  Hartman, J., Weiler, M., Schumaker, K.  BENEFITS, CHALLENGES AND SOLUTIONS OF COLLECTIONS AT SMALL PROGRAMS AND INSTITUTIONS USING EXPERIENCE FROM THE UNIVERSITY OF NORTH DAKOTA

7  DeBlieux, D., Santucci, V., Kirkland, J., Madsen, S., Madsen, M.  DEVELOPING A PILOT PALEONTOLOGICAL RESOURCE MONITORING PROGRAM FOR THE NATIONAL PARK SERVICE AT GLEN CANYON NATIONAL RECREATION AREA, UTAH

EDWIN H. AND MARGARET M. COLBERT PRIZE COMPETITION BEGINS

8  Racicot, R.  PHYLOGENETICS OF FOSSIL AND EXTANT DELPHINOIDEA (CETACEA: DELPHINOIDEA) USING BAYESIAN INFERENCE

9  Martin, J.  A NEW FOSSIL BALAENOPTERID (CETACEA, MYSTICETI) FROM THE LATE PLIOCENE SAN DIEGO FORMATION, CALIFORNIA

10  Field, D.  THE MECHANICAL DESIGN OF RORQUAL MANDIBLES: IMPLICATIONS FOR LUNGE-FEEDING FROM QUANTITATIVE COMPUTED TOMOGRAPHY

11  Rankin, B.  LATE MIDDLE TIFFANIAN (LATE PALEOCENE) MAMMALS FROM SOUTHEASTERN SASKATCHEWAN, CANADA

12  Pilbro, C.  COMPARISON OF EARLY EOCENE SAN JUAN BASIN, NM PHENACOLEMUR JEPSENI WITH PHENACOLEMUR CITATUS AND PHENACOLEMUR PRAECOX FROM BIGHORN BASIN, WY - STUDY OF THE VARIATION AND VALIDITY OF THESE PHENACOLEMUR SPECIES

13  Frazier, B.  UNCOVERING THE EVOLUTIONARY HISTORY OF A LINEAGE WITH NO FOSSIL RECORD: AN ODD PATTERN OF ENCEPHALIZATION IN AN ODD-NOSED MONKEY

14  Hensley-Marschand, B.  SEXUAL DIMORPHISM IN CRANIAL SHAPE OF THE SPOTTED HYENA (CROCUTA CROCUTA)

15  Smith, M.  REGIONAL DISJUNCTION IN PLEISTOCENE FAUNAS FROM INDIANA AND THE MIDWEST

16  Worthington, S.  CHARACTER WINNOWING: A NEW CHARACTER SELECTION PROTOCOL BASED ON PHYLOGENETIC SIGNAL
Anne, J. USING GEOLOGY TO INFER BIOLOGY: GEOCHEMICAL TECHNIQUES FOR ASSESSING DIFFERENCES BETWEEN PATHOLOGICAL AND NORMAL BONE

Tomita, T. ORIGIN OF SHARK JAW PROTRUSIONS: EVOLUTION OF SUCTION FEEDING CAPABILITIES IN FOSSIL SHARKS RECONSTRUCTED FROM THEIR HYOID ARCHES

Redman, C. LONG-TERM TRENDS IN THE RICHNESS OF LATE CRETACEOUS NONMARINE VERTEBRATE FAUNAS FROM SOUTHERN UTAH

Tschopp, E. BONY OVERGROWTH IN PHALANGES OF A CAMARASAURUS (DINOSAURIA: SAUROPODA) INDICATES OLD ONTOGENETIC AGE AND PROVIDES INSIGHTS INTO THE PROCESS OF PHALANGEAL REDUCTION IN SAUROPODS

Mitchell, J. THE FUNCTION AND EVOLUTION OF CANALS IN THE TEETH OF THE TRIASSIC ARCHOSAURIFORM UATCHITODON

Smith, A. A MORPHOLOGICAL AND MORPHOMETRIC REDESCRIPTION OF TANYTRACHELOS AHNYS

Fronimos, J. ADULT DORSAL VERTEBRAE OF THE TITANOSAURIAN SAUROPOD ALAMOSAURUS SANJUANENSIS, BIG BEND NATIONAL PARK, TEXAS

Zammit, M. ICHTHYOSAURS OF AUSTRALASIA: A REVIEW OF DIVERSITY AND DISTRIBUTION

Beardmore, S. VARIATION IN SKELETAL TAPHONOMY OF MARINE REPTILES FROM THE MIDDLE TRIASSIC OF MONTE SAN GIORGIO, SWITZERLAND

EDWIN H. AND MARGARET M. COLBERT PRIZE COMPETITION ENDS

Druckenmiller, P., Whalen, M., Kelley, N. AN UPPER TRIASSIC (NORIAN) ICHTHYOSAUR WITH GUT CONTENTS FROM THE OTUK FORMATION, WESTERN BROOKS RANGE, ALASKA

Cuthbertson, R., Russell, A., Anderson, J. NEW INFORMATION ON THE CRANIAL ANATOMY OF A JUVENILE ICHTHYOPTERYGIAN FROM THE VEGA-PHROSO SILTSTONE MEMBER (EARLY TRIASSIC) OF BRITISH COLUMBIA, CANADA

Wahl, W. SALT GLAND STRUCTURES IDENTIFIED IN A LATE JURASSIC ICHTHYOSAUR

Bolet, A., Evans, S. NEW LIZARDS (LEPIDOSAURIA, SQUAMATA) FROM THE EARLY CRETACEOUS OF LAS HOYAS (CUENCA, SPAIN)

Jiménez-Huidobro, P., Otero, R., Rubilar-Rogers, D. FIRST EVIDENCE OF A TYLOSAURINE MOSASAUR FROM CHILE

Schumacher, B., Schumacher, B. A ‘WOOLLGARI-ZONE MOSASAUR’ (SQUAMATA: MOSASAURIDAE) FROM THE CARLILE SHALE (LOWER MIDDLE TURONIAN) OF CENTRAL KANSAS AND STRATIGRAPHIC OVERLAP OF EARLY MOSASAURS AND PLIOSAURID PLESIOSAURS

Schulp, A., Vonhof, H. γ13C ISOTOPE ANALYSIS OF THE TYPE MAASTRICHTIAN MOSASAURS

Robbins, J., Polcyn, M., Ferguson, K., Jacobs, L. STABLE CARBON ISOTOPE VALUES IN MOSASAUR TOOTH ENAMEL REFLECT NICHE DIFFERENTIATION

Konishi, T. TO TILT OR NOT TO TILT? A NEW WAY OF ORIENTING QUADRATES IN PLIOPLATECARPINES (SQUAMATA: MOSASAURIDAE), AND ITS IMPLICATIONS FOR STREPTOSTYLY IN THESE MOSASAURS

Smith, A., Araújo, R., Mateus, O. A PLESIOSAUROID SKULL FROM THE TOARCIAN (LOWER JURASSIC) OF ALHADAS, PORTUGAL

Araújo, R., Polcyn, M., Mateus, O., Schulp, A. PLESIOSAURS FROM THE MAASTRICHTIAN OF BENTIABA, NAMIBE PROVINCE, ANGOLA
Simões, T., Kellner, A., Riff, D., Grillo, O., Romano, P. EVIDENCE FOR AN EARLIER PRESENCE OF PLESIOSAURS (REPTILIA, SAUROPTERYGIA) IN ANTARCTICA

Kennedy, A., Bauer, A. A HOLOCENE HERPETOFAUNA FROM NEW CALEDONIA: INSIGHTS INTO THE EFFECT OF HUMAN HABITATION ON INSULAR BIOTAS

McCartney, J., Simons, E. A NEW FOSSIL SNAKE ASSEMBLAGE FROM THE LATE EOCENE OF THE FAYUM DEPRESSION, EGYPT

Gelnaw, W., Mead, J. THE FIRST CHARACTERS USEFUL FOR IDENTIFYING FOSSIL SCOCEPHIDIAN VERTEBRAE TO THE FAMILY LEVEL

Moscato, D., Graham, R. PALEOEKOLOGY OF LATE PLEISTOCENE SNAKES AND SALAMANDERS FROM PARKER’S PIT CAVE IN THE BLACK HILLS, SD

Nydam, R., Nydam, R. SQUMATA FROM THE CONIACIAN THROUGH EARLY CAMPANIAN OF SOUTHERN UTAH

Hipsley, C., Müller, J. REVISION OF THE EOCENE AMBER LACERTID SUCCINILACERTA SUCCINEA (SQUMATA) BASED ON 3-DIMENSIONAL X-RAY COMPUTED TOMOGRAPHY

Humphries, E., Jones, M. GEOGRAPHIC VARIATION IN THE JAWS OF HOLOCENE SPHENODON (LEPIDOSAURIA: RHYNCHOCEPHALIA) DEMONSTRATED BY LANDMARK ANALYSIS

Xu, G., Gao, K. TAXONOMIC REVISION OF FUKANGICHTHYS (ACTINOPTERYGII: SCANILEPIFORMES) FROM THE MIDDLE TRIASSIC OF XINJIANG, CHINA

Lin, H., Sun, Z., Tintori, A., Jiang, D., Hao, W. NEW FINDS OF THE SUBHOLOSTEAN GENUS HABROICHTHYS FROM MIDDLE TRIASSIC OF SOUTHWESTERN CHINA

Wilson, M., Murray, A. A NEW MARINE CLUPEOMORPH FISH IN THE FAMILY SORBINICHTHYIDAE FROM THE EARLY LATE CRETACEOUS AKRABOU FORMATION OF MOROCCO

Kim, H., Chang, M., Seo, S., Kim, Y. A POSSIBLE ICHTHYODECTIFORM (PISCES, TELEOSTEI) FROM THE EARLY CRETACEOUS OF SOUTH KOREA

Gottfried, M., Ostrowski, S., Roberts, E., Stevens, N., O’Connor, P. A NEW AFRICAN RECORD FOR POLYPTERID FISHES, FROM THE LATE OLIGOCENE OF TANZANIA

Davis, M., Fielitz, C. ESTIMATING DIVERGENCE TIMES OF LIZARDFISHES AND THEIR ALLIES (EUTELEOSTEI: AULOPIFORMES) AND THE TIMING OF DEEP-SEA ADAPTATIONS

Mickle, K. REVISITING THE ACTINOPTERYGIAN PREOPERCULUM

Kirkland, J., Hunt-Foster, R., Foster, J., Loewen, M. NEWLY RECOVERED SKELETAL ELEMENTS OF THE LATE JURASSIC DINOSAUR MYMOORAPELTA FROM ITS TYPE LOCALITY IN THE MORRISON FORMATION PERMITS REEVALUATION OF ANKYLOSAUR PHYLOGENY

Leahey, L., Molnar, R., Salisbury, S. POSTCRANIAL OSTEOLOGY OF MINMI SP., A BASAL ANKYLOSAUROMORPH (DINOSAURIA: ORNITHISCHIA) FROM THE EARLY CRETACEOUS (ALBIAN) ALLARU MUDSTONE OF QUEENSLAND, AUSTRALIA

Jasinski, S., Sullivan, R. A NEW SMALL PACHYCEPHALOSAURID FROM THE SAN JUAN BASIN, NEW MEXICO AND A RE-EVALUATION OF PACHYCEPHALOSAURIDS FROM THE KIRTLANDIAN LVA (LATE CAMPANIAN)

Rivera-Sylva, H., Ortiz-Mendieta, J., de la Peña-Oviedo, I. FIRST RECORD OF A PACHYCEPHALOSAURID FROM MEXICO

Ridgwell, N., Sereno, P. A BASAL THYREOPHORAN (DINOSAURIA, ORNITHISCHIA) FROM THE TIOURAREN FORMATION OF NIGER

Frederickson, J. CRANIOFACIAL ONTOGENY IN PACHYRHINOSAURUS LAKUSTAI: EVIDENCE FOR SEXUAL DIMORPHISM IN AN ORNITHISCHIAN DINOSAUR
MONDAY AFTERNOON, OCTOBER 11, 2010
POSTER SESSION II (continued)

58 Brandau, D., Getty, M. DISCOVERY OF A NEW CHASMOSAURINE BONEBED FROM THE KAIPAROWITS FORMATION (CAMPANIAN) OF SOUTHERN UTAH

59 Lee, Y., Ryan, M., Kobayashi, Y. THE FIRST CERATOPSIAN FROM KOREA

60 Penkalski, P., Skulan, J. AN UNUSUAL CERATOPSID QUARRY FROM THE HELL CREEK FORMATION OF MONTANA

61 Clayton, K., Loewen, M., Farke, A., Sampson, S. A REEVALUATION OF EPIPARIETAL HOMOLOGY WITHIN CHASMOSAURINE CERATOPSIDS (ORNITHISCHIA) BASED ON NEWLY DISCOVERED TAXA

62 Rothschild, B. ACTUALISTIC APPROACH TO CERATOPSIAN CRANIAL ONTOGENY AND SCARS: THE FLIP SIDE OF THE JUGAL

63 Borkovic, B., Russell, A., Ryan, M. QUANTIFYING VARIATION IN CERATOPSID HORNcores AND PARIETALS

64 Sissons, R. ANKYLOSAUR FOOT MORPHOLOGY AND FUNCTION

65 Burns, M. USING SKIN TO INFER PHYLOGENY: QUANTITATIVE AND QUALITATIVE ANALYSES OF VARIATION IN THE STRUCTURE OF ANKYLOSAUR (DINOSAURIA: ORNITHISCHIA) OSTEOderms

66 Spencer, M. THE PHYLOGENETIC LABILITY OF PROBLEMATIC BASAL ORNITHISCHIANS

67 Donohue, S., Wilson, G., Breithaupt, B. NEW LATEST CRETACEOUS MAMMALS FROM THE LANCE FORMATION NEAR BLACK BUTTE STATION, SOUTHWESTERN WYOMING

68 Ladevèze, S., de Muizon, C., Matthew, C., Smith, T. PETROSAL ANATOMY AND INNER EAR STRUCTURES OF A NEW MULTITUBERCULATE MAMMAL FROM THE LATE CRETACEOUS OF CHINA: NEW DATA FROM MICRO-CT ANALYSIS AND PALEOBiOLOGIC INFERENCEs

69 Zhang, Y., Hunter, J. INTERRELATIONSHIPS OF CRETACEOUS AND PALEogene NOEPlAGIAULACIDAE (MULTITUBERCULATA, MAMMALIA)

70 Case, J. THE DEVELOPMENT OF CRUSHING PREMOLARS IN THE STAGODONTID, DIDELPHODON

71 Denton Jr., R., O’Neill, R. A NEW STAGODONTID METATHERIAN FROM THE CAMPANIAN OF NEW JERSEY, AND ITS IMPLICATIONS FOR A LACK OF EAST-WEST DISPERSAL ROUTES IN THE LATE CRETACEOUS OF NORTH AMERICA

72 Williamson, T., Brusatte, S., Weil, A. PHYLOGENY OF CRETACEOUS-PALEOCENE METATHERIANS: IMPLICATIONS FOR THE METATHERIAN RADIATION AND SURVIVORSHIP OF LINEAGES ACROSS THE K/Pg BOUNDARY

73 Rose, K., Storch, G. POSTCRANIA OF SMALL MAMMALS FROM THE LATE PALEOCENE OF WALBECK, GERMANY

74 Gould, F., Rose , K. THE POSTCRANIAL SKELETON OF ARCTOCYON MUMAK, THE LARGEST ARCTOCYONID, AND ECOMORPHOLOGICAL DIVERSITY IN PROCReODI

75 De Bast, E., Sigé, B., Smith, T. NEW DATA ON THE SMALL ARCTOCYONID PROLATIONIENS WAUDRUAe FROM THE EARLY PALEOCENE OF HAININ, BELGIUM, AND ITS RELATIONSHIPS WITH NORTH AMERICAN OXYCLAEENINES

76 Stefen, C., Lehmann, T. NEW JUVENILE AND ADULT MATERIAL OF KOPIDODON MACROGNATHUS (MAMMALIA: PAROXYCLAEENIDAE) FROM MESSEL, GERMANY

77 Shoup, B., Adams, J., Schaaf, C. NEW LOCALITIES FROM THE PALEOCENE-EOCENE THERMAL MAXIMUM TRANSITION DISCOVERED AS THE RESULT OF PROPOSED SURFACE COAL MINE EXPANSIONS IN THE POWDER RIVER BASIN OF NORTHEASTERN WYOMING

78 Ravel, A., Marivaux, L., Tabuce, R., Mahboubi, M. OLDEST BAT (CHIROPTERA, EOCHIROPTERA) FROM AFRICA: EARLY EOCENE FROM EL KOHOL (ALGERIA)
Dunn, R., Rose, K.  EVOLUTION OF EARLY EOCENE *PALAEOSINOPA* (MAMMALIA, PANTOLESTIDAE) IN THE BIGHORN BASIN, WYOMING

Stringer, G., King, L.  PALEONTOLOGICAL AND HISTORICAL SIGNIFICANCE OF THE LATE EOCENE EXPOSURES NEAR COPENHAGEN, CALDWELL PARISH, LOUISIANA


Ayoub, M., Mihlbachler, M., Solounias, N.  PALEODIET AND RESOURCE PARTITIONING IN EARLY EOCENE HERBIVOROUS MAMMALS FROM THE BIGHORN BASIN, WYOMING: EVIDENCE FROM DENTAL MICROWEAR

Anemone, R., Watkins, R., Nachman, B., Dirks, W.  AN EARLY WASATCHIAN MAMMALIAN FAUNA FROM AN EXTRAORDINARILY RICH NEW LOCALITY IN THE GREAT DIVIDE BASIN, SW WYOMING

Boardman, G., Secord, R.  PALEOENVIRONMENTAL INTERPRETATION OF THREE CHADRONIAN (LATE EOCENE) MAMMALIAN FAUNAS FROM THE MID-CONTINENTAL U.S., BASED ON BODY SIZE DISTRIBUTIONS

Burger, B., Murphey, P.  IS THERE A MAMMALIAN FAUNAL TURNOVER ASSOCIATED WITH THE MECO GLOBAL WARMING EVENT IN THE DUCHESNE RIVER FORMATION IN UTAH? PRELIMINARY EVALUATION OF NEW FOSSIL DISCOVERIES FROM THE BRENNASN BASIN MEMBER

Grohé, C., Morlo, M., Salem, M., Salem, M., Jaeger, J.  THE OLDEST APTERODONTINAE (HYAENODONTIDAE, “CREODONTA”) FROM THE MIDDLE EOCENE OF DOR EL TALHA (LIBYA)

Tomiya, S.  NEW CARNIVORAMORPHANS (MAMMALIA) FROM THE MIDDLE-EOCENE SANTIAGO FORMATION OF CALIFORNIA, U.S.A., AND PHYLOGENETIC IMPLICATIONS FOR THE ORIGIN OF CROWN-ORDER CARNIVORA

Billian, J., Anemone, R.  MODELING THE MANDIBULAR MORPHOLOGY AND MASTICATORY MECHANICS OF EOCENE MAMMALS: A 3D LASER SCANNING APPROACH

Hoganson, J., Person, J.  TOOTH PUNCTURE MARKS ON A SKULL OF *DINICTIS* (NIMRAVIDAE) FROM THE OLIGOCENE BRULE FORMATION OF NORTH DAKOTA ATTRIBUTED TO PREDATION BY *HYAENODON* (HYAENODONTIDAE)

Naples, V., Martin, L.  HOW A Saber-Toothed “Cat” Got Its Small Brain

Egi, N., Sein, C., Maung-Thein, Z., Htike, T., Takai, M.  NEW AMPHICYONID (MAMMALIA: CARNIVORA) FROM THE LOWER IRAWADDY SEDIMENTS (MYANMAR) WITH COMMENTS ON AMPHICYON SPECIES FROM THE MIOCENE OF ASIA

Ogino, S., Egi, N., Takai, M., Maung-Thein, Z., Htike, T.  A NEW SPECIMEN OF *AGRIOTHERIUM* (MAMMALIA, CARNIVORA) FROM THE LATE MIOCENE-EARLY PLIOCENE IRAWADDY SEDIMENTS, MYANMAR

Wallace, S., Schubert, B.  PHYLOGENETIC IMPLICATIONS OF *ARCTOMELES DIMOLODONTUS* USING CRANIAL MORPHOLOGY

Tucker, S., Farlow, J.  CARNIVORES FROM THE PIPE CREEK SINKHOLE (LATEST HEMPHILLIAN), GRANT COUNTY, INDIANA

Tanaka, Y., Kohno, N.  RAPID DIVERSIFICATION OF THE ODOBENIDS (CARNIVORA: PINNIPEDIA) IN THE LATE MIDDLE MIocene OF THE NORTH PACIFIC: IMPLICATIONS OF A NEW FOSSIL FROM HOKKAIDO, JAPAN

Valenzuela-Toro, A., Gutstein, C., Cozzuol, M.  A NEW TRUE SEAL MORPHOTYPE (PHOCIDAE, CARNIVORA) FROM BAHIA INGLESA FORMATION, CHILE

Churchill, M., Boessenecker, R., Clementz, M.  PRELIMINARY RESULTS OF A COMPREHENSIVE MORPHOLOGICAL PHYLOGENY OF THE PINNIPEDIA (MAMMALIA: CARNIVORA)
MONDAY AFTERNOON, OCTOBER 11, 2010
POSTER SESSION II (continued)

98  Boessenecker, R.  BARNACLE COLONIZATION OF MIDDLE PLEISTOCENE SEA LION (CARNIVORA: PINNIPEDIA) BONES ELUCIDATE THE BIOSTRATINOMY OF A FOSSIL MARINE MAMMAL

99  Sakamoto, M., Lloyd, G., Benton, M.  PHYLOGENETICALLY STRUCTURED VARIANCE IN FELID BITE FORCE: THE ROLE OF PHYLOGENY IN THE EVOLUTION OF BITING PERFORMANCE

100 Madan, M., Prothero, D., Sutyagina, A.  STASIS IN LATE PLEISTOCENE FELIDS (SABERTOOTH CATS AND ICE AGE LIONS) FROM LA BREA TAR PITS DURING THE LAST GLACIAL-INTERGLACIAL CYCLE


102 Spigelmyer, L., Bovard, B., Hartstone-Rose, A.  ASSOCIATED CRANIODENTAL AND POSTCRANIAL HYENA FOSSILS FROM THE TYPE LOCALITY OF PACHYROCUTA BELLAX, KROMDRAAI, STERKFONTEIN VALLEY, SOUTH AFRICA

103 Hartstone-Rose, A., Bovard, B., Hartstone-Rose, L.  A REEVALUATION OF THE FOSSIL JACKALS OF THE STERKFONTEIN VALLEY, SOUTH AFRICA

104 Kuhn, B., Werdelin, L., Hartstone-Rose, A., Lacruz, R., Berger, L.  CARNIVORA ASSOCIATED WITH AUSTRALOPITHECUS SEDIBA, MALAPA, GAUTENG, SOUTH AFRICA


106 Collins, K., Carlson, K., Kuhn, B., Berger, L.  MORPHOLOGICAL EXAMINATION OF AN ARTICULATED CARNIVORE ANKLE USING VIRTUAL PREPARATION AND DISARTICULATION OF THE SPECIMEN

107 Northover, J., Rybczynski, N., Schröder-Adams, C.  EVIDENCE FOR CORRELATED EVOLUTION BETWEEN LONG BONE COMPACTNESS, SWIMMING BEHAVIOR AND BODY MASS IN ARCTOIDEA (MAMMALIA: CARNIVORA)

108 Voss, M.  SIRENIAN DIVERSITY IN THE OLIGOCENE OF GERMANY


TUESDAY MORNING, OCTOBER 12, 2010
SYMPOSIUM: MAKING CONNECTIONS: THE EVOLUTION AND FUNCTION OF JOINTS IN VERTEBRATES

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301

MODERATORS: Casey Holliday, Matthew Vickaryous

8:00  Holliday, C., Gardner, N.  STRUCTURE AND FUNCTION OF THE REPTILIAN MANDIBULAR SYMPHYSIS: INSIGHTS FROM SQUAMATES

8:15  Osi, A.  JAW MECHANISM, DENTAL OCCLUSION AND EFFECTIVE ORAL FOOD PROCESSING IN HETERODONT CROCODYLIFORMS: AN UNEXPECTED VARIABILITY

8:30  Gill, P., Rayfield, E., Robson-Brown, K., Gostling, N.  A FUNCTIONAL INVESTIGATION INTO THE JAW JOINTS OF TWO OF THE Earliest STEM MAMMALS; MORGANUCODON WATSONI AND KUEHNEOTHEIRUM PRAECURSORIS

8:45  Ravosa, M., Ning, J., Stock, S., Stack, M.  JAW-JOINT FUNCTION AND PLASTICITY IN MAMMALS

9:00  Luo, Z.  MORPHOLOGICAL EVOLUTION OF THE DOUBLE CRANIOMANDIBULAR JOINT IN THE CYNODONT-MAMMALIAFORM TRANSITION

9:30 Bright, J., Gröning, F., Rayfield, E. MAMMALIAN SKULL CONSTRUCTION AND THE IMPORTANCE OF CRANIAL SUTURES IN BIOMECHANICAL FINITE ELEMENT ANALYSIS

9:45 Maddin, H., Wake, M. EXPLORING THE INFLUENCE OF FOSSORIALITY ON TETRAPOD CRANIAL ARCHITECTURE, A FOCUS ON CRANIAL JOINTS

10:00 BREAK

10:15 Vickaryous, M., Reisz, R., Modesto, S., Head, J. TAIL AUTOTOMY IN THE FOSSIL RECORD: NEW INFORMATION ABOUT VOLUNTARY TAIL LOSS IN CAPTORHINID REPTILES

10:30 Pierce, S., Molnar, J., Hutchinson, J., Clack, J. REGIONAL VARIATION OF INTERVERTEBRAL JOINT STIFFNESS IN EXTANT AND EXTINCT TETRAPODS AND ITS IMPORTANCE FOR THE WATER-LAND TRANSITION

10:45 Claessens, L., Hirasawa, T. RIBCAGE ANATOMY, SKELETAL CONSTRAINT AND KINEMATICS IN EXTANT AND EXTINCT ARCHOSAURS

11:00 Ward, C., Hammond, A., Plavcan, J., Begun, D., Kordos, L. HIP JOINT MORPHOLOGY AND HOMINOID EVOLUTION: FROM QUADRUPEDAL TO SUSPENSORY TO BIPEDAL LOCOMOTION

11:15 Gatesy, S., Kambic, R., Roberts, T. BEYOND HINGES: 3-D JOINT FUNCTION IN ERECT BIPEDS

11:30 Su, A., Patel, B., Carlson, K. SUBCHONDRAL AND TRABECULAR BONE MORPHOLOGICAL CORRELATES OF LOCOMOTOR BEHAVIOR

11:45 Sullivan, C., Xu, X., Zhang, F., Drake, A., Cooper, M. FUNCTION AND EVOLUTION OF THE ANKLE JOINT IN THEROPOD DINOSAURS

12:00 Bonnan, M., Sandrik, J., Nishiwaki, T., Willhite, R., Elsey, R. NON-AVIAN DINOSAUR AND EXTANT ARCHOSAUR LIMB JOINTS: WHAT’S MISSING, WHAT’S NOT, AND WHERE DO WE GO FROM HERE?

TUESDAY MORNING, OCTOBER 12, 2010
TECHNICAL SESSION IX
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: Aaron Wood, Anthony Barnosky

8:00 Evans, A., Jones, D., IMPPS RCN: Integrating Macroecological Pattern and Processes across Scales RAPID EVOLUTIONARY RATES OVER GEOLOGICAL TIMESCALES IN MAMMALS

8:15 Wilson, G. MAMMALIAN EXTINCTION, SURVIVAL AND RECOVERY DYNAMICS ACROSS THE CRETACEOUS-PALEOGENE BOUNDARY IN NORTHEASTERN MONTANA

8:30 Wood, A., Gingerich, P. COORDINATED SHIFTS IN EARLY EOCENE EVOLUTIONARY AND PALEOENVIRONMENTAL RECORDS IN THE CLARKS FORK BASIN, WYOMING

8:45 Smith, F., Research Coordination Network, I. MAMMALIAN BODY MASS EVOLUTION OVER SPACE AND TIME

9:00 Rose, P., Fox, D. BERGMANN’S RULE IN DEEP TIME: DOES THE RELATIONSHIP BETWEEN MAMMALIAN BODY SIZE AND TEMPERATURE APPLY TO PALEOCENE MAMMALS?

9:15 Orcutt, J., Hopkins, S. BODY SIZE, CLIMATE AND TIME: A PALEONTOLOGICAL TEST OF BERGMANN’S RULE

9:30 Marcot, J., Fox, D. LATITUDINAL DIVERSITY GRADIENT OF NORTH AMERICAN MAMMALS WAS NOT CONSTANT OVER THE CENOZOIC


10:00 BREAK
TUESDAY MORNING, OCTOBER 12, 2010
TECHNICAL SESSION IX (continued)

10:15 Terry, R., Li, C., Hadly, E. PREDICTING SPECIES RESPONSES TO CLIMATIC WARMING: HINDCASTING THE PAST USING THE MODERN GEOGRAPHIC RANGE

10:30 Pardi, M., Graham, R. LOSS OF HABITAT AND BIODIVERSITY DURING TERMINAL PLEISTOCENE WARMING: WHAT SMALL MAMMAL FOSSILS TELL US ABOUT THE EFFECTS OF CLIMATE CHANGE

10:45 Muldoon, K., Rasoamiamananana, A., Aronson, A., Simons, E., Wright, P. EARLY HOLOCENE FAUNA FROM A NEW SUBFOSSIL SITE: CHRISTMAS RIVER, SOUTHCENTRAL MADAGASCAR

11:00 Tryon, C., Faith, J., Peppe, D. LATE QUATERNARY MAMMALS FROM RUSINGA ISLAND, KENYA: IMPLICATIONS FOR ENVIRONMENTAL CHANGE AND MEGAFANAUNAL EXTINCTIONS

11:15 Miller, J., Bahn, V. SPATIAL DYNAMICS AND STRUCTURE OF THE NORTH AMERICAN PLEISTOCENE MEGAFANAUNAL EXTINCTION

11:30 MacPhee, R., Willerslev, E., Froese, D., Roberts, R., Haile, J. AMERICAN MEGAFANAUNAL EXTINCTIONS, ENVIRONMENTAL DNA AND THE CONTINUING SEARCH FOR A CAUSE

11:45 Fisher, D., Beld, S. IMPACT FRACTURING OF MAMMOTH LIMB BONE DIAPHYSSES (LATE PLEISTOCENE, MICHIGAN, USA)

12:00 Barnosky, A., Matzke, N., Tomiya, S., Lindsey, E., Wogan, G. HOW PRESENT EXTINCTION RATES COMPARE WITH MASS EXTINCTION RATES: INSIGHTS FROM MAMMALS

TUESDAY MORNING, OCTOBER 12, 2010
TECHNICAL SESSION X
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Thomas Stidham, Nathan Smith

8:00 Kellner, A., Wang, X., Jiang, S., Meng, X. PRELIMINARY NOTE ON LONG-TAILED PTEROSAURS FROM WESTERN LIAONING OF CHINA

8:15 Unwin, D., Lü, J., Liu, Y., Jin, X. SEX IN PTEROSAURS

8:30 Zhou, Z., Wang, Y. VERTEBRATE DIVERSITY OF THE EARLY CRETACEOUS JEHOL BIOTA

8:45 Zhou, S., Zhou, Z., O’Connor, J. A NEW TOOTHLESS ORNITHURINE BIRD FROM THE LOWER CRETACEOUS OF CHINA

9:00 Atterholt, J., O’Connor, J., Harris, J., Li, D., You, H. AVIAN TAXONOMIC DIVERSITY AND ANATOMICAL DISPARITY IN THE LOWER CRETACEOUS XIAGOU FORMATION OF THE CHANGMA BASIN, GANSU PROVINCE, PEOPLE’S REPUBLIC OF CHINA

9:15 Liu, D., Campbell, K., Sullivan, C. MASS PREDICTION IN CHINESE MESozoIC FOSSIL BIRDS

9:30 Vinther, J., D’Alba, L., Li, Q., Clarke, J., Gao, K. FOSSILIZED COLORS OF BIRDS AND OTHER DINOSAURS: IMPLICATIONS FOR UNDERSTANDING THE EVOLUTION OF FEATHERS

9:45 Heers, A., Dial, K. FROM BABY BIRDS TO FEATHERED DINOSAURS: INCipient WINGS AND THE EVOLUTION OF FLIGHT

10:00 BREAK

10:15 David, B., Dial, K. 3-D SKELETAL KINEMATICS OF WING-ASSISTED INCLINE RUNNING (WAIR) IN ADULT CHUKAR PARTRIDGES (ALECTORIS CHUKAR): LINKING SKELETAL MORPHOLOGY AND THE WING STROKE

10:30 Nesbitt, S., Ksepka, D., Clarke, J. A STEM FROGMOUTH (AVES: PODARGIFORMES) FROM THE EARLY EOCENE GREEN RIVER FORMATION AND THE EARLY DIVERSIFICATION OF STRISORES

10:45 Smith, N. PHYLOGENETIC ANALYSIS OF PELECANIFORMES (AVES) BASED ON OSTEANALOGICAL DATA: IMPLICATIONS FOR WATERBIRD PHYLOGENY AND FOSSIL CALIBRATION STUDIES
TUESDAY MORNING, OCTOBER 12, 2010
TECHNICAL SESSION X (continued)

11:00  Smith, A.  COMBINED PHYLOGENETIC ANALYSIS OF PAN-ALCIDAE (AVES, CHARADRIIFORMES): THE CONTRIBUTION OF FOSSILS TO THE RESOLUTION OF AVIAN SYSTEMATIC RELATIONSHIPS AND DIVERGENCE ESTIMATION

11:15  Ksepka, D., Fordyce, R., Ando, T., Jones, C.  NEW SPECIES FROM THE LATE OLIGOCENE OF NEW ZEALAND REVEAL THE SKELETAL PLAN OF STEM PENGUINS (AVES: SPHENISCIFORMES)


11:45  Witmer, L., Ridgely, R., James, H., Olson, S., Iwaniuk, A.  NEUROANATOMY, SKULL MORPHOLOGY AND THEIR BEHAVIORAL IMPLICATIONS FOR THE REMARKABLE, RECENTLY EXTINCT “PLATYPUS-DUCK” TALPANAS LIPPA (AVES: ANSERIFORMES) FROM KAUAI, HAWAII

12:00  Boyer, A., James, H., Olson, S., Grant-Mackie, J.  ECOLOGICAL CHANGE IN A CONSERVATION HOTSPOT: THE FOSSIL AVIFAUNA OF ME AURE CAVE, NEW CALEDONIA

TUESDAY AFTERNOON, OCTOBER 12, 2010
TECHNICAL SESSION XI

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301
MODERATORS: Doug Boyer, Andres Giallombardo

1:45  Carter, K.  A CONSTRAINT-BASED MODEL FOR PHYLOGENY RECONSTRUCTION

2:00  Lamm, K.  TREE BALANCE AND MISSING DATA COMPLICATE BAYESIAN PHYLOGENETIC ANALYSIS OF FOSSIL TAXA

2:15  Peterson, K., Lyson, T., Sperling, E., Alysha, H., Donoghue, P.  MICRORNAS AND VERTEBRATE PHYLOGENETICS

2:30  Boyer, D., Lipman, Y., St. Clair, E., Puente, J., Jernvall, J.  AN ALGORITHM USING INTRINSIC GEOMETRY OF ANATOMICAL STRUCTURES FOR AUTOMATIC IDENTIFICATION OF HOMOLOGOUS FEATURES

2:45  Joshi, S., Prieto-Marquez, A.  A NEW METHOD FOR THE QUANTITATIVE ANALYSIS OF MORPHOLOGICAL VARIATION IN VERTEBRATE PALEONTOLOGY

3:00  Schweitzer, M., Cleland, T., Zheng, W., San Antonio, J.  MOLECULAR MECHANISMS FOR THE PRESERVATION OF SOFT TISSUES AND ORIGINAL BIOMOLECULES IN FOSSILS

3:15  Moses, R.  EXPERIMENTAL DIAGENESIS OF BONE: IMPLICATIONS FOR RARE EARTH ELEMENT UPTAKE AND STABILITY

3:30  Longrich, N.  SURVIVAL AND EXTINCTION AT THE K-T BOUNDARY: NEW EVIDENCE AND NEW PERSPECTIVES FROM THE VERTEBRATE FAUNA OF CONTINENTAL NORTH AMERICA

3:45  Alroy, J., Carrano, M., Uhen, M.  HAS GLOBAL TETRAPOD BIODIVERSITY INCREASED SINCE THE CRETACEOUS?

4:00  Weinstein, D., Heim, N., Peters, S.  WHAT ARE WE MISSING?: GEOLOGICAL COMPLETENESS OF PALEONTOLOGICAL SAMPLING IN THE TERRESTRIAL CENOZOIC OF NORTH AMERICA

TUESDAY AFTERNOON, OCTOBER 12, 2010
TECHNICAL SESSION XII

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: Alan Turner, Laura Porro

1:45  Allen, E.  PHYLOGENETIC ANALYSIS OF GONIOPHOLIDID CROCODYLIFORMS OF THE MORRISON FORMATION

October 2010—PROGRAM AND ABSTRACTS 29A
TUESDAY AFTERNOON, OCTOBER 12, 2010
TECHNICAL SESSION XII (continued)

2:00 Sertich, J., O’Connor, P. THE EVOLUTION OF TREMATOCHAMPSID CROCODYLIFORMS IN AFRICA: NEW EVIDENCE FROM THE MIDDLE CRETAUCEOUS GALULA FORMATION, SOUTHWESTERN TANZANIA

2:15 Montefeltro, F., Langer, M. A NEW BAURUSCHID (CROCODYLIFORMES, SEBECOSUCHIA) FROM THE BAURU GROUP, LATE CRETAUCEOUS OF MINAS GERAIS, BRAZIL

2:30 Turner, A., Brochu, C. A REEVALUATION OF THE CROCODYLIFORM ACYNODON FROM THE LATE CRETAUCEOUS OF EUROPE

2:45 Hastings, A., Bloch, J., Jaramillo, C. NEW LARGE BLUNT-SNOUTED DYROSUARID (MESOEOUCROCYDIA) FROM THE PALEOCENE OF COLOMBIA

3:00 Brochu, C., Snyder, D. CROCODYLIANS FROM THE UINTA FORMATION (MIDDLE EOCENE, UINTAN) OF WESTERN NORTH AMERICA, RESPONSE TO CLIMATE CHANGE AND THE ORIGINS OF ALLIGATOR


3:30 Owerkowicz, T., Andrade, F., Elsey, R., Middleton, K., Hicks, J. ATMOSPHERIC HYPOXIA INCREASES BONE ROBUSTICITY IN THE AMERICAN ALLIGATOR

3:45 Woodward, H., Horner, J. OSTEOHISTOLOGICAL ANALYSIS OF ALLIGATOR MISSISSIPPIENSIS INDICATES ABSENCE OF FIBROAMELLAR BONE IN CROCODYLIANS AND CONFIRMS DETERMINATE GROWTH WITH FIRST REPORT OF EXTERNAL FUNDAMENTAL SYSTEMS: IMPLICATIONS FOR TETRAPOD OSTEOHISTOLOGY

4:00 Porro, L., Reed, D., Lemberg, J., Zapata, U., Ross, C. MANDIBULAR MECHANICS OF ALLIGATOR MISSISSIPPIENSIS: FROM BEAM MODELS TO FINITE ELEMENT ANALYSIS

TUESDAY AFTERNOON, OCTOBER 12, 2010
TECHNICAL SESSION XIII

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Elizabeth Hadley, Tim Gaudin

1:45 Croft, D., Dolgushina, T., Wesley-Hunt, G. MORPHOLOGICAL DIVERSITY IN EXTINCT SOUTH AMERICAN SPARRASSODONTS (MAMMALIA: METATHERIA)

2:00 Solé, F. EARLIEST EUROPEAN CARNIVOROUS MAMMALS (“CREODONTA”, CARNIVORA): SYSTEMATICS, PHYLOGENY, EVOLUTION AND PALEOBIOGEOGRAPHY; FAUNAS FROM THE EARLY EOCENE OF THE PARIS BASIN

2:15 Friscia, A., Kyongo, B., Macharwas, M., Rasmussen, D. THE EARLIEST CARNIVORANS FROM AFRICA

2:30 Tseng, Z., Wang, X. EVOLUTION OF STRESS CHANNELING MECHANISM IN THE SKULLS OF HYENAS: FINITE ELEMENT ANALYSIS OF KEY ECOMORPHOLOGIES

2:45 Polly, P., Lawing, A., Head, J. COMPARATIVE EVOLUTIONARY ECOLOGICAL MORPHOLOGY OF LOCOMOTION IN TERRESTRIAL VERTEBRATE CARNIVORES

3:00 Meachen-Samuels, J. CHANGES WITHIN CARNIVORE GUILDS FROM THE PLEISTOCENE AND HOLOCENE OF NORTH AMERICA

3:15 O’Keefe, F., Van Valkenburgh, B., Binder, W. CRANIODENTAL MEASURES OF DIRE WOLF POPULATION HEALTH IMPLY RAPID EXTINCTION IN THE LOS ANGELES BASIN

3:30 Hadly, E., Pinsky, M. PANMIXIA, PLASTICITY AND PLACE: INSIGHTS INTO PERSISTENCE OF THE NORTHERN FUR SEAL (CALLORHINUS URSINUS)
3:45  Jones, K., Goswami, A.  DISCORDANT CRANIAL MORPHOLOGICAL DISPARITY AND TAXONOMIC DIVERSITY IN PINNIPED VERSUS FISSIPED CARNIVORANS

4:00  Gaudin, T., Bramblett, J.  PHYLOGENETIC ANALYSIS OF EXTINCT AND EXTANT CINGULATA (XENARTHRA, MAMMALIA) BASED ON COMBINED CRANIAL AND POSTCRANIAL DATA

TUESDAY AFTERNOON, OCTOBER 12, 2010
POSTER SESSION III

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM A

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


2  Knoll, F.  WHAT IS “HALTICOSAURUS” ORBITOANGULATUS?

3  Senter, P., Kirkland, J., DeBlieux, D., Madsen, S.  THREE NEW THEROPODS FROM THE CEDAR MOUNTAIN FORMATION (LOWER CRETACEOUS) OF UTAH

4  Ibrahim, N.  A UNIQUE ANCIENT ECOSYSTEM: THE THEROPOD DOMINATED LATE CRETACEOUS KEM KEM DINOSAUR ASSEMBLAGE OF SOUTH EAST MOROCCO

5  Peecook, B., Wilson, J., Wilson, G., Hernández, R., Montellano-Ballesteros, M.  NEW TYRANNOSAUROID REMAINS FROM THE LATE CRETACEOUS ‘EL GALLO’ FORMATION OF BAJA DE CALIFORNIA, MEXICO

6  Thomson, T., Irmis, R.  FIRST OCCURRENCE OF A TYRANNOSAURID (DINOSAURIA, THEROPODA) FROM THE NESLEN FORMATION (LATE CRETACEOUS), BOOK CLIFFS AREA, UTAH

7  Lü, J., Kobayashi, Y., Xu, L., Pu, H., Wu, Y.  A NEW BASAL THERIZINOSAUROID FROM THE LOWER CRETACEOUS YIXIAN FORMATION OF LIAONING, CHINA

8  Blumhagen, E., Drake, A., Zhang, F., Xu, X., Claessens, L.  THREE-DIMENSIONAL DIGITAL RECONSTRUCTION OF FOSSIL BIRDS AND NON-AVIAN THEROPODS PRESERVED IN SLAB AND COUNTERSLAB USING LASER SURFACE SCANNING

9  Cullen, T., Ryan, M., Schröder-Adams, C., Kobayashi, Y., Currie, P.  DESCRIPTION OF THE FIRST ORNITHOMIMID (DINOSAURIA) BONEBED FROM NORTH AMERICA WITH IMPLICATIONS FOR THE DISCRIMINATION, ONTOGENY AND BEHAVIOR OF ORNITHOMIMIDS

10 Scheetz, A., Britt, B., Scheetz, R., Rauhut, O., Chure, D.  AN ORNITHOMIMID-LIKE BASAL COELUROSAUR FROM THE EARLY CRETACEOUS (APTIAN) CEDAR MOUNTAIN FORMATION OF UTAH

11 Williams, S., Brusatte, S., Mathews, J., Currie, P.  A NEW JUVENILE TYRANNOSAURUS AND A REASSESSMENT OF ONTOGENETIC AND PHYLOGENETIC CHANGES IN TYRANNOSAUROID FORELIMB PROPORTIONS

12 Persons, W.  ANATOMY OF A SPEED DEMON: THE CAUDAL MUSCULATURE OF CARNOTAURUS AND THE IMPLICATIONS FOR ABELISAUROID LOCOMOTION AND EVOLUTIONARY TRAJECTORY

13 Snively, E., Witmer, L., Ridgely, R., Wroe, S., Ryan, M.  IMPACT AND SCYTHE-LIKE JAW FUNCTION IN LARGE CRETACEOUS THEROPODS: MAJUNGSASURUS, TYRANNOSAURUS AND GIGANTOSAURUS COMPARED

14 Lavender, Z., Drake, A., Loewen, M., Zanno, L., Claessens, L.  THREE-DIMENSIONAL GEOMETRIC MORPHOMETRIC ANALYSIS AND UNIVARIANT MEASUREMENT ANALYSIS ON AN UNDESCRIBED ORNITHOMIMUS MANUS

15 Hall, L., Keenan, S.  TAPHONOMY OF A NEW SPECIMEN OF TYRANNOSAURUS REX FROM THE HELL CREEK FORMATION, MONTANA
TUESDAY AFTERNOON, OCTOBER 12, 2010
POSTER SESSION III (continued)

16 Lim, J., Kong, D., Kim, K., Kim, T. NEW DINOSAUR TRACKSITE AND UNUSUAL THEROPOD FOOTPRINTS FROM THE CRETACEOUS OF KOREA

17 Cowan, J., Lockley, M., Gierlinski, G. FIRST DROMAEOSAUR TRACKWAYS FROM NORTH AMERICA: NEW EVIDENCE FROM A LARGE SITE IN THE CEDAR MOUNTAIN FORMATION (EARLY CRETACEOUS), EASTERN UTAH

18 Zanno, L., Makovicky, P. QUANTITATIVE ANALYSIS OF HERBIVOROUS ECOMORPHOLOGY IN THEROPOD DINOSAURS: PATTERNS OF CHARACTER CORRELATION AND PROGRESSION

19 Bates, K., Benson, R., Peter, F. THE EVOLUTION OF BODY SIZE, STANCE AND GAIT IN ALLOSAUROIDEA (DINOSAURIA: THEROPODA)

20 Shychoski, L., Snively, E., Burns, M. MANEUVERED OUT OF A CORNER: LIGAMENT ENTHESES OF THE ARCTOMETATARSUS ENHANCED TYRANNOSAURID AGILITY

21 Noto, C. GEOMETRIC MORPHOMETRIC ANALYSIS OF THEROPOD MANUAL UNGUALS: EVOLUTIONARY AND ECOLOGICAL IMPLICATIONS

22 Wilson, L., Dececchi, T. A SURVEY OF BONE MICROSTRUCTURE IN THEROPOD FORELIMBS WITH REGARDS TO FUNCTION

23 Hwang, S., Claire, P. SPECIES AND GENUS-LEVEL VARIATION IN THE TOOTH ENAMEL MICROSTRUCTURE OF TYRANNOSAURID DINOSAURS

24 Criswell, K. BUILDING A COMPARATIVE MORPHOLOGICAL ATLAS FOR LUNGFISH: NEW INFORMATION ON THE SKELETAL ANATOMY OF TRANODIS CASTRENSIS

25 Shimada, K., Kirkland, J. A MYSTERIOUS KING-SIZED MESOZOIC LUNGFISH FROM NORTH AMERICA

26 Ortiz, D., Lewis, P., Kennedy, A., Bhullar, B., Hancox, J. PRELIMINARY ANALYSIS OF DIPNOI (OSTEICHTHYES: SARCOPTERYGII) FOSSILS FROM DRIEFONTEIN, SOUTH AFRICA

27 Wendruff, A., Scott, B. DIVERSITY OF CAUDAL FIN MORPHOLOGY IN LOWER TRIASSIC COELACANTHS FROM BRITISH COLUMBIA, CANADA

28 Main, D., Parris, D., Grandstaff, B. IMPLICATIONS OF A NEW LUNGFISH SPECIES (DIPNOI: CERATODONTIDAE) FROM THE CRETACEOUS (CENOMANIAN) WOODBINE FORMATION AT THE ARLINGTON ARCHOSAUR SITE, NORTH TEXAS

29 Shirley, M., Schachner, E., Shaw, C. ASYMMETRIC SKELETAL ADAPTATION TO A DEBILITATING PATHOLOGY IN THE HINDLIMB OF POPOSAURUS GRACILIS (ARCHOSAURIA: POPOSAUROIDEA)

30 Fernández, M., Paulina Carabajal, A., Gasparini, Z., Herrera, Y., Chong, G. A METRIORHYNCHID CROCODYLIFORM BRAINCASE FROM NORTHERN CHILE

31 Stocker, M. CLARIFICATION OF THE SKELETAL ANATOMY OF PHYTOSAURS BASED ON COMPARATIVE ANATOMY AND THE MOST COMPLETE SPECIMEN OF ANGIORTHINUS

32 Lecuona, A. THE AXIAL SKELETON OF GRACILISUCHUS STIPANICICORUM: AUTAPOMORPHIC CHARACTERS AND ITS PHYLOGENETIC INFORMATION WITHIN THE CONTEXT OF CRUROTARSI

33 Mancini, M., Hungerbuehler, A. TOWARDS A STABLE PHYTOSAUR TAXONOMY: DISTINGUISHING CHARACTERISTICS BETWEEN PSEUDOPALATUS AND REDONDASAURUS (PHYTOSAURIDAE: PSEUDOPALATINAE)

34 Hatcher, J., Janzic, A. FIRST OCCURRENCE OF THE MARINE CROCODYLIFORM TERMINONARIS FROM THE UPPER CRETACEOUS (TURONIAN) OF MANITOBA

35 Adams, T., Polcyn, M., Mateus, O., Winkler, D., Jacobs, L. NEW OCCURRENCE OF THE LONG-SNOUTED CROCODYLIFORM, TERMINONARIS CF. T. ROBUSTA, FROM THE WOODBINE FORMATION (CENOMANIAN) OF TEXAS
Schwimmer, D. ONE OR TWO SPECIES OF THE GIANT CROCODYLIAN DEINOSUCHUS?

Manning, P., Milan, J., Falkingham, P. DINOSAURS WALK TALL: A CROCODYLIAN TRACE FROM THE LANCE FORMATION (UPPER CRETACEOUS) OF WYOMING

Masters, S., Sandau, S., Burk, D., Krumenacker, L. A UNIQUE EOCENE CROCODYLIAN FROM THE UINTA BASIN, UTAH

Jímenez Vázquez, O., Brochu, C. CROCODYLIFORMS FROM THE EARLY MIocene DOMO DE ZAZA LOCALITY OF CUBA

Sanders, R., Farmer, C. THE PULMONARY ANATOMY OF ALLIGATOR MISSISSIPPIENSIS: A UNIDIRECTIONAL AIR FLOW SYSTEM THAT FORESHADOWS THE AVIAN RESPIRATORY SYSTEM

Tsai, H., Owerkoicz, T., Felbinger, K., Andrade, F., Hicks, J. CHRONIC EXERCISE DOES NOT ALTER LIMB BONE MORPHOLOGY OR MICROSTRUCTURE IN THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS)

Bourke, J., Witmer, L. THE NOSE KNOWS: THE EFFECTS OF NASAL CAVITY ANATOMY ON AIRFLOW IN ALLIGATORS

Hurlburt, G. ESTIMATION OF CROCODYLIAN BODY FORM FROM SNOUT-VENT LENGTH AND TAIL GIRTH

Silcox, M., Dalmyn, C., Hrenchuk, A., Bloch, J., Boyer, D. ENDOCRANIAL ANATOMY OF LABIDOLEMUR KAYI AND ITS RELEVANCE TO THE EVOLUTION OF THE BRAIN IN EUARCHONTOGRILES

Dirks, W., Anemone, R., Beard, K., Nachman, B., Tafforeau, P. DENTAL EMERGENCE SEQUENCES IN THE EUARCHONTA AND A POTENTIAL SYNAPOMORPHY OF EUPRIMATES

Bomberger, C., Sandau, S. PRELIMINARY REPORT ON THE DISCOVERY OF A LARGE EOCENE PRIMATE FROM THE UINTA FORMATION OF NORTHEASTERN UTAH

Tsukui, K., Meng, J. HIGH-RESOLUTION TEMPORAL VARIATIONS IN SIZE AND SHAPE OF MOLAR DENTITION AMONG NOTHARCTUS FROM THE MIDDLE EOCENE BRIDGER FORMATION, BRIDGER BASIN, SW WYOMING

Westgate, J., Cope, D., Beard, K. FIRST OCCURRENCE AND SIGNIFICANCE OF MAHGORITA STEVENSI IN A LATE MIOCENE PRIMATE COMMUNITY IN A LATE MIOCENE (LATE UINTAN) TETHYAN-INFLUENCED GULF COAST COMMUNITY

Ramdarshan, A., Marivaux, L., Merceron, G. DENTAL MICROWEAR ANALYSIS REVEALS SPATIAL AND TEMPORAL VARIABILITY IN THE DIET OF TWO EOCENE PRIMATES FROM FRANCE

Kirk, E., Daghighi, P., Macrini, T., Bhullar, B., Rowe, T. VIRTUAL ENDOCAST OF ROONEYIA VIEJAENSIS (MAMMALIA, PRIMATES)

Miyata, K., Beard, K., Gunnell, G., Tomida, Y. FIRST DISCOVERY OF EOCENE PRIMATES FROM JAPAN: THE EARLIEST RECORD OF SIVALADAPIDAE

Eastham, L., Begun, D., Kordos, L. PALEOECOLOGY OF A LATE MIOCENE Hominid Locality in Northern Central Hungary: Preliminary Stable Isotope Analysis of the Rudabanya Fauna

Knigge, R., McNulty, K. RE-EVALUATION OF HOMINOID FACIAL SYNAPOMORPHIES WITH IMPLICATIONS FOR THE TAXONOMIC STATUS OF AFROPITHECUS TURKANENSIS

Jenkins, K. PREDATION ON EARLY MIOCENE PRIMATES, PROCONSUL, DENDROPITHECUS AND LIMNOPITHECUS FROM RUSINGA ISLAND

Bennett, V., Goswami, A. MORPHOMETRIC ANALYSIS OF CRANIAL SHAPE IN FOSSIL AND RECENT EUPRIMATES

Chester, S., Beard, K. LATE PALEOCENE MICROMOMYID PLESIADAPIFORMS (MAMMALIA, EUARCHONTA) FROM BIG MULTI QUARRY, WASHAKIE BASIN, WYOMING
Kibii, J., Berger, L., de Klerk, B. *AUSTRALOPITHECUS SEDIBA*: A TAPHONOMIC PERSPECTIVE

Halenar, L. FORELIMB MORPHOLOGY AND LOCOMOTOR PROFILE OF *PROTOPITHECUS* AND *CAIPORA*, THE “GIANT” PLEISTOCENE NEW WORLD MONKEYS

Bobe, R. ESTIMATING TIME RANGES IN PLIO-PLEISTOCENE HOMINIDS

Massey, J., McNulty, K., Baab, K. SEXUAL DIMORPHISM IN THE HOMININE SUPRAORBITAL TORUS: IMPLICATIONS FOR IDENTIFYING SEX IN FOSSIL HUMANS

Gilbert, C. PLIO-PLEISTOCENE AFRICAN PAPIONIN PHYLOGENETIC HISTORY AND BIOGEOGRAPHY

Hammond, A., Koscielniak, N., Plavcan, J., Ward, C. 3D ANALYSIS OF PRIMATE HINDLIMB JOINTS: RECONSTRUCTING POSITIONAL ABILITIES IN EXTINCT PRIMATES

Velez-Juarbe, J., Domning, D. THE OLIGOCENE AND MIOCENE SIRENIAN FAUNA OF PUERTO RICO: REVIEW AND NEW ADDITIONS

Barrow, E., Seiffert, E., Simons, E. CRANIAL MORPHOLOGY OF *THYROHYRAX DOMORICTUS* (HYRACOIDEA: MAMMALIA) FROM THE EARLY OLIGOCENE OF EGYPT


Anaya Daza, F., Shockey, B., Croft, D. SPARASSODONTS OF SALLA: SPECIES RICHNESS AND NEW TAXA OF CARNIVOROUS MARSUPIALS FROM THE LATE OLIGOCENE OF BOLIVIA

Weiler, M., Schumaker, K., Pearson, D. MARSUPIALS AND INSECTIVORES FROM THE OLIGOCENE OF SOUTHWESTERN NORTH DAKOTA FROM A PREVIOUSLY UNDESCRIBED COLLECTION FROM THE PIONEER TRAILS REGIONAL MUSEUM

Furió, M., Ruiz-Sánchez, F., Crespo-Roures, V., Freudenthal, M., Montoya, P. NEW DIDELPHIMORPH (MARSUPIALIA, MAMMALIA) AND DIMYLID (EULIPOTYPHLA, MAMMALIA) REMAINS FROM THE LATE EARLY MIOCENE OF SPAIN


Browne, I., Smith, K., Czapelewski, N. NEW COLLECTIONS OF LATE HEMINGFORDIAN AND EARLY BARSTOVIAN SMALL MAMMALS FROM THE BARSTOW FORMATION, MOJAVE DESERT, CALIFORNIA

Martín, J. THE YOUNGEST VERTEBRATE ASSEMBLAGE FROM THE ELLENSBURG GROUP, WILBUR LOCALITY (HEMPHILLIAN), CENTRAL WASHINGTON

Rincón, A., Solórzano, Á., McDonald, H. NEW MAMMAL RECORDS FROM THE EARLY MIOCENE CASTILLO FORMATION OF VENEZUELA


Maguire, K. MAMMALIAN RANGE DYNAMICS ACROSS THE MID-MIOCENE CLIMATIC OPTIMUM IN THE JOHN DAY BASIN, OREGON

Hoffman, J., Clementz, M. UNDERSTANDING GRASSLAND EXPANSION, CLIMATIC FACTORS AND HYPSODONTY EVOLUTION THROUGHOUT THE MIOCENE IN THE JOHN DAY BASIN, OREGON

Miller, E., Wood, A. PALEOENVIRONMENTAL RECONSTRUCTION OF BULUK, EARLY MIOCENE, KENYA
TUESDAY AFTERNOON, OCTOBER 12, 2010
POSTER SESSION III (continued)


78 Gomez Cano, A., Hernández Fernández, M., Garcia Yelo, B. SAMPLING BIAS AND REDUNDANCY IN MAMMALIAN COMMUNITIES: DO THEY AFFECT TO PALAEOENVIRONMENTAL APPROACHES?

79 Hopkins, S., Calede, J., Gusey, A. RECONSTRUCTING HABITAT DIVERSITY FROM FAUNAS OF THE MIDDLE AND LATE MIOCENE OF EASTERN OREGON

80 Sameh, M., Croft, D. ECOLOGICAL STRUCTURE AND HABITAT OF TWO MIDDLE MIOCENE SOUTH AMERICAN MAMMAL PALEOCOMMUNITIES

81 Gusey, A., Davis, E. DIVERSITY BIASES OF THE PUBLISHED RECORD OF FOSSILS AT NINE MIOCENE MAMMALIAN FAUNAS OF NEVADA AND OREGON

82 Finarelli, J., Badgley, C. DIVERSIFICATION OF MIOCENE MAMMALS IN NORTH AMERICA, WITH RESPECT TO TECTONIC AND CLIMATIC HISTORY

83 Nargolwalla, M. A REAPPRAISAL OF BIOPROVINCIALITY IN MIDDLE AND LATE MIOCENE EURASIAN MAMMALS

84 Thasod, Y., Saegusa, H., Ratanasthien, B., Jintasakul, P., Hanta, R. STEGODONTID (PROBOSCIDEA, MAMMALIA) FOSSILS FROM THA CHANG SAND PITS, NAKHON RATCHASIMA PROVINCE, THAILAND

85 Schwartz, L. THE SEDIMENTOLOGY AND STRATIGRAPHY OF BULLOCK CREEK, AUSTRALIA - AN IMPORTANT BIOCHRONOLOGIC MARKER FOR AUSTRALIA’S MID-CENOZOIC

86 Yann, L., Schiebout, J. RARE EARTH ELEMENTS AS AN INVESTIGATIVE TOOL INTO THE SOURCE, AGE AND ECOLOGY OF LATE MIOCENE TO LATE PLEISTOCENE FOSSILS FROM THE TUNICA HILLS, LOUISIANA

87 Hulbert Jr., R., MacFadden, B., Sanborn, S., West, C. SPATIAL-TEMPORAL LIMITATIONS OF AGE DETERMINATION USING RARE EARTH ELEMENTS WITH NEOGENE FAUNAS FROM FLORIDA

88 McAfee, R. DISCOVERY OF THE JUGAL BONE IN THE HAITIAN GROUND SLOTH NEOCNUS (MAMMALIA, PILOSA. MEGALONYCHIDAE) AND THE IMPLICATIONS FOR DIETARY RECONSTRUCTION

89 Shaw, B. SLOTHS UP A TREE: ELUCIDATING SEMI-ABOREAL LOCOMOTION OF SMALL GROUND SLOTHS (SUPERORDER XENARTHRA, ORDER PILOSA)

90 Holte, S., Schubert, B., Wallace, S. AN ANALYSIS OF THE MEGALONYX JEFFERSONII MATERIAL FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA AND AN EXAMINATION OF MEASURING TECHNIQUES FOR GROUND SLOTHS

91 Bryk, A., Feranec, R., Semken, H. STABLE ISOTOPE ANALYSIS OF AN EXTINCT PLEISTOCENE GROUND SLOTH, MEGALONYX JEFFERSONII, FROM THE TARKIO VALLEY OF SOUTHWESTERN IOWA: IMPLICATIONS FOR BIOAPATITE DIAGENESIS

92 Zurita, A., Carlini, A., Gillette, D. A NEW GLYPTODONTINAE (XENARTHRA, GLYPTODONTIDAE) FROM NORTHERN SOUTH AMERICA: ITS IMPLICATIONS IN THE GREAT AMERICAN BIOTIC INTERCHANGE

93 Kalthoff, D. GIANTS AND THEIR LITTLE SECRETS: TOOTH MICROSTRUCTURES IN MYLODONTID SLOTHS (MAMMALIA, FOLIVORA)

94 Rountrey, A., Fisher, D. AN EVALUATION OF PRETREATMENT METHODS FOR STABLE ISOTOPE ANALYSIS OF DENTIN CARBONATE

95 Broska, J., Tütken, T., Alt, K. ASSESSING CALCIUM ISOTOPES AS DIETARY PROXY FOR TERRESTRIAL VERTEBRATES
TUESDAY AFTERNOON, OCTOBER 12, 2010
POSTER SESSION III (continued)

96 Higgins, P., MacFadden, B., Bershaw, J., Garzoni, C. MODELING COMPLEX PAST ENVIRONMENTS WITH BULK ISOTOPIC DATA

97 Boyd, C. FOSSILS, MOLECULES AND THE HISTORICAL RECORD: NEW APPLICATIONS FOR STRATIGRAPHIC CONSISTENCY METRICS

98 Malenda, H., Simpson, E., Szajna, M., Fillmore, D., Hartline, B. DEPOSITIONAL SETTING OF FISH-PART SANDSTONES AND CONGLOMERATES: A TAPHONOMIC INTERPRETATION OF A RARE LACUSTRINE STRAND LINE

99 Moore, J., Krumenacker, L., Varricchio, D. ASSESSING THE CHARACTERISTICS DEFINING THE TAPHONOMIC MODE OF VERTEBRATE FOSSIL ASSEMBLAGES USING ORDINATION ANALYSIS

100 Sundell, K., Rothschild, B. PATHOLOGY AND LIFE EXPECTANCY: RECOGNITION OF AN ANCIENT TUMOR

101 Bennett, III, G. QUANTIFYING COLLECTION BIAS AND ASSESSING PALEOECOLOGICAL UTILITY OF MICROVERTEBRATE FOSSILS FROM ANTHILLS

102 Breithaupt, B., Matthews, N. AN EARLY JURASSIC DESERT ICHNOFAUNA: PALEONTOLOGICAL RESOURCES IN THE VERMILION CLIFFS NATIONAL MONUMENT AND PARIA CANYON-VERMILION CLIFFS WILDERNESS

103 Van Orden, E., Behrensmeier, A. BONE ABRASION AND TRANSPORT DISTANCE: TAPHONOMIC EXPERIMENTS IN THE EAST FORK RIVER, WYOMING

WEDNESDAY MORNING, OCTOBER 13, 2010
SYMPOSIUM: EVOLUTION OF THE MODERN AFRICAN FAUNA
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301
MODERATORS: Nancy Stevens, Lars Werdelin, William Sanders

8:00 Gheerbrant, E., Amaghzaz , M., Bouya, B. NEW DATA ON THE PRIMITIVE UNGULATE (CONDYLARTH-LIKE) MAMMALS FROM THE PALEOCENE OF THE OULED ABDOUN BASIN, MOROCCO

8:15 Borths, M., Seiffert, E., Goodenberger, K., Simons, E. THE OLDEST FAYUM CREODONT: DENTAL AND HUMERAL MORPHOLOGY OF A NEW PROVIVERRINE HYAENODONTID FROM THE EARLIEST LATE EOCENE OF EGYPT

8:30 Stevens, N. EVOLUTION OF THE AFRICAN FAUNA: PALEOGENE TO NEOGENE FAUNAL TRANSITIONSRecorded IN THE LATE OLIGOCENE NSUNGWE FORMATION OF TANZANIA

8:45 Sanders, W. AFRO-ARABIA AS THE CRUCIBLE OF PROBOSCIDEAN EVOLUTION

9:00 Domning, D., Gingerich, P., Zalmout, I. A REVIEW OF THE AFRICAN FOSSIL SIRENIA


9:45 Gunnell, G. CENOZOIC AFRICAN BAT COMMUNITIES

10:00 BREAK

10:15 Peigné, S., Werdelin, L. A REVIEW OF THE FOSSIL RECORD OF CARNIVORA (MAMMALIA) IN AFRICA

10:30 Lewis, M., Werdelin, L. PATTERNS OF EVOLUTION IN EASTERN AND SOUTHERN AFRICAN CARNIVORA

10:45 Seiffert, E., MacLatchy, L., Cote, S. A CRANIUM OF THE EARLY MIOCENE TENREC ERYTHROZOOTES FROM NAPAK, NORTHEASTERN UGANDA
WEDNESDAY MORNING, OCTOBER 13, 2010
SYMPOSIUM: EVOLUTION OF THE MODERN AFRICAN FAUNA (continued)

11:00 Andanje, S., Chritz, K., Cerling, T. COMPARISON OF THE LIFETIME HISTORIES OF HIPPOS FROM DIFFERENT ENVIRONMENTS USING STABLE ISOTOPES

11:15 Uno, K., Cerling, T., Harris, J., Leakey, M., Nakaya, H. DIFFERENTIAL DIET CHANGE AMONG EAST AFRICAN HERBIVORES FROM THE LATE MIOCENE TO PLIOCENE BASED ON CARBON ISOTOPE DATA FROM FOSSIL ENAMEL

11:30 Bernor, R., Gilbert, W., Wolf, D. EVOLUTIONARY HISTORY OF THE AFRICAN EQUIDAE

11:45 Werdelin, L., Peigné, S. HOW ADEQUATE IS THE NEOGENE FOSSIL RECORD OF AFRICA? AN ANALYSIS BASED ON CARNIVORA

12:00 Harrison, T. NEW ESTIMATES OF HOMINOID TAXONOMIC DIVERSITY IN AFRICA DURING THE NEOGENE AND ITS IMPLICATIONS FOR UNDERSTANDING CATARRHINE COMMUNITY STRUCTURE

WEDNESDAY MORNING, OCTOBER 13, 2010
TECHNICAL SESSION XIV

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B

MODERATORS: Stephen Brusatte, Randall Irmis

8:00 Brusatte, S., Niedzwiedzki, G., Butler, R. NEW POLISH FOOTPRINTS PULL ORIGIN AND DIVERSIFICATION OF DINOSAUR STEM-LINEAGE INTO EARLY TRIASSIC

8:15 Upchurch, P., Barrett, P., Xu, X., Li, K. NEW INFORMATION ON THE TAXONOMY AND PHYLOGENETIC RELATIONSHIPS OF MIDDLE AND LATE JURASSIC SAUROPODS FROM CHINA

8:30 Whitlock, J., D’Emic, M., Fisher, D., Smith, K., Wilson, J. TRENDS IN SAUROPOD TOOTH SIZE, SHAPE AND REPLACEMENT RATE

8:45 Pittman, M., Upchurch, P., Hutchinson, J. THE EVOLUTION OF TAIL VARIATION IN SAUROPOD DINOSAURS

9:00 Wilson, J., D’Emic, M., Ikejiri, T., Moacdieh, E., Whitlock, J. A NOMENCLATURE FOR VERTEBRAL FOSSAE IN SAUROPODS AND OTHER SAURISCHIAN DINOSAURS

9:15 Sues, H., Nesbitt, S., Berman, D., Henrici, A., Sullivan, R. A NEW BASAL THEROPOD DINOSAUR FROM THE COELOPHYSIS QUARRY (UPPER TRIASSIC) OF GHOST RANCH, NEW MEXICO


9:45 Britt, B., Chure, D., Engeleman, G., Scheetz, R., Hansen, R. MULTI-TAXIC THEROPOD BONEBEDS IN AN INTERDUNAL SETTING OF THE EARLY JURASSIC EOLIAN NUGGET SANDSTONE, UTAH

10:00 BREAK

10:15 Sereno, P. NOASAURID (THEROPODA: ABELISAUROIDEA) SKELETON FROM AFRICA SHOWS DERIVED SKELETAL PROPORTIONS AND FUNCTION


10:45 Carr, T. ONTOGENETIC VARIATION IN TYRANNOSAURUS REX: RESULTS FROM A NUMERICAL CLADISTIC ANALYSIS

11:00 Loewen, M., Sertich, J., Irmis, R., Sampson, S. TYRANNOSAURID EVOLUTION AND INTRACONTINENTAL ENDEMISM IN LARAMIDIA: NEW EVIDENCE FROM THE CAMPANIAN WAHWEAP FORMATION OF UTAH


October 2010—PROGRAM AND ABSTRACTS 37A
WEDNESDAY MORNING, OCTOBER 13, 2010
TECHNICAL SESSION XIV (continued)


11:45 Tsuihiji, T., Watabe, M., Tsogtbaatar, K., Suzuki, S., Barsbold, R. A NEW TROODONTID (DINOSAURIA: THEROPODA) FROM THE LATE CRETACEOUS OF THE GOBI DESERT IN MONGOLIA

12:00 Jackson, F., Jackson, R., Varricchio, D., Zelenitsky, D. UNCOVERING THEROPOD EGGS: WATER VAPOR CONDUCTANCE AND NESTING STRATEGY OF TROODON

WEDNESDAY MORNING, OCTOBER 13, 2010
TECHNICAL SESSION XV
DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Kerin Claeson, Brian Swartz

8:00 Qiao, T., Zhu, M. A URANOLOPHUS-LIKE LUNGFISH FROM THE PRAGIAN (EARLY DEVONIAN) OF YUNNAN, SOUTH CHINA

8:15 Lu, J., Zhu, M. NEUROCRANIAL MORPHOLOGY OF A BASAL ONYCHODONT QINGMENODUS REVEALED BY HIGH-RESOLUTION COMPUTED TOMOGRAPHY

8:30 Swartz, B. THE FIRST TRISTICHOPTERID (STEM-TETRAPOD) FROM THE MIDDLE DEVONIAN OF WESTERN NORTH AMERICA: FURTHER EVIDENCE OF PARALLELISM IN THE TETRAPOD STEM-GROUP

8:45 Lund, R., Emily, G., Grogan, E. DIVERSITY AND DISTRIBUTION OF FISH IN A MISSISSIPPIAN BAY: THE BEAR GULCH FISH FAUNA

9:00 Greenfest-Allen, E., Lund, R., Grogan, E. COMMUNITY STRUCTURE OF THE MISSISSIPPIAN BEAR GULCH BAY FISHES


9:45 Claeson, K. THE FIRST PHYLOGENY OF RAJIDAE TO INCLUDE EXTINCT AND EXTANT TAXA SIMULTANEOUSLY

10:00 BREAK

10:15 Lane, J. THE ORIGINS AND EVOLUTIONARY RELATIONSHIPS OF HYBODONT SHARKS: NEW INFERENCES BASED ON SKELETAL MORPHOLOGY

10:30 Ehret, D. MACROEVOLUTION OF LARGE BODY SIZE IN MEGATOOTHED (LAMNIFORMES: OTODONTIDAE) SHARKS

10:45 Sallan, L. FUNCTIONAL MORPHOLOGY AND MODULAR LAGS IN THE EARLY DIVERSIFICATION OF RAY-FINNED FISHES (ACTINOPTERYGII)

11:00 Schultz, H., Arratia, G., González Rodríguez, K. THE EARLY APPEARANCE OF ADVANCED EUTELEOSTS AND THE CONTROVERSY BETWEEN MOLECULAR CLOCK AND GEOLOGICAL APPEARANCE OF ACTINOPTERYGIANS

11:15 Chang, M., Miao, D., Wang, N. ASCENT WITH MODIFICATION: FOSSIL FISHES WITNESSED THEIR OWN GROUP’S ADAPTATION TO THE UPLIFT OF THE TIBETAN PLATEAU DURING THE LATE CENOZOIC
WEDNESDAY MORNING, OCTOBER 13, 2010
TECHNICAL SESSION XV (continued)

11:30 Liu, J., Chang, M., Wilson, M. THE FOSSIL CATOSTOMID JIANGHANICHTHYS FROM CHINA AND IMPLICATIONS FOR THE EVOLUTION OF BASAL CATOSTOMIDS (CYPRINIFORMES, ACTINOPTERYGII)

11:45 Miyashita, T., Snively, E., Murray, A. MICRO-CT SCANNING TECHNOLOGY REVEALS DEVELOPMENT OF DIPLOSPONDYLY IN AMIA CALVA

12:00 Darras, L., Purnell, M., Hart, P., Turingan, R. INVESTIGATING THE DIET OF EXTANT AND FOSSIL FISHES THROUGH MICROTEXTURAL ANALYSIS OF TEETH

WEDNESDAY AFTERNOON, OCTOBER 13, 2010
TECHNICAL SESSION XVI

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 301
MODERATORS: Tobin Hieronymus, Karen Sears

1:45 Baermann, E., Sánchez, I., Andrés Rodrigo, M., Alcalde, G., Morales, J. TOTAL EVIDENCE ANALYSIS OF THE ANTILOPINAE WITH IMPLICATIONS FOR THE EARLY HISTORY OF AFRICAN ANTELOPES

2:00 Faith, J. THE FOSSIL RECORD OF EXTINCTION: THE DEMISE OF THE BLUE ANTELOPE (HIPPOTRAGUS LEUCOPHAEUS) IN SOUTHERN AFRICA


2:30 Bormet, A., Marcot, J., Sears, K. EVOLUTIONARY RATES AND PATTERNS OF ARTIODACTYL LIMB REDUCTION

2:45 Sears, K., Bormet, A., Rockwell, A., Powers, L., Grobis, M. DEVELOPMENTAL MECHANISMS UNDERLYING TRENDS IN ARTIODACTYL LIMB REDUCTION: A CASE STUDY IN THE DOMESTICATED PIG, SUS SCROFA

3:00 Cuddahee, R., Madden, R., Churchill, S., Bobe, R. NON-DIETARY ABRASIVES AND THE DENTAL EVOLUTION OF PLIO-PLEISTOCENE SUIDAE (ARTIODACTYLA: MAMMALIA)

3:15 Hieronymus, T., Cooper, L., Vinyard, C., Thewissen, J. INFERRING DIET FROM MORPHOLOGY IN EARLY WHALES: MORPHOMETRIC ANALYSIS OF FEEDING STRATEGY IN REMINGTONOCETUS

3:30 Uhen, M., Clementz, M. LIFE HISTORY AND ECOLOGICAL INFORMATION INFERRED FROM STABLE ISOTOPE ANALYSIS OF THE DENTITION OF ZYGORHIZA KOCHII (CETACEA: BASILOSAURIDAE)

3:45 Moran, M., Thewissen, J., Bajpai, S. SACRAL FUSION IN MODERN AND FOSSIL CETACEA

4:00 Ekdale, E., Berta, A., Deméré, T. PHYLOGENETIC IMPLICATIONS OF THE PETROTYMPANIC COMPLEX OF BALEEN WHALES (CETACEA, MYSTICETI)

WEDNESDAY AFTERNOON, OCTOBER 13, 2010
TECHNICAL SESSION XVII

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, SPIRIT OF PITTSBURGH BALLROOM B
MODERATORS: Hans Larsson, Matthew Lamanna

1:45 Csiki, Z., Brusatte, S., Vremir, M., Norell, M. BEING A THEROPOD ON AN ISLAND: A PECULIAR DROMAEOSAURID FROM THE MAARSTRAIT OF THE TRANSylvANIAN BASIN, ROMANIA

2:00 Larsson, H., Hone, D., Dececchi, T., Sullivan, C., Xu, X. THE WINGED NON-AVIAN DINOSAUR MICRORAPTOR FED ON MAMMALS: IMPLICATIONS FOR THE JEHOL BIOTA ECOSYSTEM

2:15 Lamanna, M., Li, D., Harris, J., Atterholt, J., You, H. FIRST NON-AVIAN DINOSAUR FROM THE LOWER CRETACEOUS (APTIAN) XIAGOU FORMATION OF THE CHANGMA BASIN, NORTHWESTERN CHINA
2:30 Watanabe, A., Sereno, P. A LARGE SHORT-SNOUTED DROMAEOSAURID (THEROPODA: MANIRAPTORA) FROM INNER MONGOLIA

2:45 Pei, R. ASSESSING MORPHOLOGICAL RATES OF CHANGE: AN EXAMPLE USING COELUROSAURIAN DINOSAURS

3:00 Hone, D., Jonah, C., Sullivan, C., Currie, P. ELONGATION AND REDUCTION OF THE ARM IN THEROPOD DINOSAURS


3:30 Mori, H., Britt, B. PRELIMINARY DETRITAL ZIRCON AGES FOR THREE STRATIGRAPHIC UNITS OF THE CEDAR MOUNTAIN FORMATION AND STATISTICAL ANALYSES OF ITS FAUNAS

3:45 Suarez, C., Gonzalez, L., Ludvigson, G., Kirkland, J., Cifelli, R. OXYGEN ISOTOPIC COMPOSITION OF VERTEBRATE PHOSPHATE FROM THE CEDAR MOUNTAIN FORMATION, UT: A TOOL FOR DECIPHERING BOTH GLOBAL AND SMALL-SCALE CLIMATE CHANGE AND ECOLOGIC PARTITIONING

4:00 Montanari, S., Norell, M. LATE CRETACEOUS PALEOENVIRONMENTS OF THE GOBI DESERT: RECONSTRUCTIONS FROM STABLE ISOTOPES OF DINOSAUR FOSSILS

WEDNESDAY AFTERNOON, OCTOBER 13, 2010
TECHNICAL SESSION XVIII

DAVID L. LAWRENCE CONVENTION CENTER, EAST LOBBY, ROOM 304
MODERATORS: Sergio Dias-da-Silva, Kenneth Angielczyk

1:45 Dias-da-Silva, S., Sengupta, D., Cabreira, S., da Silva, L. FIRST RECORD OF CHIGUTISAURIDS (STEREOSPONDYLI, TREMATOSAURIA) IN THE SANTA MARIA FORMATION (UPPER TRIASSIC OF SOUTHERN BRAZIL)

2:00 McHugh, J. A SPECIES-LEVEL PHYLOGENETIC ANALYSIS OF TEMNOSPONDYLI (VERTEBRATA: CHOANATA)

2:15 Angielczyk, K., Ruta, M. GEOMETRIC MORPHOMETRIC ANALYSIS OF SKULL SHAPE IN CARBONIFEROUS AND PERMIAN TEMNOSPONDYL AMPHIBIANS

2:30 Sidor, C., Steyer, J., Angielczyk, K., Smith, R., Tolan, S. NEW INFORMATION ON THE PERMIAN AND TRIASSIC VERTEBRATE FAUNAS OF THE LUANGWA BASIN, ZAMBIA

2:45 Báez, A. ANURAN ASSEMBLAGE FROM THE LOWER CRETACEOUS OF SPAIN: NOVEL INSIGHTS ON THE BASAL RADIATION OF CROWN-CLADE ANURA

3:00 Dong, L., Wang, Y. A STEM-GROUP ANuran FROM THE LOWER CRETACEOUS OF WESTERN LIAONING, CHINA

3:15 Wang, Y., Dong, L., Evans, S. POLYDACTYLY IN A MESOZOIC SALAMANDER FROM CHINA

3:30 Redelstorff, R., Orr, P., McNamara, M. DIE AND ROT: EXPERIMENTAL TAPHONOMY OF TADPOLES

3:45 Meyer, T., Anderson, J. WHEN IS AN ASTRAGALUS NOT AN ASTRAGALUS? TARSAL FUSION IN HYLONOMUS, THE EARLIEST KNOWN AMNIOТЕ

4:00 Tsuji, L., Reisz, R., Müller, J. THE LATE PERMIAN REPTILE EMEROLETTER LEVIS FROM RUSSIA AND THE PHYLOGENY OF THE NYCTEROLETTER PARAREPTILES
1. Escaso, F., Silva, B., Ortega, F., Malafaia, E., Sanz, J. A Portuguese specimen of *Camptosaurus Aphanoecetes* (Ornithopoda: Camptosauridae) increases the dinosauiran similarity among the upper Jurassic Alcobaça and Morrison formations.

2. Thomas, D. A description of the cranial anatomy of an exceptionally well-preserved specimen of *Tenontosaurus tilletti* (Ornithopoda, Dinosauria) from the Antlers Formation of Oklahoma.


4. Herrero, L., Farke, A. Morphological variation in the hadrosaur dinosaur *Gryposaurus* from the Kaiparowits Formation (Late Campanian) of Southern Utah.

5. Scheetz, R., Britt, B., Higgerson, J. A large, tall-spined iguanodontid dinosaur from the early Cretaceous (Early Albion) basal Cedar Mountain Formation of Utah.


10. Levitt, C., Irmis, R. An articulated small juvenile hadrosaurid dinosaur (Ornithischia: Ornithopoda) from the Campanian Kaiparowits Formation, Utah.

11. King, L., Yacobucci, M., Farver, J. Use of finite element analysis to determine the optimum angle of the scelosaur (*Dinosauria*) metatarsals.


13. Van Dongen, B., Wogelius, R., Buckley, M., Lyson, T., Manning, P. Preservation of organic molecules in a hadrosaur dinosaur from the Hell Creek Formation, North Dakota (USA).


15. Brink, K., Zelenitsky, D., Evans, D., Therrien, F. Affinities of lambeosaurine (Ornithischia: Hadrosauridae) embryos from Devil’s Coulee (Campanian), Alberta.


18. Marugán-Lobón, J., Chiappe, L. Testing the consistency of the lateral semicircular canal as a comparative coordinate system for craniofacial descriptions in saurischian dinosaurs.
Boehmer, C., Rauhut, O. 3D MORPHOMETRIC ANALYSIS OF THE PRESACRAL VERTEBRAE OF PLATEOSAURUS: IMPLICATIONS FOR VERTEBRAL EVOLUTION IN SAUROPODOMORPH DINOSAURS

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Curry Rogers, K., D’Emic, M., Cagan, A. TITANOSAUR OSTEODERM ONTOGENY, ANATOMY AND FUNCTION: NEW DATA FROM RAPETOSAURUS KRAUSEI (MAEVARANO FORMATION, MADAGASCAR)

Carballido, J., Schwarz-Wings, D., Marpman, S., Sander, M., Pabst, B. SYSTEMATIC REEVALUATION OF “TONI”, THE JUVENILE SAUROPOD FROM THE MORRISON FORMATION

Turner, L., Neufeld, B., Chadwick, A., Spencer, L. TEN YEARS EXCAVATION AT AN EXTENSIVE LANCIAN EDMONTOSAURUS BONEBED IN NORTHEASTERN WYOMING

Santos-Cubedo, A., Poza, B., Suñer, M., de Santisteban, C. NEW REMAINS OF A TITANOSAUR (DINOSAURIA: SAUROPODA) FROM THE EARLY CRETACEOUS OF SPAIN

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Wilhite, R., Bonnan, M., Sanders, R. APPENDICULAR JOINT RECONSTRUCTION IN SAUROPOD DINOSAURS BASED ON COMPUTED TOMOGRAPHY OF A MAMMAL, A BIRD AND A CROCODILIAN

Woodruff, D., Fowler, D. ONTOGENETIC INFLUENCE ON NEURAL SPINE BIFURCATION IN DIPLODOCOCIDEA (DINOSAURIA: SAUROPODA): A CRITICAL PHYLOGENETIC CHARACTER

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EXTREME VARIATION IN THE SAGITTAL CREST OF TAPIRUS POLKENSKIS FROM THE GRAY FOSSIL SITE, TN

ABERNETHY, Aaron, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA

The excellent preservation and quantity of fossil tapirs from the Gray Fossil Site in north-eastern Tennessee provides a great opportunity for comparison and analysis of several skeletal characteristics. Intraspecifically, modern tapirs show little to no variation in the morphology of the sagittal crest. Specifically, a small percentage of the specimens at Gray display a well defined sagittal crest composed of two thin temporal ridges on the parietals that merge and extend vertically from the braincase; crests that form large flattened parietal tables, which can also extend vertically; crests where the temporal ridges merge briefly; while other specimens exhibit little or no sagittal crest. Several hypotheses may explain the observed variation and are addressed here: 1) more than one species is present at Gray, 2) sexual dimorphism, 3) ontogeny, 4) feeding behaviors and dietary choice, 5) pathogenic responses, or 6) the sagittal crest is simply a highly variable character in Tapiurus polkensis. Previous work has determined coefficients of variation are consistent with a single species. Four separate crest states within the Gray sample would also suggest up to four species when compared to modern analogues, which is unlikely considering the tapir’s ecological niche as a large low level browser. To date, no osteological evidence of sexual dimorphism exists for tapirs, and no correlation between crest morphology and sex was observed here. Several juveniles identified by having unerupted cheek teeth display well defined sagittal crests, while some adults with heavily worn teeth have minor thickening of the temporal ridges with no true crest, therefore no distinct correlation between age and crest state could be established. Concerning hypothesis 4, three different patterns of wear exist within the sample, and there is some correlation between these and crest morphology. No cranial pathologies were found to be associated with a crest type. Despite some correlations evident in the sample the sagittal crest could simply be a variable character due to intraspecific variation.

NEW OCCURRENCE OF THE LONG-SNOUTED CROCODYLIFORM, TERMINONARIS CF. T. ROBUSTA, FROM THE WOODBINE FORMATION (CENOMANIAN) OF TEXAS

ADAMS, Thomas, Hufington Dept. of Earth Sci, SMU, Dallas, TX, USA; POLCYN, Michael, Huffington Dept. of Earth Sci., SMU, Dallas, TX, USA; MATEUS, Octávio, CICEe, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal and Museu da Lourinhã, Portugal, Lourinhã, Portugal; WINKLER, Dale, Huffington Dept. of Earth Sci., SMU, Dallas, TX, USA; JACOBS, Louis, Huffington Dept. of Earth Sci., SMU, Dallas, TX, USA

A specimen of the longirostrine crocodyliform Terminonaris was recovered in 2006 from the northeast shore of Lewisville Lake, Denton County, Texas. It is represented by a nearly complete rostrum consisting of fused premaxillae and maxillae, nasals, partial jugal and lacrimal, dentaries, and partial splenials. The anterior ends of the premaxillae are transversely broad and ventrally directed. The jugal, lacrimal and the position of the frontals extend anteriorly to the same level. These characters diagnose the Lewisville Lake specimen to the genus Terminonaris. The nasals contact with the premaxilla at the level between the ninth and tenth maxillary tooth, indicating a stronger affinity with T. robusta than that of T. browni. However, because the posterior portion of the skull is missing, the Lewisville Lake specimen is conservatively referred to as Terminonaris cf. T. robusta. A second specimen, also collected from Lewisville Lake, consists of a fragment of maxilla and an osteoderm. The fossils derive from the Arlington Member in the uppermost part Woodbine Formation, which represents an age no younger than early Middle Cenomanian (approximately 96 Ma). Terminonaris is known from the Early to Middle Turonian of North America (Saskatchewan, Montana, Minnesota, and Kansas), and the Late Cenomanian of Germany. The Lewisville Lake specimens are not only significant for being the first record of Terminonaris in Texas; they are also the earliest and the southernmost occurrence of this crocodyliform globally.
Evolution of the Modern African Fauna, Wednesday 11:00

COMPARISON OF THE LIFETIME HISTORIES OF HIPPOS FROM DIFFERENT ENVIRONMENTS USING STABLE ISOTOPES

ANDANJE, Samuel, Biodiversity Research and Monitoring, Kenya Wildlife Service, Nairobi, Kenya; CHIRITZ, Kendra, Department of Biology, University of Utah, Salt Lake City, UT, USA; LARSON, Peter, Black Hills Inst of Geological Research, Hill City, SD, USA

Stable isotope analysis (SIA) has the potential to elucidate aspects of ecology in fossil organisms that are not easily observable using traditional palaeontological techniques, such as diet and migration. Before SIA can be applied to ancient specimens with confidence, more work must be done on modern analogues living in a variety of environments in order to understand how environmental parameters are recorded in the isotopic signature of diagenetically resistant tissues, such as tooth enamel. We present data from isotope measurements taken at City, UT, USA; CERLING, Thure, Department of Geology and Geophysics, University of Nairobi, Kenya; CHRITZ, Kendra, Department of Biology, University of Utah, Salt Lake City, UT, USA; LARSON, Peter, Black Hills Inst of Geological Research, Hill City, SD, USA.

Harpagofututor from the male Harpagofututor volcellorhinus to the female Harpagofututor volcellorhinus reveals sexual dimorphism in the pectoral fin and girdle between these male specimens and the previously described females. The pectoral fin of the female Harpagofututor is paddle-like, characterized by a single series of axes from which thin radials radiate both dorsally and ventrally. This is distinct from the male pectoral fin in that the elements of the latter are appreciably more robust. The male fin axes are very broad and support jointed radials which are also considerably broader than in the female. These larger radials of Harpagofututor are positioned closer together in series than in females. To support the more robust paddle, the pectoral girdle of male Harpagofututor is correspondingly more developed than that of females. This sex-based variation in anatomy suggests distinction in how these structures are used, possibly for display purposes. Such a correlation has been reported in extant fish with comparable sex-based pectoral dimorphism. In addition to pectoral fin and girdle dimorphism, the male Harpagofututor also possessed denticulated ethmoid claspers and pelvic fins, augmenting the already large body of evidence for pervasive sexual selection in Bear Gulch chondrichthians. We also found the sexually dimorphic pectoral girdon described here to be comparable to that of the Scottish relative, Chondrichelys problematica. Otherwise, the male Chondrichelys pectoral fin is distinct from the male Harpagofututor in exhibiting distinct morphologies in its leading digit, and in addition, in the relative proportions of the caudal fins. The dermal features of the cranium, dentition and body, similarly, in pectoral fin structure of the American Chondrichelys and Scottish Chondrichelys accentuates the close relationship between these fish.

Posters Session IV, (Wednesday)

FUNCTIONAL SHIFT IN THE DENTITION OF EXTANT AND FOSSIL MAMMALS

ANDERS, Ulrike, Universität Bonn, Bonn, Germany; VON KOENIGSWALD, Wigraph, Universität Bonn, Bonn, Germany

Bunodont teeth are generally regarded as being used for crushing food. However, in some species of Sus (scrofa) and fossil forms such as Stetteri (genus), the degeneration of the cheek teeth opens up the possibility of functional changes. During ontogeny wear causes the flattening of the surface and enamel margins of the exposed dentine fields in the cusps may function as shearing edges. Crushing elements in the cheek teeth are present on the bunodont dentition with the eruption of the deciduous fourth premolar shortly after birth. Whether the first molar comes in function the crushing area shifts distally and the deciduous fourth premolar with exposed dentine bordered by enamel margins modifies to functional shearing. Measurements in Sus scrofa show that the relationship between crushing surfaces and shearing edges remains almost constant in the dentition throughout a long period of individual age. In older individuals badly worn teeth give the impression of functional disability but the loss of crushing surfaces and afterwards shearing edges in the anterior region is compensated by the late eruption of the posterior second and third molars. Thus, the functional shift can be recognized from the anterior to the posterior region. To increase the efficiency Sus scrofa has enlarged third molars with an increased number of cusps. Accompanied with an elongation of the tooth exchange crushing and shearing surfaces are functional over a longer period. The functional shift might give advantage to large or even hypsodont third molars as in Phacochoerus while anterior teeth may be expelled. Furthermore, the elongation of the tooth eruption phase and the posterior shift of the functional area favour the evolution of a horizontal tooth exchange as seen in some fossil and extant proboscideans.

Posters Session IV, (Wednesday)

How to Mold and Cast a Mummy Dinosaur

ANDERSEN, Arthur, Virtual Surfaces Inc., Mt Prospect, IL, USA; LICHKOJ, Joseph, Cubic Vision Inc., Deerfield, IL, USA; JONES, Martin, Ford Motor Co., Livonia, MI, USA; LARSON, Peter, Black Hills Inst of Geological Research, Hill City, SD, USA

Traditional molding and casting of fossil bones is a time-honored process going back to the first preparators. The result is a very accurate cast of the original fossil specimen. However, some specimens are so unique and delicate that traditional molding and casting would destroy the specimen. We found this to be the case with Leonardo, a mummy dinosaur. The molding process involves the usual cleaning of excess matrix, gluing broken pieces and filling in any cracks. Mold release agents may be applied. To accurately record the surface geometry, latex and/or rubber is applied to the fossil surface; which is then backed with foam or fiberglass to maintain the shape. Once the rubber and backing elements have cured, they are removed. Of course, a fossil would require several separate mold jackets to enclose the entire specimen. The mold jackets can now be filled with a casting compound such as a polyester acrylic resin or polyurethane. Leonardo has skin impressions, exposed fossilized bone, and a myriad of small and large surface cracks. He is a very unique specimen. But filling the cracks along with extensive application of chemical release agents, compromises the chemical signature of the surface. After some discussion we opted to employ the use of a non-contact 3-D scanner. Once the scanning is complete, it is followed-up with data editing and rapid prototyping. The scanning itself took 7 days complete, which included the main preparators’ body, a separate tail section and his right arm. Over 300 scans were made to insure that as much detail was included. And since the scans are line-of-sight, every feature required multiple sessions. In total, over 10 minutes accrued. Data editing required 4 months, which resulted in a series of 32 blocks suitable for rapid prototyping. The rapid prototyped blocks were sent to the Black Hills Institute for assembly, molding and casting. Also rapid prototyped were 1/4 and 1/10 scaled models. Thus a valuable specimen remains in pristine condition, saved for future studies.

Posters Session IV, (Wednesday)

NEW SPECIMENS OF THIEMBYS BREVICRISTA (RODENTIA) FROM THE MIDDLE EOCENE BRIDGER FORMATION, GREEN RIVER BASIN, WYOMING

ANDERSON, Deborah, St. Norbert College, De Pere, WI, USA; KEIL, Kim, St. Norbert College, De Pere, WI, USA

New specimens from the Green River Basin allow for the lower dentition of the middle Eocene rodent Thiembys brevicrista to be described and compared with other species of the genus for the first time. Previously, only the upper denture and a partial maxilla were known from Bridgerian (Br) 3. Included in the new sample are the first specimens of lower molars, additional upper molars, and maxillary fragments including a partial zygomatic arch

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that preserves the relationship of the arch to the first upper molar. The specimens are from Br1-2, documenting the co-existence of T. brevicrista with T. perditus, T. nini, T. plicatus, and T. corrugatus. Thisbemys brevicrista is intermediate in size between T. plicatus and T. corrugatus and can be distinguished from these species based on several crown pattern characters; its anterior width of p4 significantly greater than the anterior width; metaconid displaced buccally; ecolophid straight with two enamel extensions into the talonid basin; deep lingual gorge extending one third the distance across the talonid basin; presence of distinct hypocoonulids; protoconid arms connected to deeply incised crenulations on m1-2; m3 having anterior width exceeding posterior width and enamel blocking the posterior aspect of the talonid basin. In T. brevicrista the posterior aspect of the anterior part of the zygomatic arch has a narrow angle and more posterior position when compared to T. plicatus. Patterns of dental evolution in Thisbemys and other ischyurids provide additional documentation of the early Bridgerian expansion in mammalian diversity. Discovery and description of the lower molars clarifies the alpha taxonomy for Thisbemys, which is one of several ischyurid genera to show increased species diversity coincident with the late early Eocene Climatic Optimum (EECO, 53-50 MA).

Physical Drivers and Marine Tetrapod Evolution, Monday, 10:15

FLIGHTLESS WING-PROPELLED DIVERS: SOUTHIER PROSPERITY VERSUS NORTHERN EXTINCTION

ANDO, Tatsuro, Ashoro Museum of Paleontology, Ashoro, Japan

Flightless wing-propelled divers have evolved 4 times in 3 lineages of modern birds (Neornithes). Many superficial similarities result from the morph-functional constraints of a flightless wing-propelled diving lifestyle, in turn reflecting similar ecological habitat. Though wing-propelled divers are perceived as a good example of convergence, their evolutionary histories show a drastic contrast between the North and South. While penguins (Sphenisciformes) in the Southern Hemisphere seem to have been thriving throughout the Cenozoic, their Northern Hemisphere counterparts, the plotopterids (Pelecaniformes) and the flightless auks (Glaucous and Lucas auks: Charadriiformes), had undergone extinctions without exception. Were the evolutionary histories of those flightless wing-propelled divers driven by common phenomena? Comparative approaches to assessing their diversity should help to interpret their evolutionary ‘drivers’.

In general, fluctuations in the diversity of wing-propelled divers seem to be correlated with the sea level changes through the Cenozoic. The different timings and locations of marine invasions by those birds suggest that invasions need not have been triggered by large-scale global events, such as the mass extinction at the end of the Cretaceous - although about this time penguins did become flightless and probably obligate marine birds. The demise of giant diving birds at the end of the Oligocene, and the incoming of new groups in the Middle Miocene, are seen in both hemispheres and thus imply that there were common ‘drivers’ for them. “Biotic” factors have been suggested to explain the demise of giant forms, but it is unlikely that direct competition or predation by smaller marine mammals such as pinnipeds and porpoises drove giant diving birds to extinction concurrently in both hemispheres. It may be possible that larger-sized marine mammals have affected those birds through the trophic cascade. Rather complicated interpretations are needed since they are not “true” final consumer in the trophic chains.

Poster Session II, (Monday)

AN EARLY WASATCHIAN MAMMALIAN FAUNA FROM AN EXTRAORDINARILY RICH NEW LOCALITY IN THE GREAT DIVIDE BASIN, SW WYOMING

ANEMONE, Robert, Western Michigan University, Kalamazoo, MI, USA; WATKINS, Ronald, Curtin University, Perth, Australia; NACHMAN, Brett, University of Texas, Austin, TX, USA; DIRKS, Wendy, University of Newcastle, Newcastle, United Kingdom

Early Eocene deposits from the Great Divide Basin (GDB) in Sweetwater County, Wyoming have been the subject of vertebrate paleontological investigations episodically since the 1950s, and intensively since the middle 1990s. During Western Michigan University’s summer field season, we located a new fossil mammal locality (WMI-U-2009-01) of unprecedented faunal richness and diversity. This locality occurs in a massive (10 m thick) fluvial sandstone whose microstratigraphy and sedimentology suggest deposition by large-scale sheet floods. These would have been high-energy but ephemeral floods that would rapidly carry, and quickly deposit, a great deal of sediment along with skeletal remains of terrestrial consumers in the trophic chains. Rather complicated interpretations are needed since they are not ‘true’ final consumer in the trophic chains.

Poster Session IV, (Wednesday)

SEXUAL DIMORPHISM IN HIND LIMBS OF LATE EOCENE BASILOSAURUS AZIS (MAMMALIA, CETACEA), WADI AL HITAN WORLD HERITAGE SITE, EGYPT

ANTAR, Mohammad, Wadi Hitan World Heritage Site, Fayum, Egypt; ZALMOUT,iyad, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA; GINGERICH, Philip, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA

Wadi Al Hitan is a UNESCO World Heritage Site in Egypt established to preserve and exhibit an exceptionally rich and accessible record of late Eocene fossil whales. The archaeo-
cetes Basinosaurus isis and Dorudon atrox dominate the early Eocene interval that has yielded the most whales to date, but several additional species are present. We have mapped literally hundreds of well preserved specimens of Basinosaurus and Dorudon. Sabaudit specimens of Dorudon atrox are common, providing a basis for growth studies but obscuring the achievement of recognition differences in adult specimens. All Basinosaurus isis specimens found to date are adult, and these sort into subtly larger and smaller specimens. Discoveries of the protocelat Maiaeetus inamo is dimorphic raises the question of sexual dimorphism in Basinosaurus and other basiosaurids. In Maiaeetus the male specimen averages about 12% larger in linear dimensions than the known female, and has a larger canine that corroborates interpretation as a male. A 12% difference in linear measurements corresponds to an expected mean difference of a little more than two standard deviation units between the sexes (2 0.05 − 10 0.10 on a natural log scale). Normally we expect to find 95% of specimens within two standard deviations of the mean, for an expected range of four standard deviation units. With two-standard-deviation dimorphism, we expect to find 95% of specimens, males and females, in a range of five standard deviation units. This also raises the possibility that dimorphism can be recognized by sample bimodality even in small samples. To test this we studied femur diaphysis length for femora representing seven different individuals of Basinosaurus isis. The resulting distribution spans seven standard deviations and is clearly bimodal, with modes even more separated than expected. Four specimens have shorter diaphysis and cluster together, and three specimens have longer diaphyses and cluster together. Each small sample spans about three standard deviation units, but the separation between modes is five standard deviation units. For comparison, two femora of later North American Basinosaurus cediloidea differ by four standard deviation units. We interpret Basi-
osaurus isis and B. cedoidea with smaller femora as females, and those with larger femora as males. By this criterion, the complete skeleton of B. isis under study at present, WH-74 collected in 1989 and 2005, is a female. The posterior half of the Smithsonian skeleton, USNM 12261, is a male. 

Poster Session II, (Monday)

PLEISOSAURS FROM THE MAASTRICHTIAN OF BENTIABA, NAMIBIA PROVINCE, ANGOLA

ARAÚJO, Ricardo, Southern Methodist University, Dallas, TX, USA; POLCYN, Michael, Southern Methodist University, Dallas, TX, USA; MATEUS, Octávio, Museu da Lourinhã & Universidade Nova de Lisboa, Lourinhã, Portugal; SCHOUP, Anne, Maastricht Museum of Natural History, Maastricht, Netherlands

Recent excavations at the Maastrichtian locality of Bentiba, Namibia Province, in the south-ern part of Angola, have yielded high quality and partially articulated plesiosaur specimens that indicate at least three taxa were present. A new elasmosaur is the most abundant and well-preserved plesiosaur taxon at Bentiba. It is known from a complete articulated paddle and other elements of the skeleton, many of which remain to be collected. The most diagnos-tic elements so far recovered are the complete pelvic and pectoral girdles, which indicate that the Bentiba elasmosaur is probably a new genus because it bears an asymmetrical ventral process of the coracoids, a complete coridiform posterior coracid vacuity, and pronounced excavation of the anterior border of the coracoids, among other characters. A polyclotylic is identified on the basis of confluent basioccipital tubers. Tourangisaurus, a genus initially named from the Late Cretaceous of New Zealand, is identified by short but massive propodi-als with no distal facets for epipodials and by the nearly symmetrical anterior and posterior borders of the ischium. The presence of Tourangisaurus in Angola extends the geographic range of this genus and suggests austral affinities for the Angolan plesiosaur fauna, as opposed to the early mosasaur and turtle records in Angola, which indicate northern affinity. Because the South Atlantic Ocean opened at its southern extent prior to the completion of the tropical Atlantic Gateway, plesiosaurs with southern affinities could have entered the coastal waters of Angola multiple times both prior to and after the evolution of mosasaurs, leading to the biogeographic pattern reflected in marine tetrapods from the Maastrichtian of Angola. Thus, the high quality specimens from Bentiba are critical for a phylogenetic understanding of southern hemisphere plesiosaur biogeography specifically and Cretaceous marine tetrapod biogeography generally.

Technical Session I, Sunday 11:00

ACRETACEOUS ARMOURY: MULTIPLE ANYKOSAURID TAXA IN THE LATE CRETACEOUS OF ALBERTA, CANADA AND MONTANA, USA

ARBOUR, Victoria, University of Alberta, Edmonton, AB, Canada

Several taxa of anyksaurid dinosaurs from the Late Cretaceous of North America have been reassigned to the genus Euoplocephalus. Unlike any other dinosaur known from numerous localities, Euoplocephalus is thought to be present in both the Dinosaur Park, Horsehoe Canyon, and Two Medicine Formations, and possibly the Oldman Formation. This suggests that further examination of specimens referred to Euoplocephalus is required in order to verify whether this genus transcends formal boundaries, or should be split into several taxa. Euoplocephalus has been considered highly morphologically variable, espe-cially in terms of cranial morphology. However, examination of more than 60 specimens, including 13 skulls, shows that these variations are stratigraphically segregated. Anyksaurus
des from the Horsehoe Canyon Formation are found to be distinct from Euoplocephalus, which is restricted to the Dinosaur Park Formation. Anodontosaurus, the holotype of which is from the Horsehoe Canyon Formation, is therefore distinct from Euoplocephalus, and is a valid taxon. Euoplocephalus specimens from Montana appear to be similar to those from the Dinosaur Park Formation. When compared with Euoplocephalus, Anodontosaurus possesses distinctive skull and cervical half ring ornamentation. Although previously thought to repre-sent variation within Euoplocephalus, differences in tail club morphology are also correlated with stratigraphy. Anodontosaurus tail clubs typically have a greater width:length ratio than Euoplocephalus and are characterized by pointed, triangular knob osteoderms in dorsal view. Dyoplosaurus from the Dinosaur Park Formation, was recently suggested to be distinct from Euoplocephalus based on pelvic morphology. The taxonomic assignement of Natural History Museum specimen R5161 (“Scelosaurus”) is still uncertain, buthis specimen does not appear to be referable to Euoplocephalus based on cervical half ring morphology. Royal Ontario Museum specimen 813 includes armour not found inNatural History Museum speci-men R5161 and represents a distinct but as yet indeterminate taxon. Ankylosaurid diversity in the Late Cretaceous of Alberta and Montanas greater than previously recognized.

Poster Session I, (Sunday)

THE UTILITY OF POSTCRANIAL ELEMENTS IN DIAGNOSING SOUTHERN AFRICAN MICROFAUNA

ARNEY, Irina, Sam Houston State University, Huntsville, TX, USA; LEWIS, Patrick, Sam Houston State University, Huntsville, TX, USA; THIES, Monte, Sam Houston State University, Huntsville, TX, USA

Micromammals are informative environmental indicators due to their ecological specific-ity, sensitivity to environmental change, and small habitat ranges. As such, small mammal assemblages are often useful in paleoenvironmental reconstructions, particularly in cave localities which frequently preserve large samples. While species composition and relative abundance of these fossil assemblages are needed to reliably reconstruct paleoenvironments, lower-tier taxonomic identification using mandibles, maxilla and teeth can be ambiguous due to overlapping morphologies. Data from postcranial elements is often overlooked as a source of apomorphies. In order to test the value of micromammal postcrania in identifying taxa from a Pleistocene fossil assemblage from northwestern Botswana, an examination of 13 known modern species trapped at the Koanaka Hills locality of Ngamiland Province was undertaken. Results from this analysis indicate that the femur displays genus-specific morphological features. Femoral characteristics that are most diagnostic include proximal to distal length, features of the neck (width, length, and angle), head size, greater trochanter size, lesser trochanter size, inter-trochanteric angle, and third trochanter size and position. While individual features tend to overlap between genera, the suite of these characteristics allowed confident diagnosis of the genera examined. Our analysis also proved useful in dif-ferentiating between two species of Gerbilliscus (G. brunti and G. leucogaster). An exami-
nation of the fossil small mammal femora (early to middle Pleistocene in age) collected from the Koanaka South Bone Cave locality yielded distinctions consistent with the morphology of the modern taxa, indicating that the postcranial elements may allow for more confident micromammal identification. Many of the taxa studied in this analysis are widespread in southern Africa and are known to occur at many fossil localities in the region.

Poster Session IV, (Wednesday)

NOVEL CHARACTERS FOR HIGH LEVEL PHYLOGENY OF PLACENTAL MAMMALS

ASHER, Robert, Department of Zoology, Cambridge, United Kingdom; HAUGHTER, Lionel, Department of Zoology, Cambridge, United Kingdom

The recently established phylogenetic framework for living placental mammals enables a sophisticated level of character analysis. Phenotypes previously thought to be without much significance for high-level nodes (e.g., vertebral variation, timing of dental eruption) may prove to be key apomorphies in distinguishing major clades within placental mammals. For example, vertebral variation has been shown to be relatively low due in part to stabilization selection. Among humans, departures from a neck skeleton with seven ribless vertebrae has already been associated with high frequency of fetal and/or childhood pathology and infrequent survival to reproductive age. The extent to which other mammals also exhibit this pattern has not yet been adequately quantified. Here, we present data from the axial skel-et of embryonic, fetal, and near-term non-human mammals, focusing on afrotherians and xenarthrans, and quantify their vertebral counts and incidence of axial skeleton anomalies (e.g., asymmetries, non-thoracic ribs). Our data show that most mammals have at least some variation in the axial skeleton, with a few exceptions this variability tends to be greater in afrotherians (e.g., hyracoids, tenrecids) and xenarthrans (e.g., pilosans) than in other mammals (e.g., carnivorans, rodents, talpids). Investigating this character complex in certain extinct groups is difficult, because sample sizes of enigmatic taxa such as the Malagasy “aardvark” or endemic South American ungulates are small. We seek to test the extent to which such extinct clades exhibit features differentially present in “northern” vs. “southern” placental mammals.

Technical Session X, Tuesday 9:00

AVIAN TAXONOMIC DIVERSITY AND ANATOMICAL DISPARITY IN THE LOWER CRETACEOUS XIANGOU FORMATION OF THE CHANGMA BASIN, GANSU PROVINCE, PEOPLE’S REPUBLIC OF CHINA

ATTERHOLT, Jesse, University of California, Berkeley, Berkeley, CA, USA; O’CONNOR, Jingmai, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; HARRIS, Jerald, Physical Sciences Department, Dixie State College of Utah, St. George, UT, USA; LI, Da-Qing, Fossil Research and Development Center, Third Geology and October 2010—PROGRAM AND ABSTRACTS 55A
several levels has been inferred from the associated fauna as well as magnetostratigraphic Early Pleistocene to the Middle Pleistocene: Equus altidens (from Early Pleistocene levels); Middle Pleistocene mammalian assemblage. We report the presence of three distinct equid taxa have been identified from these localities, constituting a typical late Early Pleistocene to the Terrassa alluvial fan system (Vallès-Penedès Basin). About thirty mammalian fossil localities (Cal Guardiola and Estacio de Vallparadís) from the Pleistocene section of Torrent (Dept. BABVE) and Institut Català de Paleontologia, Universitat Autònoma de Barcelona, 56A © 2010 by the Society of Vertebrate Paleontology AURELL GARRIDO, Josep, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; MADURELL-MALAPEIRA, Joan, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; ALBA, David, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; MOYA-SOLA, Salvador, ICREA at Unitat d’Antropologia Biológica (Dept. BÁRBARA), Departament de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain

The occurrence of the new specimen and Ornitomorpha are known from this avifauna, suggesting that these clades may have been considerably diverse in the Xiagou paleoecosystem. This situation contrasts with that in the Jehol Group, where enantio- mithines appear both numerically and taxonomically more abundant than ornithornithines. The occurrence of the new specimen and Gansus in the Xiagou Formation emphasizes the importance of its avifauna for deciphering the early evolution and radiation of Ornithornitha, and, ultimately, of the extant avian clade Neornithes.

Poster Session I, (Saturday)

TOPOGRAPHIC CHANGE AND Plio-PLEISTOCENE BETA DIVERSITY OF THE NORTH AMERICAN GREAT BASIN AND GREAT PLAINS

ATWATER, Amy, University of Oregon Dept. Geological Sci., Eugene, OR, USA; DAVIS, Edward, University of Oregon Dept. Geological Sci. and MNCH; EUGENE, OR, USA

Beta diversity measures the difference between average local and overall diversity within a region and can be expressed in either richness or evenness. Previous studies have suggested that beta diversity can be driven by external factors such as changing climate or changing topography. We are investigating the effects of climatic and topographic change on beta diversity through time by exploring the Pleocene and Pliocene of the Great Basin and Great Plains faunal provinces of North America. We expected beta diversity in the Great Basin to have become elevated relative to the Great Plains at the beginning of the Pliocene when the Great Basin reached its current topographic complexity. We analyzed records from the FAUNMAP database for beta diversity in terms of both richness and evenness. Preliminary results for richness beta diversity support the hypothesis of a topographic control of Great Basin beta diversity and reject the hypothesis of a primary climatic control; however, there is some suggestion that Pleistocene climate cycling caused a secondary increase in beta diversity. Additionally, Holocene values from fossil sites are greater than measured values from modern mammalogy collections, suggesting a strong, potentially significant, decrease in beta diversity between fossil sites and the modern landscape. Our preliminary evenness results are equivocal in relation to the hypothesis of tectonic control and suggest that evenness may be responding in a more complex way than richness. Previous work suggested that evenness metrics are more sensitive and so may better illustrate the transition from Miocene to Plio-Pleistocene beta diversity in the Great Basin.

Poster Session JV, (Wednesday)

EQUIDS FROM THE PLEISTOCENE SECTIONS OF VALLPARADIS (TERRASSA, VALLES-PENEDES BASIN, NORTHEASTERN IBERIAN PENINSULA)

AURELL GARRIDO, Josep, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; MADURELL-MALAPEIRA, Joan, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; ALBA, David, Institut Català de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; MOYA-SOLA, Salvador, ICREA at Unitat d’Antropologia Biológica (Dept. BÁRBARA), Departament de Paleontologia, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain

During the last fifteen years, palaeontological excavations have been carried out in two localities (Cal Guardiola and Estacio de Vallparadís) from the Pleistocene section of Torrent de Vallparadís (Terrassa, Northeastern Iberian Peninsula), which geologically corresponds to the Terrassa alluvial fan system (Vallès-Penedès Basin). About thirty mammalian fossil taxa have been identified from these localities, constituting a typical late Early Pleistocene to Middle Pleistocene mammalian assemblage. We report the presence of three distinct equid species from the Pleistocene section of the Torrent de Vallparadís, which spans from the late Early Pleistocene to the Middle Pleistocene: Equus altidens (from Early Pleistocene levels); and Equus cf. hydruntinus and E. cf. ferus (from Middle Pleistocene levels). The age of the several levels has been inferred from the associated fauna as well as magnetostratigraphic data. Equus altidens is a middle-sized stenonian equid from the late Villafrianchian. It is char-
Anuran Assemblage from the Lower Cretaceous of Spain: Novel Insights on the Basal Radiation of Crown-Claude Anura

The Cretaceous Konservat-Lagerstätte of Las Hoyas is world-known for the innumerable well-preserved remains of plants, invertebrates, and aquatic, as well as terrestrial, vertebrates that it has produced. The fossils are contained in laminated fine-grained carbonates of the Barremian La Huerguina Limestones Formation, which outcrops in the Serranía de Cuenca, central eastern Spain. A total of fifteen mostly articulated anuran specimens from this fossiliferous site, some of which belong to either tadpoles at advanced stages of metamorphosis or to recently metamorphosed individuals, were studied. Some of these specimens minimally represent a taxon that is either a stem group piposaur or a member of Xenosaurus (= Pipoidae); this placement is based on the fusion of the frontoparietais into an azygous element and a parasphenoid that lacks also underlying the otic capsules. However, the presence of plesiomorphic features, such as a neural arch being free of the ground, and a semidigitigrade stance, in which the disto-ventral portions of the ungual phalanx contact the ground, are morphologically similar to the nearly coetaneous Eodiceroscostatus and Eodiceros santonjae from northeastern Spain, although there are conflicting interpretations of these features of the latter taxon. The Las Hoyas material thus provides new evidence for the evolution of some of the most basal lineages of crown-anurans.

Early Eocene Chalicotheres: Litolophus (Perissodactyla, Mammalia) Possesses Hooflike Unguals Rather Than Claws

Litolophus gobiensis, including ungual phalanges, were unearthed recently from basal Arshanto Formation, Erlian Basin, Nei Mongol, China. The unguals of Litolophus are characterized by being wider than high, proximodistally compressed with two foramina placed laterally, and by having relatively deep and wide sagittal notches, pointed distal angles, and the distal ends as thick as proximal ones. Preliminary comparisons of Litolophus unguals with those of other perissodactyls, including bronchotheres, amyodontids, tapiroirs, and advanced chalicotheres, show that the unguals of Litolophus display a combination of features present in other perissodactyl groups even including advanced chalicotheres. The combination of features of Litolophus unguals include: (1) truncate contours, distal ends as thick as proximal ones and two laterally placed foramina, which are shared with some hoof-reduced bronchotheres and amyodontids; (2) pronounced sagittal notches and distal angles, which are the traits of most tapiroirs with relatively well-developed hoofs; (3) two laterally placed foramina and relatively deep sagittal notches, which represent characters of claws of advanced chalicotheres. In general, the unguals of Litolophus are morphologically more similar to hoofs than to claws, however, the combination of characters make them differ from any other perissodactyl hoofs and/or claws. With respect to telomotion, Litolophus probably has a semidigitigrade stance, in which the disto–ventral portions of the ungual phalans contact the ground and the basal phalanx hypertends to some extent, resulting in the middle phalans being free of the ground. This pattern of locomotion is similar to that of some advanced chalicotheres, and implies the trend towards claws in advanced chalicotheres.

Investigating Titanosaur Evolution Using Phylogenetic Analysis

TITANOSAUR stocks known from the upper Barremian (UK) and other Barremian deposits have been shown to represent a neovenatorid allosaurid. Discovery of an Early Cretaceous Australian spinosaurid significantly extends the geographic distribution of the group, which is otherwise known from South America, Europe and eastern Asia at this time. It also adds to the Otway Group theropod fauna, which minimally comprises a tyrannosaurid, oviraptorosaur, neovenatorid, and abundant indeterminate taxa. The Cretaceous Konservat-Lagerstätte, which is world-known for the innumerable well-preserved remains of plants, invertebrates, and aquatic, as well as terrestrial, vertebrates that it has produced. The fossils are contained in laminated fine-grained carbonates of the Barremian La Huerguina Limestones Formation, which outcrops in the Serranía de Cuenca, central eastern Spain. A total of fifteen mostly articulated anuran specimens from this fossiliferous site, some of which belong to either tadpoles at advanced stages of metamorphosis or to recently metamorphosed individuals, were studied. Some of these specimens minimally represent a taxon that is either a stem group piposaur or a member of Xenosaurus (= Pipoidae); this placement is based on the fusion of the frontoparietais into an azygous element and a parasphenoid that lacks also underlying the otic capsules. However, the presence of plesiomorphic features, such as a neural arch being free of the ground, and a semidigitigrade stance, in which the disto-ventral portions of the ungual phalanx contact the ground, are morphologically similar to the nearly coetaneous Eodiceroscostatus and Eodiceros santonjae from northeastern Spain, although there are conflicting interpretations of these features of the latter taxon. The Las Hoyas material thus provides new evidence for the evolution of some of the most basal lineages of crown-anurans.

Definitive Spinosaur Theropod from the Lower Cretaceous of Australia and Its Implications for Gondwana Palaeobiogeography

Barrett, Paul, Natural History Museum, London, United Kingdom; Benson, Roger, University of Cambridge, Cambridge, United Kingdom; Rich, Thomas, Museum Victoria, Melbourne, Australia; Wignall, Paul, Museum Victoria, Melbourne, Australia; Barrett, Paul, Natural History Museum, London, United Kingdom; Benson, Roger, University of Cambridge, Cambridge, United Kingdom; Rich, Thomas, Museum Victoria, Melbourne, Australia; Wignall, Paul, Museum Victoria, Melbourne, Australia; Barremian, UK; Baryonyx walkeri has been shown to represent a neovenatorid allosaurid. Discovery of an Early Cretaceous Australian spinosaurid significantly extends the geographic distribution of the group, which is otherwise known from South America, Europe and eastern Asia at this time. It also adds to the Otway Group theropod fauna, which minimally comprises a tyrannosaurid, oviraptorosaur, neovenatorid, and abundant indeterminate taxa. Similar taxa are known from coeval Laurasian sites, suggesting a longer interval for faunal exchange between Gondwana and Laurasia, and across Gondwana, than previously appreciated. For example, Fukuiraptor (Aptian-Albian, Japan) has been posited as the sister-taxon of Australovenator from Queensland. Similarly, the hitherto unexpected presence of tyrannosaurs and oviraptorosaurs in Australia demonstrates that ‘Laurasia’ taxa were present in Gondwana, suggesting that all of these groups had potentially cosmopolitan late Mesozoic distributions. Theropod phylogenies predict the origins of major coelurosaurian clades in the Middle Jurassic, an inference supported by new discoveries (e.g., Procercosaurus). Consequently, these occurrences in the Gondwanan Early Cretaceous imply that many theropod lineages were present in areas/intervals that remain poorly sampled (e.g., Africa, India, Antarctica). Additional fieldwork, and critical reappraisal of historical material, is likely to yield additional surprises in the poorly known Middle Jurassic to Early Cretaceous linkages of Gondwana.
Allosauroids were a diverse group of non-avian theropods that dominated predatory niches in Late Cretaceous ecosystems, including terrestrial and aquatic environments. The diversity and adaptive radiation of allosauroids provide insights into the evolution of body size, stance, and gait in this group of dinosaurs. The study of allosauroid osteology, particularly in the pelvic and hindlimb regions, has revealed allometric patterns and muscle distribution that are consistent across different clades and species. Similarities in the center of mass and muscle configuration between basal allosauroids and the derived clade Carcharodontosauria suggest a common ancestry and functional convergence in predatory behavior.

**Poster Session III, (Tuesday)**

**CRANIAL MORPHOLOGY OF THYROHYRAX DOMORICTUS (HYRACOIDEA: MAMMALIA) FROM THE EARLY OLIQUENECENE OF EGYPT**

BARROW, Eugene, University of Oxford, Oxford, United Kingdom; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA; SIMONS, Elwyn, Duke Lemur Centre, Durham, NC, USA

The Jebel Qatrani Formation in the Fayum Depression, Egypt, has yielded a diverse hyraxoid fauna that includes small- and large-bodied forms. Thyrho hyrax domorictus is one of the most common hyracoids found in the upper sequence of the Formation, from sites dating to between 29-30 Ma. The dental morphology of T. domorictus is more similar to that of living hyraxes than other Paleogene species, but additional morphological evidence is needed to test the hypothesis of procaviid affinities. Two fairly complete crania and other cranial fragments of T. domorictus are known and provide a number of additional craniofacial characters for phylogenetic analysis. The specimens are comparable in size to other small-bodied Fayum hyraxes and extant procaviids. T. domorictus has a relatively long rostrum that is perforated by a nasomaxillary fossa, which is also present in Miocene Afrosyrohyrax and Prohyrax and older Thyrho hyrax pygmeus. The frontal bones are smooth and flat and the temporal and sagittal crests are well-developed. The orbit is positioned above the molars and is closed posteriorly by a complete post-orbital bar that bears a small parietal contribution. As in extant procaviids, a complete post-orbital bar is also present in Miocene Procytherus, but this species lacks a parietal contribution. Compared to other Fayum hyraxes, T. domorictus exhibits relatively derived, and more procaviid-like, cranial morphology. The cranium of T. domorictus is most similar to the extant genus Dendrohyrax, a form that has a relatively long rostrum compared with other procaviids, and which shares a similar morphology of the orbit and cranial roof with T. domorictus. Phylogenetic analysis including morphological and molecular data from a large sample of living and extinct afrotherians places Thyrho hyrax domorictus as the closest known Paleogene relative of Procaviidae, supporting the hypothesis of Procaviidae as the closest known Paleogene relative of Procaviidae. Phylogenetic analysis including morphological and molecular data from a large sample of living and extinct afrotherians places Thyrho hyrax domorictus as the closest known Paleogene relative of Procaviidae, supporting the hypothesis of Procaviidae as the closest known Paleogene relative of Procaviidae. Phylogenetic analysis including morphological and molecular data from a large sample of living and extinct afrotherians places Thyrho hyrax domorictus as the closest known Paleogene relative of Procaviidae, supporting the hypothesis of Procaviidae as the closest known Paleogene relative of Procaviidae. 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INCONGRUENCE BETWEEN MORPHOLOGICAL DATA PARTITIONS: AN EXAMPLE FROM THE FOSSIL RECORD OF THE ARCHOSAUROMORPHA

BENNETT, S. Christopher, Fort Hays State University, Hays, KS, USA

Testing morphological and molecular data sets against one another for incongruence has become commonplace; however, testing for incongruence can also be done with partitioned morphological data sets from fossil taxa. As a demonstration a published data set of 126 morphological characters from 14 archosauromorph taxa, in which most taxa are known only from fossils, was partitioned into five partitions, each associated with different grades of bipedal cursorial locomotion, and the other four with characters from the skull and mandible, postcranial axial skeleton, forelimb, and hindlimb, respectively. Homogeneity testing using PAUP showed that the Cursorial partition is incongruent with other partitions and with all other characters at the P=0.01 probability level. In order to identify the source of the incongruence, each taxon was deleted and the partitioned data set from the remaining 13 taxa was tested for homogeneity. Significant incongruence remained after deletion of 13 of the taxa, whereas deletion of one taxon, the Pterosauria, removed all significant incongruence, demonstrating that the incongruence resulted from the coding of that taxon for the cursorial characters. The cause of the incongruence was interpreted as homoplasy in hindlimb morphology, and after reevaluating and revising the characters of the Cursorial partition, a revised data set was tested for homogeneity and had no significant incongruence between partitions.

Poster Session III, (Tuesday)

MORPHOMETRIC ANALYSIS OF CRANIAL SHAPE IN FOSSIL AND RECENT EUPRIMATES

BENNETT, Verity, University College London, London, United Kingdom; GOSWAMI, Anjali, University College London, London, United Kingdom

Quantitative analysis of morphology can recognize subtle patterns in morphological evolution and identify convergences that can aid ecological interpretations of extinct taxa. Here, we use geometric morphometrics to analyse skulls from 28 modern and extinct genera of euprimates, including the Eocene adapiforms Adapis and Leptadapis, and the Quaternary lemurs Archaeolemur, Palaeopropithecus, and Megaladapis, to test if fossil primates occupy the same regions of morphospace as their extant relatives and to identify any convergences in cranial morphology across fossil and extinct primates. 33 landmarks were gathered with a Microscribe 3-D digitizer from a total of 382 specimens. Data were treated with Procrustes superimposition to remove all non-shape differences and then subjected to Principal Components Analysis. PC1 (25.7% of the total variance) divided haplorhines, with wide and short skulls, at the negative end from strepsirrhines and most fossil taxa, with long and narrower skulls, at the positive end. Megaladapis defines the positive extreme of this axis, while hooloer monkeys and Archaeolemur overlap in the middle. PC2 (16.5%) involved a shift from a long vault and short, wide face towards a shorter vault and longer face. Haplorhines, strepsirhines and adapisiforms overlap at the negative end of PC2, whilst haplorhines such as Gorilla and Pan defined the positive end. PC3 (7.2%) chiefly showed widening and ventro-dorsal shortening of the vault with tassiers at the positive extreme, Archaeolemur and Cacajao at the negative extreme and adapisiforms overlapping with most haplorhines and strepsirrhines in the middle. On PC4 (5.2%) Alouatta and Megaladapis lie at the positive end, with a narrower and shorter cranial vault, while the other strepsirrhines and some haplorhines overlap at the negative end of PC4. Although strepsirrhines and haplorhines are generally distinct in morphospace, there is some overlap along the major axes of variation. Most adapisiforms fall within or close to strepsirrhine space, while Quaternary lemurs deviate from extant strepsirrhines, either exploiting unique regions of morphospace or converging on haplorhines.

Poster Session III, (Tuesday)

QUANTIFYING COLLECTION BIAS AND ASSESSING PALEOECOLOGICAL UTILITY OF MICROVERTEBRATE FOSSILS FROM ANTHILLS

BENNETT, III, George, Shenandoah Valley Discovery Museum & George Mason University, Winchester, VA, USA

Throughout the semiarid and arid portions of North America the harvest ant (Pogonomymex) is known to collect pebbles and debris in order to coat the surface of its mounds, and in the process can concentrate vertebrate microfossils enabling easy surface collecting or screen washing. It is intuitively apparent that collecting from such anthills will yield smaller skeletal elements than general surface collecting as a result of the limited strength of the ants. But how much collection bias results from ant hill mining? Is there useful paleoecological information to be gleaned from such sites when compared to conventional screen washing and surface collecting? A series of localities in the upper Hell Creek Formation of eastern Montana have been evaluated by surface collecting, screen washing anthills, and conventional screen washing. The conical, shed teeth of fish, lizards, champsosaurs, dinosaurs, and crocoddilians (n=395), were measured and used to analyze the size-class distribution and taxonomic diversity recovered by these three collection methods. Data show that conventional screen washing consistently does not sample the smallest (<5mm) skeletal elements and that ant hill recovered specimens make up over 80% of specimens in that size category. Likewise, fossils over 15mm are underrepresented not only on anthills but also when using conventional screen washing. At a single site well-sampled by all three methods, anthill screen washing produced the greatest taxonomic diversity (n=10). Overall, ant hill collection yielded nearly two thirds of the teeth (n=248) and the only record of the theropod dinosaur Troodon. Although fossils gathered by ants are out of stratigraphic context, they expose a portion of the thanatocoenose that is commonly underestimated. Detecting the smallest taxa or assessing size-class structure by recovering the smallest individuals of a taxon is best accomplished by combining anthill screening with traditional screen washing where possible.

Evolution of the Modern African Fauna, Wednesday 11:30

EVPRI MES

BERNOR, Raymond, Howard University, Washington, DC, USA; GILBERT, William, California State University, East Bay, Hayward, CA, USA; WOLF, Dominik, Howard University, Washington, DC, USA

African Eupri mates are known from localities of late Miocene to Recent age. Three-toed equids of the tribe Hippiprionini first appear in the earlier late Miocene and persist well into the middle Pleistocene. The first appearance of Equus in eastern Africa is in the Omo Shungura sequence (lower Member G) at ca. 2.36 Ma. This is somewhat later than in Eurasia, where Equus first appears at 2.6 Ma. We recognize a diverse assemblage of African hipparions, including the following supraspecific groups: "Cormohipparion," "Sivalhippus," Euryg om hippus, Cremohipparion, and possibly Hipparion s.s. (the last two in northern Africa only). The earliest occurrence in Africa, "Cormohipparion," is a descendant of the North American genus Cormohipparion that first occurred in the Old World at 11.2 Ma and is first known to occur at 10.5 Ma in North Africa. The taxon "Sivalhippus" refers to a late Miocene (ca. 10 Ma) group of African and South Asian hipparions currently undergoing systematic revisi on. The Eurasian genera Hipparion s.s. and Cremohipparion apparently made a successful range extension into northern Africa during the late Turolian, ca. 7 Ma, where they are reported from Sahabi, Libya. Eurygnathohippus is a genus of African Hipparionini that first appears in the late Miocene Nawata Formation, Kenya, and successfully radiated throughout unforsted Africa in the late Miocene-Pleistocene. The last occurrence of Eurygnathohippus is at circa 1.0 Ma when the most derived form, E. corinthi lius, occurred in southern and eastern Africa. Extant Old World Equus includes cabaline horses, hemiones, and the African asses and zebras. Late Pliocene-early Pleistocene African Equines (E. oldowayensis and E. koba) are the large and similar Eurasian Equus stenonis. Smaller Equus are present in Africa by the later early Pleistocene. Several African Pleistocene localities are shedding new light on the origin of African asses and zebras, but their relationships to earlier clades of Old World Equus have not been established. We update our understanding of later Neogene African equid systematics and biogeography including recently published genomic data on Holartic and African Equus.

Poster Session IV, (Wednesday)

DESCRIPTION OF THE OLDEST CAVIOMORPHS AND A PHYLOGENY OF THE GROUP’S INITIAL RADIATION

BERTRAND, Ornella, University Montpellier II ISE-M and American Museum of Natural History, New York, NY, USA; FLYNN, John, American Museum of Natural History, Division of Paleontology, New York, NY, USA; CROFT, Darin, Case Western Reserve University, Department of Anatomy, Cleveland, OH, USA; WYSS, Andre, University of California, Department of Earth Science, Santa Barbara, CA, USA

South America was an isolated island continent during most of the Cenozoic, resulting...
MIO-PLIOCENE FAUNAL EXCHANGES BETWEEN EURASIA AND AFRICA: THE RECORD OF RARE BOVID TAXA

BIBI, Fayal, Institut de Paleontomatologie et Paleontologie humaine: Evolution et Paléoenvironnements, Poitiers, France

Three fossil bovid taxa previously known only from Eurasian deposits are newly document-
ed from the Mio-Pliocene assemblages of the Middle Awash (Afar Region, Ethiopia). These are Protopsyriacus vinayaki, Pachyportax latidens, and ?Caprini cf. Protopyra/Pachytragus. All three constitute first records for these taxa in Africa, P. vinayaki and P. latidens oth-
erwise known only from the Siwaliks (Pakistan and India) and the Baynunah (United Arab Emirates). The probable caprine is indeterminate to genus or species but bears strong resem-
bance to Protopyra and Pachytragus, documented from the Greco-Iranian province. These three boids significantly augment the record of sub-Saharan fossil taxa of Eurasian affini-
ties, demonstrating stronger biome connections between sub-Saharan Africa and southern Asia in the Mio-Pliocene than later in the Plio-Pleistocene. The Middle Awash taxa are also very rare, being represented by only one or two specimens each from otherwise
rich assemblages, highlighting the importance of an attentive specimen-based approach to fossil assemblages for elucidation of past evolutionary and biogeographic trends. The record of East and southern African fossil boids of Eurasian affinities is reviewed, including the reduncin Kohus procerctonis and species of “Boselaphini” (Tragoprotax spp.).

DISTAL PHALANGES OF ECONE NORTH AMERICAN NOATHERCINITES (MAMMALIA, PRIMATES): IMPLICATIONS FOR PRIMATE AND ANTHROPOID ORIGINS

BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; RANDALL, Zachary, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; SILOX, Mary, University of Toronto at Scarborough, Toronto, ON, Canada; CHESTER, Stephen, Yale University, New Haven, CT, USA; BOYER, Doug, Brooklyn College, New York, NY, USA

Presence of nails instead of claws on some or all digits, associated with specialized grasping behaviors, has been recognized as a diagnostitc trait of Primates. Discovery of a nail-bearing distal phalax on the halluc of Paleocene plesiadapiform Carpolestes simpsoni suggests that this feature originated earlier in primate evolution than previously supposed. Morphology of the C. simpsoni hallucal distal phalanx is not identical to that of extant primates, suggest-
ing the possibility of convergence. When the morphology of Eocene adapoid euprimates is taken into consideration, this contrast is less marked. Some of the non-hallucal distal phalanges of Eocene noathercines are similar to the hallucal distal phalax of C. simpsoni in being dorsoventrally deeper at the proximal end and recurved towards the tip. Lateral profiles of these phalanges are more “claw-like” than in living primates, suggesting that they may rep-
resent a transitional claw-to-nail morphology. Furthermore, partial skeletons of nothercine euprimates from the Bridger Basin, Wyoming, show that distal phalangeal morphology is more variable than previously appreciated. Some elements are short, wide, dorsoventrally compressed and easily recognizable as the hallucal distal phalanx based on their similarity to those of extant lemurs. Others are shorter and less compressed, similar to those of the non-
hallucal distal phalanges of lemurs. Still others are elongate, narrow, and somewhat curved in lateral profile, similar to the distal phalax for the grooming claw in extant strepsirhines and the non-anthropoid haptorhine, Tarsius. The range of variation in distal phalangeal mor-
phology of N. tenebrosus is similar to that found in lemurs. This variation is consistent with previous observations of one species of European adapoid Eurolopemur, which was inter-
prefectly developed to having a grooming claw. In contrast, the adapoid Darwinius maxillae was interpreted to have a nail-like structure on all digits, including the second toe. If true, this condition may have been inherited from a common ancestor with living anthropoids that excludes nothare-
tines and Europopemur, or have evolved independently.
study, we used non-contact laser surface scanning to capture detailed digital models of both slabs for several avian and non-avian theropods from the Late Jurassic and Early Cretaceous of China, including the holotypes of the troodontid Anchiornis and the basal bird Eoconfuciusornis. Scans were made with a Konica Mipolux Range 7 scanner with a maximum point cloud density of 40 micrometers. Different methods for digitally extracting and reconstructing laser scan surface data were explored using the three-dimensional editing software package Rapidform. Fully three-dimensional skeletal reconstructions are possible when skeletal elements are accessible from every aspect, or when a particular bone or skeleton is preserved as a natural mold on both the slab and counterslab. More commonly, however, a bone exposed on one slab is matched by a mold on the other, so that the two slabs preserve redundant information from the same bone surface. By digitally aligning slab and counterslab scans and deleting concave molds that would otherwise overlap with positive skeletal topography from the opposite slab, data from both slabs can be merged into a single digital model that exhibits all available anatomical information in the correct three-dimensional spatial arrangement. The merged digital models enable the simultaneous inspection of countersurface anatomy of fragmented skeletal elements and facilitate both visual and quantitative examination. Although laser surface scanning cannot reveal surfaces buried in slab or counterslab in contrast to digitized tomography (CT) scanning, this new methodology allows for a relatively rapid and cost efficient integration of fossil slab data that is not significantly constrained by large specimen size or radiographic contrast between bone and matrix.

Poster Session II, (Monday)

PALEOVIRONMENTAL INTERPRETATION OF THREE CHADRONIAN (LATE EOCENE) MAMMALIAN FAUNAS FROM THE MID-CONTINENTAL U.S., BASED ON BODY SIZE DISTRIBUTIONS

BOARDMAN, Grant, University of Nebraska-Lincoln, Department of Geosciences, Lincoln, NE, USA; SECORD, Ross, University of Nebraska-Lincoln, Department of Geosciences, Lincoln, NE, USA

One of the richest and best preserved sequences of late Eocene and early Oligocene mammals in the world occurs in deposits of the western Great Plains and Rocky Mountain region. In spite of the richness of these faunas, paleoenvironmental interpretations for this interval are still somewhat uncertain, ranging from savanna to closed forest based on conflicting proxies. Here we use ranked body size distributions (cenograms) in three middle Chadronian mammalian faunas to infer paleohabitats and climatic conditions. We compare faunas from Flagstaff Rim (Wyoming) and northwestern Nebraska in the White River Group (or Formation), and the Renova Formation of southwestern Montana (Pipestone Springs Fm.). The distribution of body size, as calculated from the area of the lower first molar (m1), indicates that all three faunas are composed predominantly (52-62%) of taxa weighing under 0.5 kg (i.e. small-bodied mammals). This distribution is similar to that seen in modern forests and woodlands. Several parameters of ranked body weight graphs, determined from modern studies, can be used to assess the structure of local vegetation (closed vs. open habitat) and environmental moisture (rainfall, etc.). The slopes of the medium-sized (0.5-10 kg) mammals in all three Chadronian faunas (0.42, 0.33, and 0.456, respectively) are indicative of seasonal moisture, with Nebraska being the least seasonal of the three. These slopes likely indicate a dry-season. Minimal offsets (i.e. the gap) in logged body weight between small- and medium-sized mammals are 0.11, 0.34, and 0.37 for the Flagstaff Rim, Nebraska, and Pipestone Springs faunas, respectively. Slopes below 0.5 indicate that these faunas all lived in forested habitats, but that forests in the last two were more open than at Flagstaff Rim. Analyses of trophic categories with regard to body weight indicate that each of the three faunas was dominated by small- to large-sized herbivores, with a relative abundance of small- to medium-sized frugivores. The mid-continental U.S. during the Middle Chadronian, as inferred from body size distributions, was relatively densely forested and experienced seasonal precipitation, which is in general agreement with paleofloral interpretations. Future work will include comparison of late Eocene and early Oligocene habitats based on body size distributions in conjunction with isotopic analysis of tooth enamel to test hypothesized trophic categories.

Poster Session III, (Tuesday)

ESTIMATING TIME RANGES IN Plio-PLEISTOCENE HOMINIDS

BOBE, Rene, University of Georgia, Athens, GA, USA

Estimating the relative abundance of hominids as part of larger vertebrate samples is critical in evaluating the uncertainties associated with first and last occurrences, and therefore with known hominid time ranges. Fossil hominids are notoriously rare, but estimating their abundance in the larger context of fossil vertebrates has been difficult. A key problem is that fossil hominids are consistently sought after and collected, but many of the other vertebrates that co-occur with hominids are not. Here I present data from systematic collection efforts in the Koobi Fora Formation of Kenya and use these data to estimate the relative abundance of hominids in these Pliocene and Pleistocene deposits. The fossils were collected during three field seasons and include nearly 400 specimens. The data are now included in the Turkana Paleontology Database, which is used to provide a larger context for these analyses. The database currently has about 17,000 records of fossil vertebrates collected over the last few decades. The data are used to place error bars on estimates of the time of origination of Homo and the extinction of Paranthropus. Results show large error bars associated with these events, and thus show that our knowledge of the timing of key events in human evolution remains very poorly constrained.

Poster Session IV, (Wednesday)

3D MORPHOMETRIC ANALYSIS OF THE PRESACRAL VERTEBRAE OF PLATEOSAURUS: IMPLICATIONS FOR VERTEBRAL EVOLUTION IN SAUROPODOMORPH DINOSAURS

BOEHMER, Christine, Ludwig Maximilians Universität, Munich, Germany; RAUHUT, Oliver, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany

Sauropodomorph dinosaurs are noteworthy for their highly complex and variable vertebral morphology and vertebral count. However, the exact mode and pattern of variation of vertebral shape remains uncertain. Thus, it is often uncertain whether additional cervical vertebral, for example, represent new elements or dorsal vertebrae that have been incorporated into the cervical vertebral column. In the absence of other criteria, such as specific soft tissue associations, or genetic information, vertebral morphology is the only clue to resolve this issue. A distinction between cervical and dorsal vertebral can usually be established, although there are usually one or two vertebral which exhibit a transitional condition. With the use of 3D geometric morphometric analysis of the presacral vertebrae of Plateosaurus, we are able to objectively evaluate the morphology throughout the entire presacral axial column (excluding possible size effects). 3D scans were landmarked with predefined homologous points using the computer software Landmark. The data points were chosen to capture important morphological characteristics, such as the shape of the vertebral body, the form and relative position of the pre- and postzygapophyses, parapophysis and diapophysis, as well as the outline of the neural spine. The relative warps analysis revealed a very distinctive pattern, including four different groupings. The first group is characterized by a general elongated and flat shape, and contains almost all cervical vertebrae. The following groups include a variety of shorter and higher morphologies. The second cluster includes mainly anterior dorsal vertebrae. There is a slight overlap with the third group that includes the last two posterior cervicals, as well as a middorsal vertebra. The fourth accumulation of data points represents the posterior dorsal vertebrae. These results imply that it is very unlikely to include other taxa in this study to compare species with varying vertebral count. Eventually, we hope to find patterns that reveal new insights into axial patterning in sauropodomorphs.

Poster Session II, (Monday)

BARNACLE COLONIZATION OF MIDDLE PLEISTOCENE SEA LION (CARNIVORA: PINNIPEDIA) BONES ELUCIDATE THE BIOSTRATINOMY OF A FOSSIL MARINE MAMMAL

BOESSENECKER, Robert, Montana State University, Bozeman, MT, USA

Fossil evidence of barnacle encrustation of vertebrate skeletal elements is reported from the Middle Pleistocene Port Oxford Formation of southern coastal Oregon. This material includes two associated thoric vertebrae and a femur referable to the extinct sea lion Proteonarthetus uulyses that are encrusted by a total of 1400+ individual barnacles identified as Solidobalanus sp. Because these barnacles are encrusting endoskeletal elements, the host sea lion must have died and been at least partially skeletonized at the time of colonization. It is possible that larger, older individuals representing the first colonization of the bones may have settled on the bony substrate while soft tissue (e.g. ligaments, cartilage) still remained in place; barnacles are absent from most articula surfaces, and large barnacles are unevenly distributed. The size, probable ontogenetic age, and lifespan of extant Solidobalanus indicus a minimum exposure time (and thus minimum duration of time averaging) of 4-7 months. Additionally present are much smaller barnacles encrusting larger individuals, which contribute to a bimodal size distribution, and indicate two distinct colonization events. The wide distribution of Solidobalanus on some of these elements suggests these were regularly overturned by bottom currents, which would keep some barnacles from smothering by prolonged contact with the sediment, similar to recently reported balanoliths from the modern and fossil record. This is the first example of a balanolith with a vertebrate fossil as a nucleus. The discovery of barnacle attachment scars on these bones indicates the possibility of identifying the former occurrence of barnacles on other vertebrate remains in the fossil record. Detailed study of this assemblage has yielded a wealth of biostratinomic data that otherwise would not have been preserved. This study promotes awareness of encrusting and boring organisms and their traces, as they (when present or recognized) provide rich additional sources of data regarding to the biostratinomic history of fossil vertebrates.

Poster Session IV, (Wednesday)

QUANTIFYING SHIFTS IN OSTEOCLASTICITY IN THE HUMERUS OF FOSSIL PENGUINS (AVES: SPHENISCIFORMES)

BOLES, Zachary, North Carolina State University, Raleigh, NC, USA; KSEPKA, Daniel, North Carolina State University, Raleigh, NC, USA

Penguin wing bones exhibit substantial modifications in gross morphology and microstructure associated with the transition to flightless wing-propelled diving. One derived feature is the extreme reduction of the narrow cavity in the humerus, presumably related to demands for neutral buoyancy. In this study, we attempt to reconstruct the transition from the hollow humerus ancestral for living birds to the osteoclastic humerus of penguins by quantifying properties of this bone for a range of stem and crown fossil penguins as well as extant in-group and out-group species. Thin-sections through the midshaft were created using standard histological techniques. These thin-sections were imaged and sediment infilling was digitally removed from the fossils. The software Bone Profiler was used to determine center of density and quantify the compactness profiles of the sections. The Cortico-Diaphyseal Index
(CDI), a measure of cortical thickness independent of body size, was calculated as a proxy of density. CDI values ranged from 0.5351 for a basal Eocene penguin species from Seymour Island to 1.476 for the extant Aptenodytes. When ancestral CDI values are reconstructed using Mesquite, a clear trend in increasing density along the lineage leading from the basal node in Sphenisciformes to crown Spheniscidae is observed. This trend is supported whether all branch lengths are considered equal or are extrapolated from a time-calibrated cladeogram. Thus, we can infer that while basal penguins retained a less dense humeral cross-section (CDI=54%-63% of the reconstructed ancestral value for Spheniscidae), essentially modern levels of osteosclerosis arose within the penguin stem lineage during the Paleogene. While a clear pattern of increasing CDI is observed, the developmental processes underlying this transition remain uncertain in the absence of growth series for stem penguins. Examination of additional skeletal elements may provide more data bearing on this issue.

Poster Session II, (Monday)

NEW LIZARDS (LEPIDOSAURIA, SQUAMATA) FROM THE EARLY CRETACEOUS OF LAS HOYAS (CUENCA, SPAIN)

BOLET, Arnau, Institut Català de Paleontologia, Cerdanyola del Vallès, Spain; EVANS, Susan, Department of Cell and Developmental Biology, University College of London, London, United Kingdom

The Early Cretaceous Las Hoyas fossil site (Cuenca, Spain, Late Barremian) is known for yielding extremely well-preserved freshwater and terrestrial vertebrate fossils, including those of squamates. Recently described squamate material includes six specimens of Meyasaurus (including the holotype), and a taphonomically unusual specimen containing the disarticulated remains of several juvenile Meyasaurus and also a Hoyalacerta. However, the record has been expanded in recent years with the recovery of five additional specimens of Meyasaurus, an undetermined paramacellodid (represented by a fragment of skin with osteoderms), a new specimen of Scansenia, and another specimen representing a new genus. The additional Scansenia specimen lacks its anterior portion but adds new, phylogenetically important information such as the presence of ovoid trunk osteoderms (not preserved in the type species). The new genus is represented by a single, almost complete, specimen characterized by its small size, elongate body, and short limbs (but proportionally long feet). Scansenia, Hoyalacerta and the new genus are currently known only from Las Hoyas, but Meyasaurus and paramacellodids have been reported from other sites both within and beyond the Iberian Peninsula. Our understanding of Mesoceous squamate palaeobiogeography is limited by the known record, but localities like Las Hoyas offer an opportunity to study the composition of a concrete Early Cretaceous squamate assemblage. The quality and abundance of its specimens and their taxonomic diversity is rivalled only by the somewhat older deposits of the Yixian Formation in China.

Poster Session III, (Tuesday)

PRELIMINARY REPORT ON THE DISCOVERY OF A LARGE EOCENE PRIMATE FROM THE UINTA FORMATION OF NORTHEASTERN UTAH

BROMLEY, G. L., Caruso, Intermountain Paleo-Consulting, Vernal, UT, USA; SANDAU, Stephen, Intermountain Paleo-Consulting, Vernal, UT, USA

Cranial and postcranial elements from a large primate were discovered during a reconnaissance survey conducted in late 2009 in the Uinta Basin, Utah. The fossils were discovered in a gray-green, fine-grained, subangular, tuffaceous sandstone high in the Uinta V (Wagonhound Member) of the Eocene Uinta Formation. Skeletal elements discovered surficially were poorly preserved, while those recovered from the subsurface were relatively well preserved. Cranial elements collected include the greater part of the left mandible (P3- M1, length ~33mm), a small portion of the right mandible with nearly complete P2 (length 5.5mm), a right, anterior maxillary fragment with preserved canine, other isolated tooth fragments including a partial right M1 (length 4.6mm), and other unidentified skull fragments. Postcranial material includes a well preserved distal right humerus (external-internal condyle width 29mm), proximal and distal ends of the right ulna, the right radial diaphysis (length 87mm), twelve partial to complete thoracic and lumbar centra, a nearly complete lumbar vertebrae, seven partial caudal centra, rib and inanominate fragments, partial left and right tibial diaphyses, partial proximal and distal femora, a complete right calcaneum (length 34mm) and talus (talcr talar length 11mm, trochlear length 13mm), assorted tarsals, four partial metatarsals, two proximal phalanges, five medial phalanges, and one complete and three partial unguals. Though incomplete, the M1 shows a simple paracone and metacone with distal and mesial ridges bearing crenulation. A well developed pyramidal metaconule sits on the mesial edge on the tooth with crenulated boards which run down the side of the tooth toward the distal. The shape of the so-called cubital fossa. These data have significant implications for inferring non-avian dinosaur locomotion. We suggest that investigation of these trends in additional extant taxa, the establishment of confidence intervals, and renewed searches for osteological correlates between calcified epiphysis cartilages are needed and promising. Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 12:00

NON-AVIAN DINOSAUR AND EXTANT ARCHOSAUR LIMB JOINTS: WHAT’S missing, WHAT’S and WHERE DO WE GO FROM HERE?

BONNAN, Matthew, Western Illinois University, Macomb, IL, USA; SANDRIK, Jennifer, Western Illinois University, Macomb, IL, USA; NISHIWAKI, Takahiko, Western Illinois University, Macomb, IL, USA; WILHITE, Ray, Auburn University, School of Veterinary Medicine, Auburn, AL, USA; ELSEY, Ruth, Louisiana Department of Wildlife and Fisheries, Rockefeller Wildlife Refuge, Grand Chenier, LA, USA

In non-avian dinosaur long bones, the once-living chondroepiphysis (joint surface) overlays a now-fossilized calcified cartilage zone. Although the shape of this zone is used to infer non-avian dinosaur locomotion, it remains unclear how much it reflects chondroepiphysis shape. Previously, we investigated the effect of chondroepiphysis removal in Alligator, Namida, and Struthio using traditional and geometric morphometrics (GM). We reported that whereas extant archosaur long bone dimensions experienced significant changes after removal of the chondroepiphysis, shape changes were less pronounced. In non-avian dinosaurs, the shape of calcified cartilage in weight-bearing long bones more closely reflects the shape of the missing chondroepiphysis than previously anticipated. Continued investigation of these data has revealed further trends. In both Alligator and the bird taxa, larger individuals show less truncation than smaller individuals. For both the humerus and the femur, length is the least truncated measurement, whereas measures of distal breadth and the distance to the anatomical landmarks (deltopectoral crest, fourth trochanter) are the most truncated. In all cases, humerus dimensions are more truncated than those of the femur. Our GM data on extant archosaur long bones shows that, for adult, stress-bearing elements, condyles and other articular features of the chondroepiphysis are retained as distinct, unambiguous features in the underlying calcified cartilage. Additionally, we have discovered a correlation between radial condyle size and extent on the cranial face of the humerus and the size and shape of the so-called cubital fossa. These data have significant implications for inferring non-avian dinosaur locomotion. We suggest that investigation of these trends in additional extant taxa, the establishment of confidence intervals, and renewed searches for osteological correlates between calcified and epiphyseal cartilages are needed and promising.

Poster Session II, (Monday)

QUANTIFYING VARIATION IN CERATOPSID HORNCORES AND PARIETALS

BORKOVIC, Benjamin, University of Calgary, Calgary, AB, Canada; RUSSELL, Anthony, University of Calgary, Calgary, AB, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA

The horns and parietal ornaments of ceratopsid dinosaurs show considerable variation between genera and also between, and even within, species. These structures played an important role in ceratopsid evolution and their function has long been a source of discussion. Gaining a better grasp of the variability observed in these structures is a first step toward understanding how selection was acting upon them. Using material from fossil collections within Alberta, Canada I gathered morphometric data relating to horncore morphology in specimens of Centrosaurus, Styracosaurus and Triceratops. I also examined parietal hook and spike morphology in Centrosaurus and Pachyrhinosaurus. Measurements of horn dimensions, shape and curvature were gathered from three fully articulated specimens as well as several complete or partial skulls. Additional metrics of body and skull size were taken where possible. Morphometric studies of dinosaur material are often hampered by limited sample sizes, a problem potentially alleviated in some ceratopsian taxa by large assortments of bonebed fossils. Sixty disarticulated horncores collected from bonebeds are stored at the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta, Canada and these were measured as well. Comparisons with data from articulated specimens suggest that bonebed fossils have the potential to increase sample sizes but the lack of corresponding body size information limits their usefulness in assessing patterns in horn variation. Although useful at the generic level, horncore morphology was found to be too variable to distinguish between species, but parietal ornaments remain diagnostic despite high variability.

Technical Session XVI, Wednesday 2:30

EVALUATION RATES AND PATTERNS OF ARTIODACTYL LIMB REDUCTION

BORKOVIC, Benjamin, University of Calgary, Calgary, AB, Canada; MARCOT, Jonathan, University of Illinois, Urbana, IL, USA; ; University of Illinois, Urbana, IL, USA

Many clades of artiodactyls show evolutionary reductions in the number of distal elements of their limb skeleton, either through the fusion of two bones or the loss of bones entirely. This reduces the limb’s distal weight and provides more stability among elements of the limb distal. It is, therefore, likely an adaptation to cursorial locomotion. Cenozoic environmental changes that led to the spread of open environments (e.g., savannas) might have provided an impetus for artiodactyl limb adaptation. To establish the historical pattern of artiodactyl limb reduction, we defined 50 discrete characters of artiodactyls limbs that describe the reduction, fusion or loss of elements. We then determined the character states of a sample of living and extinct artiodactyl genera, and mapped these onto a composite phylogeny of artiodactyls to determine the timing of evolutionary changes. We then estimated the rate of evolution in each of thirty-two-million-year-long intervals. There is a considerable
peak in evolutionary rate in the Middle Eocene. Notably, this coincides perfectly with an observed peak in ungulate origination rate suggesting a possible relationship between the radiation of the major groups of living artiodactyls and the reduction of their limbs. The rate of limb evolution gradually declines throughout the Oligocene, but increases again around the Oligocene-Miocene boundary. This coincides with some recent estimates of the spread of grassland ecosystems in North America, suggesting a possible link between environmental change and artiodactyl limb evolution. Finally, there is a decrease in evolutionary rate after the Middle Miocene, suggesting a biomechanical limit to the degree of limb reduction.

Evolution of the Modern African Fauna, Wednesday 9:15

THE OLDEST FAYUM CREODONT: DENTAL AND HUMERAL MORPHOLOGY OF A NEW PROVIVERRINE HYAENODONTID FROM THE EARLIEST LATE EOCENE OF EGYPT

BOTHA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa; SMITH, Roger, Stony Brook University, Stony Brook, NY, USA; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA; GOODENBERGER, Katherine, Stony Brook University, Stony Brook, NY, USA; SIMONS, Elwyn, Duke Lemur Center, Durham, NC, USA

Hyaenodontid creodonts were the most abundant and diverse carnivorous mammals of the African Paleogene, and are common in the late Eocene and early Oligocene deposits of the Fayum Depression in northern Egypt. Many of the Fayum hyaenodontids were likely derived from a basal, parapelychid assemblage of small to medium-sized species known as “proviverrines”. The evolutionary history of proviverrines is poorly understood, though recent discoveries in the Paleocene of Morocco suggest an African origin for the clade. Here we present dental and postcranial material of the oldest Fayum proviverrine, from the ~37 Ma (earliest late Eocene) Birkit Kerur Gourati 2 (BQ-2). The BQ-2 taxon is known from isolated upper and lower teeth and partial mandibles that preserve p3, m2, and m3 with varying levels of wear. The lower molars have relatively small metastyles that subdivide the protoconid, metacristids, and protoconulids that are generally narrower in the Fayum than in living species. The upper molars lack a well-defined protocone, have a well-developed cingular, and a reduced and elongated cingular. Extant Nasua and Potos appear to be comparable functional analogues. BQ-2 has yielded remains of three additional hyaenodontids; these taxa promise to illuminate the origin of Fayum lineages, and, more broadly, the early biogeography of Hyaenodontidae.

Poster Session III, Tuesday 9:15

BONE HISTOLOGY OF CARNIVORE COPROLITES FROM THE UPPER PERMIAN SOUTH AFRICAN KAROBO BASIN

BOTHIA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa

Microscopic analysis of fifteen coprolites from the Upper Permian Tropidostoma Assemblage Zone (Beaufort Group, Karoo Supergroup) of South Africa reveals well-preserved bone fragments with identifiable histological features, tooth fragments and, in some specimens, numerous narrow filamentous structures. Due to the large size and presence of bone inclusions, the most likely producers of the coprolites are carnivores, such as the gorgonopsian therapsids Gorgonops, Aelurognathus, Cynognathus, and Lycosuchus. Two distinct bone tissue patterns are observed. Type A, which represents the majority of the inclusions, is characterized by abundant, haphazardly arranged globular osteocyte lacunae in highly vascularized fibro-lamellar bone, and in some cases the vascular canals are extraordinarily enlarged. Annuli are rarely present. Taken together, these characteristics indicate a rapid bone deposition rate. Limb bone cross-sections are small (complete sections up to 3.7 mm in diameter) and combined with the rapid bone deposition rate, suggest that the bone fragments belong to juvenile or perinatal individuals. Type B also comprises small bone sections, but is characterized by more slowly forming parallel-fibered or lamellar-zonal bone tissue and vascularization is either poor or non-existent. Although positively identifying the bone inclusions to generic level is not possible, several features of the bone microstructure allow us to offer several possibilities. As dicynodont therapsids were the most abundant herbivores in the Tropidostoma Assemblage Zone, we suggest that the fragments containing bone tissue Type A are most likely from dicynodonts. Those containing bone tissue Type B do not exhibit typical therapsid bone tissue structure and may instead belong to reptiles or parareptiles such as Youngina, Sauropsictus or Pareiasaurus, which typically exhibit more slowly forming growth patterns compared to therapsids. This study is the first to analyse bone inclusions in coprolites from the South African Karoo Basin and has provided new insight into the paleoecology of the Upper Permian Tropidostoma Assemblage Zone.

THE NOSE KNOWS: THE EFFECTS OF NASAL CAVITY ANATOMY ON AIRFLOW IN ALLIGATORS

BOURKE, Jason, Ohio University, Athens, OH, USA; WITMER, Lawrence, Ohio University, Athens, OH, USA

The role of respiratory turbinates (RTs) in dinosaur physiology has been contentious. The necessity of RTs for maintaining heat and water balance ultimately relies on knowledge of how air flows through the nasal cavity. However, very few studies have actually addressed the effects of respiratory airflow and nasal cavity anatomy on heat and water balance. Here we present the first study that directly links the presence of RTs to remarkable extinct species, subfossil bones from the human era can also reveal changes in the nasal cavity affect airflow patterns in extinct taxa, it will be possible to test hypotheses of airflow in the nasal cavity—and hence respiratory physiology—of dinosaurs.

Technical Session X, Tuesday 12:00

ECOLOGICAL CHANGE IN A CONSERVATION HOTSPOT: THE FOSSIL AVIFAUNA OF ME AURE CAVE, NEW CALEDONIA

BOYER, Alison, Yale University, New Haven, CT, USA; JAMES, Helen, Smithsonian Institution, Washington, DC, USA; OLSON, Storrs, Smithsonian Institution, Washington, DC, USA; GRANT-MACKIE, Jack, University of Auckland, Auckland, New Zealand

Through the continuing accumulation of fossil evidence, it is clear that first human arrival on islands around the world was linked to a rise in the extinction rate for vertebrates. In addition to remarkable extinct species, subfossil bones from the human era can also reveal changes in the composition and structure of ecological communities due to ancient human environmental impacts. New Caledonia is a large and biogeographically distinct island in the southwest Pacific and is renowned for biotic assemblages found nowhere else in the world. We examined bird bones from the M̱ē Auré Cave site (WMD007), located in lowland dry forest on the west coast of New Caledonia. The taphonomy of deposition, body-size spectrum, and species composition of faunal remains were consistent with barn owl (Tyto alba) predation as the main form of deposition of vertebrate bones. The owl pellet deposit recorded the extinct...
tion of two species and extirpation of at least two other species from the lowlands in the past 1200 years. Species richness of birds in the stratigraphic deposit was quite high, reflecting the diversity of birds in the dry forest. However, we found substantial turnover in the relative abundance of species in the cave deposit, with edge and open country birds becoming more common through time. These changes may reflect a severe reduction of dry forest habitat due to human activities. This work provides a temporal record of avifaunal and environmental change in the threatened dry forest habitat, and this information should be particularly informative for ongoing conservation and restoration efforts.

Technical Session XI, Tuesday 2:30

AN ALGORITHM USING INTRINSIC GEOMETRY OF ANATOMICAL STRUCTURES FOR AUTOMATIC IDENTIFICATION OF HOMOLOGOUS FEATURES FOR AUTOMATIC IDENTIFICATION OF HOMOLOGOUS FEATURES

BOYER, Doug, Brooklyn College, City University of New York, Brooklyn, NY, USA; LIPMAN, Yaron, Princeton University , Princeton, NJ, USA; ST. CLAIR, Elizabeth, Stony Brook University, Stony Brook, NY, USA; PUENTE, Jesus, Princeton University , Princeton, NJ, USA; JERNVALL, Jukka, University of Helsinki, Helsinki, Finland

The first step in any biometric study is the identification of anatomical reference points on which to base comparisons among specimens. Once corresponding sets of reference points are defined on specimens of interest, measurements are collected and used for analyses of shape variation in order to address phylogenetic, functional, or developmental questions. Despite the quantitative rigor of shape studies, the more fundamental step, the determination of anatomical correspondence points, is largely qualitative. Assuming the possibility of error in shape variation in order to address phylogenetic, functional, or developmental questions. De-

Poster Session II, (Monday)

DISCOVERY OF A NEW CHASMOSAURINE BONEBED FROM THE KAIPAROWITS FORMATION (CAMPAIGN) OF SOUTHERN UTAH

BRANDAU, Deanna, University of Utah, Dept. Geology and Geophysics and Utah Museum of Natural History, Salt Lake City, UT, USA; GETTY, Michael, Utah Museum of Natural History, Salt Lake City, UT, USA

Extensive bonebeds of centrosaurine ceratopsid dinosaurs are known from Canada and Mont-

tana, containing dozens to hundreds of individuals, whereas similar chasmosaurine bonebeds are unknown to date, and multiple associated chasmosaurine specimens are extremely rare. Here we report the discovery of an unusual multi-individual chasmosaurine ceratopsid bonebed from the lower half of the Upper Cretaceous Kaiparowits Formation (middle Campanian) in Grand Staircase-Escalante National Monument, Utah. Most of the ceratopsid remains from the Kaiparowits Formation are associated or partially articulated single indi-

viduals associated with channel sandstones. In contrast, UMNH Locality 945 is a multiaxial bonebed containing the articulated skeleton of a juvenile chasmosaurine, a disarticulated skeleton of a second juvenile chasmosaurine individual, and a partially articulated alligator-

oid crocodilian skeleton, along with isolated turtle fragments, preserved in a sandy clayey siltstone. The larger, articulated chasmosaurine contains parts of the skull, most of the axial skeleton, and nearly complete limbs, and is the most complete articulated vertebrate skeleton discovered in fine-grained matrix from the Kaiparowits Formation. The smaller ceratopsid is fragmentated, but includes a supraorbital horn, portions of the frill, both dentaries, an ar-

ticulated forelimb, isolated humerus and ulna, and both femora and fibulae. The crocodilian was discovered directly above the larger articulated ceratopsian and appears to be nearly complete, including the skull, limbs, axial skeleton and osteoderms. We interpret locality 945 as a mud-dominated floodplain where slight fluvial reworking partially disarticulated and deposited the carcases together prior to burial, in stark contrast to the channel environment for other Kaiparowits chasmosaurine localities. A similar depositional setting is found at two other juvenile chasmosaurine localities in the Kaiparowits Formation, but these are isolated partial skeletons. The juvenile chasmosaurine specimens from locality 945 provide further insight into chasmosaurine osteology by clarifying the phalangeal count for the chasmosau-

rine manus and pes.

Technical Session VIII, Monday 2:15

PHYLOGENETIC EXPERIMENTS ON CURRENT SCENARIOS OF EARLY GNATHOSTOME EVOLUTION

BRAZEAU, Martin, Museum für Naturkunde, Berlin, Germany; FRIEDMAN, Matt, University of Oxford, Oxford, United Kingdom

Despite an ever-growing wealth of fossil data, the problems of early gnathostome origins and interrelationships remain contentious and unresolved. At present, early transformations leading to the origin of jaws from a jawless antecedent are undocumented, and the origins of osteichthyans and osteichthyans remain hazy. With the exception of a few recent examples, these questions have resisted explicit cladistic solutions in favor of traditional taxonomic methods. Thus, existing approaches are insufficient to document the early mor-

phological transitions leading to each of these major clades. This investigation uses recently published cladistic character data sets to examine character evolution in early gnathostomes. A series of experiments on different branching arrangements reflecting different views of gnathostome evolution are compared. The results have manifold implications for hypotheses of early gnathostome evolution. Firstly, 'acanthodians' cannot be sustained as a monophylet-
ic group if one or more spiny gnathostomes are considered stem chondrichthyans. Secondly, a long list of characters used in support of placoderm monophyly is shown to likely mislead identification of new fossil stem gnathostomes. This arises from the fact that untested char-

acter lists (as opposed to synapomorphy schemes arising from cladistic analysis) will tend to overestimate the actual number of synapomorphies arising from the congruence test. In any case, competing monophyletic and paraphyletic interpretations share similar implications about gnathostomes as primitively flat-bodied, benthic animals. Thirdly, the notion of placo-

derms as stem-osteichthyans is examined critically on the grounds that the shared features of placoderms and some newly discovered osteichthyans are shown to be gnathostome symmorphies or convergences. These experiments illustrate the value of explicit, tree-based approaches to character data and the value of rooting ingroup analyses of jawed vertebrate evolution on jawless vertebrate outgroups.

Poster Session III, (Tuesday)

AN EARLY JURASSIC DESERT ICHNOFAUNA: PALEONTOLOGICAL RESOURCES IN THE VERMILION CLIFFS NATIONAL MONUMENT AND PARIA CANYON-VERMILION CLIFFS WILDERNESS

BREITHAUPT, Brent, Bureau of Land Management, Cheyenne, WY, USA; MATTHEWS, Neffra, Bureau of Land Management, Denver, CO, USA

The Vermilion Cliffs National Monument (VCNM) and the Paria Canyon-Vermilion Cliffs Wilderness encompasses nearly 400,000 acres of land managed by the BLM (under the National Landscape Conservation System) in Coconino County, Arizona and Kane County, Utah. In Early Jurassic times (~190 million years ago), a vast (~350,000 sq km) desert covered the region, which was approximately 10 degrees N latitude on the western edge of Pangaea. This geographic position led to a dry, hot, sparsely vegetated,olian environment. Tropical winds blowing from the north formed the largest deposit of windblown sand in earth’s history. At times, this erg (sand sea) may have reached thickness in excess of 700 m. Today, these sands of the Navajo Sandstone create the picturesque geology in the VCNM area. In addition, this region contains thousands of fossil tracks preserved as underprints in convex hyporelief and occasionally in concave epirelief on dune foreset beds, as well as interdune bounding and truncation surfaces. Various trace fossils have been observed, in-
cluding tridactyl (Grallator) and tetradactyl (Batrachopus and Navahopus) forms, as well as unique invertebrate traces (i.e., Entradichus Ichnofossils). These ichnites preserve a variety of interesting preservational and behavioral features related to a desert fauna of theropods, prosauropods, crocodylomorphs, protoamnians, and arthropods moving up, down, and across a landscape of repose on the dunes during the Jurassic summer season. This unique, ichnaocoassemblage warrants the high level of documentation provided by close-range photogrammetry. Three-dimensional image datasets created from digital photography provide a permanent digital record of fossil tracks and is a non-destructive method to obtain 3D data for assessment. These data provide valuable information for the understanding of this Early Jurassic desert ecosystem, as well as understanding the kinematics of footprint formation in arid,olian environments.


MAMMALIAN SKULL CONSTRUCTION AND THE IMPORTANCE OF CRANIAL SUTURES IN BIOMECHANICAL FINITE ELEMENT ANALYSIS

BRIGHT, Jen, University of Bristol, Bristol, United Kingdom; GRÖNING, Flora, University of York, York, United Kingdom; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom

Cranial sutures are important sites in the mammalian skull, as they have been proposed to act not only as regions of growth, but also as areas of micrometer-scale flexibility that mitigate high bone strains associated with feeding. Finite Element (FE) Analysis is steadily gaining popularity with vertebrate paleontologists by offering a unique opportunity to observe the cranial biomechanics of extinct animals. Validation studies on extant taxa are essential in order to understand the effects of sutures on FE models, and are crucial for producing bio-

mechanically valid results when investigating skull function in fossil taxa. A full-field strain study using Digital Speckle Pattern Interferometry (DSP1) was used in vitro on the zygomat-

ic arch of a modern domestic pig (Sus scrofa) to assess the nature of stress and displacement across a large and patent suture. Our results show that the suture localises a high strain gradi-
ent, and whilst it does not greatly reduce the nearby bone strain, it does permit the independent movement (less than 2µm) of the two adjacent bones. This experimental data was used to determine that the best way of modelling cranial sutures both in tension and compression in FE analysis is to introduce regions of more compliant 3D elements. Further sutures were then introduced to the FE model of the pig skull used, and the results compared with in vitro strain gauge data from the same animal, and models without sutures. Thus, the cumulative effects on the overall distortion of the skull from multiple small displacements at the sutures were observed. With a better picture of sutureal mechanical behaviour established, questions regarding the ontogenetic and evolutionary patterns of suture fusion in fossil taxa may begin to be addressed with the FE method.

Poster Session IV, (Wednesday)

AFFINITIES OF LAMBEOSAURINE (ORNITHISCHIEN; HADROSAURIDAE) EMBRYOS FROM DEVIL’S COULEE (CAMPANIAN), ALBERTA

BRINK, Kirstin, University of Toronto, Toronto, ON, Canada; ZELENITSKY, Darla, University of Calgary, Calgary, AB, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; THERRIEN, Francois, Royal Tyrrell Museum, Drumheller, AB, Canada

Juvenile individuals of lambeosaurine hadrosaurs are difficult to assign to lower taxonomic levels because they lack a developed cranial crest. Juvenile lambeosaurine skulls are relatively well known from the Late Cretaceous of North America, and include rare nestling and levels because they lack a developed cranial crest (dinosaurichy). Here, these embryonic specimens are re-evaluated for species-specific characters and to determine their precise stratigraphic context. Re-examination of the embryos reveals that the nasals are less complete than previously suggested, and evidence of a bifurcated rostral process is not preserved. In order to quantitatively assess possible morphological affinities of the embryonic material, we performed a principal components analysis of size corrected, cranial linear measurements of 20 juvenile skulls, representing four lambeosaurine species. This analysis reveals little differentiation between taxa, stressing the lack of quantitative diagnostic features exclusive of the cranial crest, although the embryonic skull is most similar to juveniles of Corythosaurus in PC morphospace. Furthermore, the current understanding of the stratigraphic record in Alberta and Montana suggests that the Alberta embryos are approximately one million years older than the oldest occurrence of diagnostic H. stebingeri. Temporally, the upper Oldman Formation at Devil’s Coulee is equivalent to the upper Dinosaur Park Formation in Dinosaur Provincial Park, Alberta, where both Lambeosaurinae and Corythosaurinae are found. The lack of diagnostic features of the embryos from Devil’s Coulee, and their stratigraphic occurrence, suggest the presence of a species-level identification is uncertain, and therefore may not represent H. stebingeri as previously suggested.

Technical Session XIV, Wednesday 9:45

MULTI-TAXIC THERIOPOD BONEBEDS IN AN INTERDUNAL SETTING OF THE EARLY JURASSIC EOLIAN NUGGET SANDSTONE, UTAH

BRITT, Brooks, Brigham Young University, Provo, UT, USA; CHUERE, Daniel, Dinosaur National Monument, Jensen, UT, USA; ENGELEMMANN, George, University of Nebraska, Omaha, NE, USA; SCHEETZ, Rodney, Brigham Young University, Provo, UT, USA; HANSEN, Robin, Bureau of Land Management, Vernal, UT, USA

Worldwide, Early Jurassic theropods are rare and poorly known, with only three reported North American genera (Dilophosauroidea, "Syntarsus" kayentakatea, Segisaurus). Here, we report the discovery of three theropod bonebeds preserved in decimeter-scale, superimposed sandstones deposited in an interdunal environment in the Early Jurassic Nugget Sandstone of northeastern Utah. Based on the presence of two scapular forms (narrow and distally expanded blades), two coelophysoid-grade genera may be present. One taxon is represented by a small (16 cm-long femur) associated postcranial skeleton (BUU 19002) consisting of a pelvis, hind limbs, caudals, and other bones. All components of the broad pelvis are fused. The hind limb is gracile with a relatively short femur, long tibiotarsus (fused tibia-astragalus-calcaneum) and relatively narrow postcrania. The skull is expanded and broad, with a relatively long and narrow snout. The premaxillary teeth are unknown. Referral of this new material to Corythosaurus aff. stebingeri, a taxon known from the Two Medicine Formation of Montana, based on their stratigraphic occurrence and the presence of a rostrally bifurcated nasal process (dinosaurichy). Here, these embryonic specimens are re-evaluated for species-specific characters and to determine their precise stratigraphic context. Re-examination of the embryos reveals that the nasals are less complete than previously suggested, and evidence of a bifurcated rostral process is not preserved. In order to quantitatively assess possible morphological affinities of the embryonic material, we performed a principal components analysis of size corrected, cranial linear measurements of 20 juvenile skulls, representing four lambeosaurine species. This analysis reveals little differentiation between taxa, stressing the lack of quantitative diagnostic features exclusive of the cranial crest, although the embryonic skull is most similar to juveniles of Corythosaurus in PC morphospace. Furthermore, the current understanding of the stratigraphic record in Alberta and Montana suggests that the Alberta embryos are approximately one million years older than the oldest occurrence of diagnostic H. stebingeri. Temporally, the upper Oldman Formation at Devil’s Coulee is equivalent to the upper Dinosaur Park Formation in Dinosaur Provincial Park, Alberta, where both Lambeosaurinae and Corythosaurinae are found. The lack of diagnostic features of the embryos from Devil’s Coulee, and their stratigraphic occurrence, suggest the presence of a species-level identification is uncertain, and therefore may not represent H. stebingeri as previously suggested.

Technical Session XII, Tuesday 3:00

CROCODYLIANS FROM THE UNTA FORMATION (MIDDLE EOCENE, UNTAN) OF WESTERN NORTH AMERICA, RESPONSE TO CLIMATE CHANGE AND THE ORIGINS OF ALLIGATOR

BROCHU, Christopher, University of Iowa, Iowa City, IA, USA; SNYDER, Daniel, Middle Georgia College, Cochran, GA, USA

We identified four crocodylian species (at least two of which are new) from the Middle Eocene Untan Formation of eastern Utah. Two are alligatorines (Procrocodilus utahensis) and a new species named from Devil’s Coulee, Alberta. Although the new alligatorine has a relatively short snout, it lacks the enlarged cheek teeth that characterized earlier relatives. This is consistent with suggestions that the American alligator, an ecological generalist, evolved from more specialized ancestors. The other two species are stem crocodylioids—a large form similar (and possibly referable to "Crocodylus" affinis and a new species of Brachyurychampsa preserving the first known lower jaws for the genus, revealing a relatively long mandibular symphysis including the splenial. Holocephalosuchus (Irisuchispirchampses) are known from Untan units in Texas and California but have not been found in the UNTA Formation. These deposits help fill a substantial gap in the crocodylian record of western North America between the diverse faunas of pre-Untan age (when five or more species may have coexisted and depauperate Chadronian faunas with only a single species (Alligator praelimsis). Lower crocodiliform diversity in UNTAN units relative to the Campanian and earlier times might indicate a response to the global transition from greenhouse to icehouse conditions that took place during the Eocene.

Poster Session III, (Tuesday)

ASSESSING CALCIUM ISOTOPES AS DIETARY PROXY FOR TERRESTRIAL VERTEBRATES

BROSKA, Julia, Institut für Anthropologie, Johannes Gutenberg-Universität Mainz, Mainz, Germany; TÜTKEN, Thomas, Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Rheinsische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany; ALT, Kurt, Institut für Anthropologie, Johannes Gutenberg-Universität Mainz, Mainz, Germany

Calcium (Ca) is an essential major element of great importance for the physiology and structure of bone. The formation of all vertebrates involves a Ca Andersen biominerals. Bone Ca isotopic compositions provide unique information regarding the influence of diet and physiology on Ca iso- trope fractionation processes in vertebrates. This is necessary to characterize the influence of diet and physiology on Ca isotopes in skeletal tissues of modern animals before applying them as a proxy to determine the diet of extinct vertebrates and to reconstruct ancient foodwebs. In this study bone "Ca of different extant vertebrates with a broad range of diets from savannah ecosystems in eastern Africa were analyzed by TIMS and isotopic dilution using a "Ca double spike. The aim was to infer how dietary and trophic level differences are reflected in bone "Ca values. Investigated taxa, predominantly mammals, were ideally sampled from the same area/foodweb and comprise grazers and browsers (small/large body size, ruminants/non-ruminants), carnivores, insectivores, frugivores, and tubers. Established patterns for diet and trophic level such as "Ca and "N values of collagen as well as Sr/Ca and Ba/Ca of skeletal apatite were analyzed on the same bone specimens and compared with the "Ca values to further assess dietary differences and trophic level relationships. "Ca values of bone "Ca of different extant vertebrates with a broad range of diets from savannah ecosystems in eastern Africa were analyzed by TIMS and isotopic dilution using a "Ca double spike. The aim was to infer how dietary and trophic level differences are reflected in bone "Ca values. Investigated taxa, predominantly mammals, were ideally sampled from the same area/foodweb and comprise grazers and browsers (small/large body size, ruminants/non-ruminants), carnivores, insectivores, frugivores, and tubers. Established patterns for diet and trophic level such as "Ca and "N values of collagen as well as Sr/Ca and Ba/Ca of skeletal apatite were analyzed on the same bone specimens and compared with the "Ca values to further assess dietary differences and trophic level relationships. "Ca values of bone "Ca of different extant vertebrates with a broad range of diets from savannah ecosystems in eastern Africa were analyzed by TIMS and isotopic dilution using a "Ca double spike. The aim was to infer how dietary and trophic level differences are reflected in bone "Ca values. Investigated taxa, predominantly mammals, were ideally sampled from the same area/foodweb and comprise grazers and browsers (small/large body size, ruminants/non-ruminants), carnivores, insectivores, frugivores, and tubers. Established patterns for diet and trophic level such as "Ca and "N values of collagen as well as Sr/Ca and Ba/Ca of skeletal apatite were analyzed on the same bone specimens and compared with the "Ca values to further assess dietary differences and trophic level relationships.

Poster Session IV, (Wednesday)

BASAL OROTHIPOD (DINOSAURIA: ORNITHISCHIA) TEETH FROM THE BRIDGER CREEK FORMATION (CAMPAHIAN-PALEOCENE) NORTH SLOPE, ALASKA: TAXONOMY AND FAUNAL COMPARISON

BROWN, Caleb, University of Toronto, Toronto, ON, Canada; DRUCKENMILLER, Patrick, University of Alaska Museum of the North, Fairbanks, AK, USA

A diverse and prolific record of polar dinosaurs comes from the Upper Cretaceous (Campanian-Maastrichtian) sediments of the Prince Creek Formation exposed on Alaska’s North Slope. Previous assignment of basal ornithopod (‘hylsiophodontid’) material from this formation is based on a single cheek tooth, which has been referred to Thescelosaurus. However, reexamination of this material does not support its assignment to this taxon. Here we describe more recently discovered material, including five isolated premaxillary teeth and one lateral tooth, which confirms the presence of a basal ornithopod taxon in this formation. The premaxillary teeth crowns are bulbous and turnip-shaped, with multiple longitudinal striae circumscribing the tooth. The lateral tooth is leaf-shaped and characterized by ten vertically oriented, parallel ridges. The premaxillary teeth are most similar to those of Thescelosaurus, whereas the cheek tooth is more similar to its sister taxon Parkosaurus, for which premaxillary teeth are unknown. Referal of this new material to Thescelosaurus would represent the oldest occurrence of this taxon and considerably extend its stratigraphic range.
A more intriguing possibility is that the premaxillary teeth may also be referred to Parkosaurus, an interpretation that is more parsimonious from a stratigraphic perspective. Parkosaurus is known exclusively from coeval deposits of the upper Horseshoe Canyon Formation (Edmontonian). In contrast, Thescelosaurus is known from younger, latest Maastrichtian formations of Lancian age. Previously, faunal comparisons of the Prince Creek Formation have largely been made with non-contemporaneous formations including the Campanian-aged Judith River and Aguja formations, or to the latest Maastrichtian Hell Creek Formation. On the basis of age and faunal similarities, we suggest that a more appropriate comparison may be made with coeval rocks of the Horseshoe Canyon and Wapiti formations. This study expands our understanding of ornithischian diversity at polar latitudes in the Late Cretaceous of Alaska and underscores the importance of small, rare, or easily misidentified fossils in paleoecological studies.

Preparers’ Session, Monday 9:00

BONE BANDAGES: A CONSERVATIONALLY-SOUND REPAIR TECHNIQUE FOR BROKEN BONES HAVING LIMITED CONTACT SURFACE AREA

BROWN, Gregory, University of Nebraska State Museum, Lincoln, NE, USA

Traditional methods of repairing broken fossil bones that have significant sections missing from the surfaces to be joined include using gap fillers such as plaster or epoxy and internal reinforcement such as wooden dowels or metal rods or wires. Broken bones that have a limited contact surface area relative to the stress expected the joint have often been repaired using similar reinforcements adhered externally to the bones with various polymers. While some of these techniques may occasionally be necessary for very large, heavy bones destined for self-supporting display, they are seldom needed or appropriate for small to moderate sized research specimens. Such methods suffer from several disadvantages: filling voids can obscure potentially significant internal features or the true nature of an element; removal of traditional gap fillers and the repair of partially failed joints are often difficult or impossible without damaging the specimen; incompatable materials may actually exacerbate stress and damage to the specimen. Alternatively, the use of lightweight woven or mat (veil cloth) fiberglass, glass or polyester fiber strips saturated with a 1:2 solution (w/w) of Parabond B-72 in acetone and applied externally across a joint or unfilled gap will greatly increase the effective surface area of the joint while significantly improving shear and tensile strength and, when applied in opposition, bending strength as well. These “bone bandages” eliminate the need for gap fillers or reinforcement rods, minimally obscure both surface and internal features, are easily reversible, are stable over time and are more consistent with good conservation principles. This technique is also appropriate as a preventative reinforcement for very thin, unbroken bone which might otherwise survive normal preparation or handling.

Preparers’ Session, Monday 12:00

DESIGNING THE MODERN PREPARATION LAB: INTEGRATING NEW TECHNOLOGIES

BROWN, Matthew, University of Texas at Austin, Austin, TX, USA; ROWE, Timothy, University of Texas at Austin, Austin, TX, USA

During a recent renovation of the University of Texas at Austin Fossil Preparation Laboratory, an aging facility was updated by replacing equipment, tools, and furniture with mobile, ergonomic, and efficient systems while placing emphasis on worker and specimen safety. Traditional mechanical and chemical preparation methods are augmented by new digital technologies, and every effort was made to efficiently and cost-effectively integrate these into the laboratory workflow. Through the addition of high definition digital photo- and video-microscopy tools, workstation access to preparation record and collections databases, and wireless networking of chemical, technical, and anatomical references, Material Safety Data Sheets, map, and photographic libraries, preparators are able to immediately access any reference material necessary with the click of a mouse. Additionally, computed tomography (CT) datasets and three-dimensional digital models of specimens can be presented directly to the workbench, eliminating trips back and forth to offices or computer labs, as well as risks to laptop computers and other delicate equipment. In addition to aiding an experienced individual preparator, these digital methods also facilitate more precise instruction of new employees, ease and accuracy of record keeping, and provide exciting and engaging visual aids during education and outreach exercises.

Poster Session III, (Tuesday)

NEW COLLECTIONS OF LATE HEMINGFORDIAN AND EARLY BARSTOVIAN SMALL MAMMALS FROM THE BARSTOW FORMATION, MOJAVE DESERT, CALIFORNIA

BROWNE, Ian, Oklahoma State University, Center For Health Sciences, Tulsa, OK, USA; SMITH, Kent, Oklahoma State University, Center for Health Sciences, Tulsa, OK, USA; CZAPLEWSKI, Nicholas, University of Oklahoma, Norman, OK, USA

The middle Miocene is, in part, characterized by a period of global warming that occurred from approximately 17.2 to 14.9 Ma. Warming began during the late Hemingfordian (He 2), peaked during the early Barstovian (Ba 1), and gradually declined during the late Barstovian (Ba 2). The fossil mammal-bearing strata of the Barstow Fm. were deposited during this span of time and have the potential to provide valuable insights into the response of mammalian faunas to climate change. While the Barstow Fm. is well known for fossils of both large and small mammals, they have generally not been recovered in association with each other, and the relationships between the two groups are often unclear. In order to integrate what is known about the two groups of fossils at any given stratigraphic horizon, we are screening previously known megafaunal localities (from in situ fossiliferous strata or quarry tailings) in the Mid Hills for microvertebrates. We concentrated our initial efforts on the early Barstovian (Ba 1) locality for two reasons: this portion of the section has not been well sampled for microfossils, and warming peaked during this period of deposition. Our preliminary work in this part of the section yielded a diverse assemblage of rodents that includes: the heteromyids Cupinimus halli, Cupinimus nebraskensis, Perognathus minutus, and Protheromys lophatus; the cricetids Copemys pagei and Copemys cf. tenuis; a sciurid Miomysperomys sp.; and an undescribed zapodine (the first record of the group in the Barstow Fm.). In addition, we recovered a chiropteron (possibly a vespertilionid) from this part of the section. Our work at one of the late Hemingfordian (He 2) localities produced a well preserved right maxilla of an archaealogne leporid that shares affinities with both Hylopagus fontinalis (small size) and Hylopagus parviplicatus (P with a cement-free external anterior reentrant). This specimen is the first leporid reported from the Hemingfordian-age strata of the Barstow Formation.

Technical Session XIV, Wednesday 8:00

NEW POLISH FOOTPRINTS PULL ORIGIN AND DIVERSIFICATION OF DINOSAUR STEM-LINEAGE INTO EARLY TRIASSIC

BRUSATTE, Stephen, American Museum of Natural History, New York, NY, USA; NIEDZWIEDZKI, Grzegorz, University of Warsaw, Warsaw, Poland; BUTLER, Richard, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany

The ascent of dinosaurs and their closest relatives in the Triassic was an exemplary evolutionary radiation and has long been a subject of interest. Problematically, the earliest phase of dinosaur history, following the divergence of the dinosaur lineage from crocodyliform archosaurs, remains poorly understood. Body fossils of close dinosaur relatives are rare, but indicate that the dinosaur stem group (Dinosauriformes) originated by the latest Anisian. Dinosaurs (Dinosauria) first appear from sites in the Early/Middle Triassic of Poland, stratigraphically well constrained and identified using a conservative synapomorphies-based approach that matches diagnostic characters of skull hindlimb morphology with features of footprints. The oldest Polish site, dated as early Olenekian (ca. 248 million years ago), includes rare specimens of Protostegacutes, which exhibit synapomorphies of dinosauriforms in general and the aberrant genus Lagerpeton in particular (e.g., bunched digits, digitigrade posture, digit IV longest). These specimens are the oldest global record of dinosauriforms, are approximately eight million years older than the oldest body fossils of this clade, and several million years older than the oldest dinosauriform footprints. As these tracks are only a few million years younger than the Permo-Triassic mass extinction, they raise the possibility that the dinosauriform radiation may have been triggered by post-extinction recovery, and was not an unrelated event that occurred 15-20 million years later as widely considered. Dinosauriform tracks are rare in all three Polish assemblages, suggesting that these animals were minor faunal components. The oldest tracks are small (4 cm maximum length) and quadrupedal, a posture uncommon among the earliest dinosauriform body fossils. However, bipedality and moderately large body size (14 cm maximum track length) had arisen by the early Anisian (ca. 244 Ma). Integrating trace fossils and body fossils demonstrates that the rise of dinosaurs was a prolonged affair, with approximately 50 million years between the origin of Dinosauriformes and the first faunas entirely dominated by dinosaurs.

Poster Session III, (Tuesday)

STABLE ISOTOPE ANALYSIS OF AN EXTINCT PLEISTOCENE GROUND SLOTH, MEGALONYX JEFFERSONII, FROM THE TARKIO VALLEY OF SOUTHWESTERN IOWA: IMPLICATIONS FOR BIOAPATITE DIAGNESIS

BRYK, Alexander, Penn State University, University Park, PA, USA; FERANECKI, Robert, The New York State Museum, Albany, NY, USA; SEMKEN, Holmes, The University of Iowa, Iowa City, IA, USA

Stable isotope analyses from Xenarthran species are increasing in abundance in Pleistocene paleoecological interpretations. Diagenesis and isotopic exchange must always be a concern in these studies. The chemical processes which alter primary apatite are poorly understood. As a result, there is no unambiguous method to assess diagenetic alteration of primary isotopic signatures in bioapatite. This necessitates the use of multiple independent proxies (e.g. crystalinity indices, REE analysis, preserved organic content) to assert that primary isotopic ratios are preserved. Moreover, there is consensus that animalbone, dentine, and enamel display differential diagenetic alteration and that enamel is the most resistant. In addition, different alteration can occur between discrete functional groups within the bioapatite crystal lattice. For Xenarthrans, diagenesis is of special concern because they lack enamel-coated teeth. This study focuses on carbon and oxygen isotope composition variation within a single tooth from a late Pleistocene ground sloth, Megalonyx jeffersonii from the Tarkio Valley, Iowa. SEM examination and optical/X-ray analysis of the tooth revealed the presence of four dentine layers, all exhibiting distinct hardesses, porosities, and thicknesses. Fifty-six samples (46-51) between four separate dentine layers were taken from a longitudinally sectioned molar. Samples were processed for carbonate carbon and oxygen isotope ratios as well as for phosphate oxygen. In addition, a bulk collagen sample was prepared for an organic carbon isotope ratio and for an AMS 14C date. These data interpreted here will facilitate our understanding of potential differential diagenesis among dentine layers in Xenarthran teeth.
AXIAL PATTERNING IN THE PYGMY RIGHT WHALE CAPEREA MARGINATA: IS IT A FOURTH EXCEPTION TO THE RULE OF SEVEN?

Buchholz, Emily, Wellesley College, Wellesley, MA, USA

Rare morphological systems display stasis across diverse environments and long geological time spans. Stasis may be the product of bias in the generation of variation or of negative pleiotropic effects that occur when entrenched morphologies are disrupted. Three genera (Chlossepus, Bradypteryx, Trichechus) are traditionally recognized as exceptions to the nearly universal count of seven cervical vertebrae in the mammalian skeleton. Here we examine the pattern that the pygmy right whale, Caperea marginata, represents a fourth and unique violation of the cervical constraint. Caperea is a rare mysticete cetacean with an unusual suite of axial skeletal characters. A grackle first thoracic vertebra without rib facets, broadly expanded anteriorriost ribs, a long thorax with broadly overlapping vertebral transverse processes, plate-like posterior ribs, and an extremely short lumbar all contrast with other cetaceans and suggest an unusual development. Twenty-four individuals of diverse ontogenetic age were available for analysis at the South Australia Museum (Adelaide) and the Museum of New Zealand Te Papa Tongarewa (Wellington). Multiple, variable examples of incomplete rib fusion in neonates and dependent calves indicate that the expanded anteriorriost rib of adults is an ontogenetic fusion product of ribs 1 and 2. The composite rib articulates by way of its anterior (Rib 1) component to the sternum and by way of its posterior (Rib 2) component with thoracic vertebra 2. When rib fusion is taken into account, vertebral count in Caperrea is nearly stable at C7T1L1G16-17 or C7T1L1G16-18. The composite rib does not violate the traditional cervicothoracic boundary, as its anterior component does articulate (albeit distantly) with both the vertebral column and the sternum. Analysis of axial morphology in Caperrea and other atypical mammals suggests that structures with abaxial patterning have played key roles in providing morphological flexibility when praximal developmental constraints are very rigid.

Poster Session I (Sunday)

CHRONIOSUCHUS AS CROCODILE MIMICS

Buchwitz, Michael, TU Bergakademie Freiberg, Freiberg, Germany; WitzMANN, Florian, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany; Kogan, Ilia, TU Bergakademie Freiberg, Freiberg, Germany; Voigt, Sebastian, TU Bergakademie Freiberg, Freiberg, Germany

Chroniosuchus are a species-poor tetrapod group from the Permian and Triassic of Eurasia. On the basis of their cranial and vertebral structure they have been related to Paleozoic stem-amniotes, such as embolomeres or Seymouriamorpha. Introduced with the naming of Chroniosuchus in 1957, the comparison of chroniosuchians to crocodilians initially alluded to Chroniosuchus' elongated snout, archosaur-like preorbital openings, and overall reptiliomorph appearance. The characteristic chroniosuchian dorsal shields constituted a further analogy. Following the abundant discovery of chroniosuchian remains in association with aquatic vertebrate fossils, they soon became an example for larger aquatic to semi-aquatic predators that represented an ecomorphotype similar to those hold by crocodilians during the later Mesozoic. The hypothesis that the chroniosuchian dorsal shields evolved in a more terrestrial context – as a device for the protection of the vertebral column and trunk against damaging shear and torsional loads associated with locomotion on land – is based on their comparison with certain fossil crocodilian osteoderm shields that apparently had such a function. In fact, the dorsal osteoderm systems of chroniosuchians are remarkably similar to those of crocodilians and other suchian archosaurs in forming a craniocaudally segmented shield whose segments are attached to the spinal processes of corresponding vertebrae and can be completely drawn down through joints. In contemporary groups of crocodylians, the expanded anteriormost osteoderm bone we found distinct bundles of anteriorly and posteriorly trending Sharp's fibres in the internal osteoderm cortices of four sampled chroniosuchian taxa, indicating the attachment of epaxial muscles on the postero medial part of the ventral osteoderm surface. This feature is paralleled by crocodilians, whose paraver tebral osteoderm segments constitute a crucial part of the trunk bracing system by forming muscle attachment sites. We find likely that the chroniosuchian dorsal shield was part of an analogous type of bracing system that enforced the terrestrial capability of its bearer.

Poster Session III (Tuesday)

FORELIMB MYOLOGY OF THE BASAL THEROPOD DINOSAUR TAWA HALAEE FROM THE LATE TRIASSIC HAYDEN QUARRY OF NEW MEXICO

Burch, Sara, Stony Brook University, Stony Brook, NY, USA; Smith, Nathan, Field Museum of Natural History, Chicago, IL, USA; Nesbitt, Sterling, The University of Texas at Austin, Austin, TX, USA; Irms, Randall, Utah Museum of Natural History, Salt Lake City, UT, USA; Turner, Alan, Stony Brook University, Stony Brook, NY, USA

Reconstructing limb musculature provides important information about the function and capability of tetrapod limbs. Previous reconstructions of theropod forelimb myology have been hindered by the deteriorated nature of the deltopectoral crest. Two small, round striated areas on the posterior surface of the internal tuberosity may represent insertions for m. coraco-brachialis longus and m. scapulohumeralis posterior, and an elongate, rugose, slightly depressed area on the medial surface of the humeral shaft indicates the distal extent of m. triceps brachii. In Tawa halae, a medium-sized theropod from the Late Triassic of New Mexico, a nearly complete osteology of Tawa provides a basis for inferring muscle presence and function. The forelimb myology of a basal taxon has yet to be documented. The basal theropod Tawa halae from the Late Triassic of New Mexico provides a nearly complete osteology of Tawa halae but the forelimb myology of a basal taxon has yet to be documented. The basal theropod Tawa halae from the Late Triassic of New Mexico provides a nearly complete osteology of Tawa halae but the forelimb myology of a basal taxon has yet to be documented.

Poster Session II (Monday)

IS THE LATE MAMMALIAN FAUNAL TURNOVER ASSOCIATED WITH THE MECO GLOBAL WARMING EVENT IN THE DUCHESNE RIVER FORMATION IN UTAH?

Burger, Benjamin, SWCA, Vernal, UT, USA; Murphey, Paul, San Diego Natural History Museum, San Diego, CA, USA

The Middle Eocene Climatic Optimum (MCO) is a perplexing global warming event that represented a rapid reversal of the long term cooling trend that occurred during the late middle Eocene 40.0 million years ago. Little is known of the consequence this global warming event had on mammalian communities living at the time. The deposition of the late middle Eocene Duchesne River Formation in northeastern Utah is contemporaneous with the MECO event. Here we describe an unusual fossiliferous horizon within the Duchesne River Formation, has a published radiometric age of 39.74 ± 0.07 million years. Slightly older strata in the underlying Dry Gulch Creek and Bennett Basin members preserve a more sparse fossil record of mammals, mostly confined to the lower part of the Bennett Basin Member, an interval that was formerly referred to as the Randlel Horizon (C. 41.26 million years), and considered by many to be Uintan in age on the basis of its mammalian fauna. Although recent work has demonstrated that the upper part of the Dry Gulch Creek Member is undoubtedly Duchesnean age, the stratigraphic location of the Uintan-Duchesnean boundary within the upper part of the Bennett Basin Member or lower part of the Dry Gulch Creek Member remains undocumented, as does the nature of the associated faunal transition and relationship, if any, to the MECO. Here we describe an unusual fossiliferous horizon within the Bennett Basin Member that has so far yielded a new sample of rodents and artiodactyls. The Bennett Basin Member consists of sandstone and conglomeratic lenses interbedded with reddish-brown siltstone. The fossiliferous horizon is a single layer of light greenish-gray siltstone that contains isolated mammalian remains, with lesser amounts of turtles and crocodilian fossils that are more abundant in the underlying Uinta Formation. Continued sampling of this horizon will add to the poorly documented fauna of the lower part of the Duchesne River Formation and help to better characterize the mammalian faunal turnover at theUintan-Duchesnean boundary and its possible association with the MECO event.

Poster Session I (Sunday)

TWO PREVIOUSLY UNREPORTED TURTLES FROM THE EOCENE UINTA FORMATION, UTAH

Birk, Daniel, Intermountain Paleo-Consulting, Vernal, UT, USA; Sandau, Stephen, Intermountain Paleo-Consulting, Vernal, UT, USA; Klimek, Jason, Intermountain Paleo-Consulting, Vernal, UT, USA

Nine individual turtles representing two previously unreported taxa were collected during reconnaissance surveys in the Uinta Basin of northeastern Utah. The specimens were collected from variagated siltstones and mudstones from the uppermost Uinta C (Myton Member) of the Uinta Formation where it interfingers with the Bennett Basin Member of the Duchesne River Formation. All individuals are fragmentary and consist almost entirely of carapace and plastron fragments. Seven individuals, ranging from juvenile to adult, share characteristics with the superfamilly Testudinoidea, specifically the families Emydidae and Testudinidae. Similarities to the Emydidae include an anterior notched nuchal with a trapizoidal shaped cervical scale wider on the posterior end, a well developed longitudinal carina beginning on the ventral side of the 3rd peripheral and traveling posteriorly, along with a elongate rhombus shaped entoplastron. Similarities to the Testudinidae include costo-peripheral vacuities spanned by rib extremities originating dorsally from the distal margin of the costals and articulating in pits medially positioned on the interior margins of the peripherals beginning with the 3rd, a convex posterior margin of the nuchal, and buttresses rising from the peripherals. Similarities to both families include a deep caudal notch and prominent growth rings on the costal elements. A unique characteristic of these seven specimens is a relatively flat costal profile with a sharp angular structural carina near the proximal end of the costals maintaining an overall convex carapace shape. The remaining two individuals are more fragmentary and exhibit certain characteristics similar to the Paleoence Koinosternid turtle Hoplochelys, including carina on the dorsal side of the peripherals, digitations and dentate
sutures between the plastron and peripherals, and a carina running longitudinally down the dorsal surface of the neural. The addition of these two new taxa increases the characteristically low reptilian biodiversity of the Uinta Formation. This bias may be due to collecting or local taphonomic and climatic controls.

Poster Session II, (Monday)

USING SKIN TO INFERR PHYLOLOGY: QUANTITATIVE AND QUALITATIVE ANALYSES OF VARIATION IN THE STRUCTURE OF ANKYLOSAUR (DINOSAURIA: ORNITHISCHIA)OSTEODERMS

BURNS, Michael, University of Alberta, Edmonton, AB, Canada

Ankylosaur osteoderms have been used in the diagnoses of ankylosaur species, genera, and subfamilies, but no work has explored all possible sources (textural, morphological, and histological) of their taxonomic characters together. This study assesses the phylogenetic and taxonomic utility of these elements, using comparative material from fossil and extant tetrapod taxa. Putative differences among three ankylosaur groups (ankylosaurid, nodosaurid, and polacanthid) are evaluated via statistical and phylogenetic tests. Archosaur osteoderms all share two cortices (superficial and deep) surrounding a core of spongy bone. Ankylosaur osteoderms are united by a distinct superficial cortex, a lack of Sharpey’s fibers, and mineralized collagen structural fibers. Nodosaurid osteoderms lack a well-developed deep cortex and have a dense structural fiber system in the superficial cortex. Polacanthids have a cancellous core, although this is shared with some ankylosaurids and nodosaurids. A-test comparing cortical thickness shows significant overlap among groups, suggesting a thick cortex is not diagnostic for polacanthids. Ankylosaurid osteoderms are comparatively thin. Small ossicles (~3mm thick) are morphologically and histologically similar among all three groups. Modified elements (e.g. tail club osteoderms) do not exhibit histology consistent with the basal condition for their given ankylosaur group. This is supported by extant Caenomorpha osteoderms, which show significant correlation between histological variation (cortical thickness) and osteoderms shape in a t-test. Core Haversian bone is found only in some ankylosaur and nodosaurid osteoderms and is not necessarily indicative of any particular group. Some osteoderm shapes are diagnostic for specific ankylosaur taxa (e.g. cervical/thoracic distal spines in nodosaurids). The same is true of superficial texture, which is only useful for species-level identification in isolated cases. Incorporation of these characters into several parsimony analyses provides strong support for the Ankylosauridae and Nodosauridae, but not for a monophyletic “Polacanthidae,” which is considered a grade of primitive ankylosaurs.  

Technical Session I, Sunday 9:00

INTERACTIONS BETWEEN SEA LEVEL, SAMPLING AND DINOSAUR DIVERSITY DURING THE MESOZOIC ERA

BUTLER, Richard, Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany; BENSON, Roger, University of Cambridge, Cambridge, United Kingdom; CARRANO, Matthew, Smithsonian Institution, Washington, DC, USA; MANNION, Philip, University College London, London, United Kingdom; URCH, Paul, University College London, London, United Kingdom

The fossil record is our only window on the diversification of life in deep time, but there is a widespread concern over the effects of sampling on observed palaeodiversity. However, it is also possible to overcorrect this interdependence (or worse), especially if sampling and diversity are driven by common factors (e.g. sea-level change). Non-avian dinosaurs represent an excellent study group for investigating these relationships in the terrestrial realm, because they offer a rich, temporally extensive, and geographically varied fossil record. Additionally, several causal hypotheses exist regarding their 160-million-year diversification. Here we present the results of a detailed quantitative analysis of the dinosaur fossil record in conjunction with data on sampling and the rock record. We test two specific hypotheses: 1) whether a robust diversity signal is present within the existing fossil record; and 2) whether changes in sea level are correlated with changes in diversity. Our dataset includes multiple sea level curves, species-level information on more than 750 dinosaur taxa, and associated formational, temporal, and sampling data, available in the Paleobiology Database. Although raw data show correlations between sea level and both taxonomic diversity and sampling, these do not survive detrending or removal of short-term autocorrelation via generalized- or first-difference transformations. However, the strong correlation between diversity and sampling appears genuine even after transformation, whereas sampling-corrected diversity correspondingly shows no correlation with sea level. In fact, sea level correlations appear to result from general upward trends in all data series, and we detect no correlations between short-term sea level changes and similar-scale fluctuations in diversity or sampling. Therefore we consider the hypothesis that dinosaur diversity is tied to sea level to be poorly supported, either via direct influence or a common causative factor. Our results instead support the view that sampling variation is the preferred null hypothesis for diversity variations in the Mesozoic terrestrial realm.

Poster Session IV, (Wednesday)

DISCRIMINATING FOSSILS ARE NOT STATIC: AN ASSESSMENT OF THE DISCRIMINANT FUNCTION ANALYSIS METHOD FOR TESTING STASIS

BYKOWSKI, Richard, Indiana University, Bloomington, IN, USA; GREEN, Robin, Indiana University, Bloomington, IN, USA; O’DONNELL, Kenneth, Indiana University, Bloomington, IN, USA; SMITH, Michael, Indiana University, Bloomington, IN, USA; POLLY, P. David, Indiana University, Bloomington, IN, USA

The fossil record preserves the history of the morphological evolution of taxa throughout the Phanerzoic. However, evolution is not a smooth, continuous process but has been the subject of debate since the advent of the punctuated equilibrium model of species evolution. One classic statistical approach for determining whether a species exhibits evolutionary stasis uses discriminant function (or canonical variates) analysis to maximize the difference between samples from the first and last time slice of a species lineage: if the two samples overlap, then the lineage is judged to be in stasis. This method does not consider statistical time-series theory and may be subjective to type I and type II errors. We developed a Monte Carlo experiment in the freeware statistical program R to systematically assess the power of this method in different situations. We controlled for seven parameters: the number of traits, the number of generations in a lineage, the per-generation rate of evolution, the strength of stasis, and the standard deviation and the size of the samples. We varied each of these parameters and repeated the model with 1000 replications to determine the success rate of the discriminant function test for stasis. In this study, type I error occurs when the test incorrectly identifies a pattern as stasis and type II error occurs when the test incorrectly rejects stasis. In cases of weak or no stasis, with small numbers of traits, generations, or sample sizes, the method is prone to error. Type I error is high when there is a large population size, low rate, and no stasis. Type I error is low and type II error is high when there is a large number of traits and generations. Type II error is low when there is weak stasis and large population size. There is no type II error when stasis is strong with few traits and generations, regardless of sample size. The error rate of the discriminant function test for stasis is case dependent; however, our results suggest that it is most appropriate for evolutionary studies spanning many genera (greater than one million).

Technical Session V, Sunday 2:15

MICROWEAR, DIET AND FOSsorialITY IN MIOCENE RODENTS FROM THE GREAT BASIN

CALEDE, Jonathan, University of Oregon, Eugene, OR, USA; HOPKINS, Samantha, University of Oregon, Eugene, OR, USA

Low-magnification microwear analysis has been the subject of much interest in reconstructing the diet of fossil species. This method is based on counts of scratches and pits (i.e. the microwear signature) and has proven effective in studies of the paleodiet of ungulates, pro-boscids, lemurs, and rodents. In this study, we include eleven species of rodents ranging in diet from fungivory to folivory and focus on browsing herbivores. In addition, we also gathered data on the microwear signature of six species of browsing rodents from the Mio- cene of the Great Basin belonging to the family Geomydidae and Mylagaulidae. Our results suggest that Pliosaccosmys magnus and Mojavemys masculinens were very similar in diet to each other and to Thomomys talpoides, the northern pocket gopher. Mylagaulids exhibit a very diverse diets both across and within species and seem to be more opportunistic in their feeding behavior. Alphagaulus vetus appears to have fed on a diet of aboveground plants supplemented by seeds and nuts. Hesperognasia gaxi overlaps with numerous species with diverse diets and may have been an opportunistic feeder. Initial results for H. wilsoni suggest that it could have fed on a diet of fungi and fruits similar to that of modern chipmunks. A new, yet to be described species of the genus Hesperognasia displays a microwear signature closer to that of the North American porcupine, hinting at a mixed feeder diet. We find discrepancies between the degree of fosoriality of mylagaulid taxa as suggested by microwear and that demonstrated by cranial and skeletal evidence. Some diets may be over-imprinting the signal from browsing, erasing evidence for an underground way of life. It appears that linking microwear signature to diet and fosoriality is challenged by the conflict between those two signals, the variability in diet in opportunistically-feeding small mammals, and possible evolutionary baggage. This last issue suggests the need for a more careful examination of the evolutionary baggage. This last issue suggests the need for a more careful examination of the microwear data for interpreting the diet of these taxa.
Maryland. Spheno Run has thus far produced a diverse vertebrate fauna especially rich in marine reptiles. These include the turtles Peritresius ornatus and Taphropis sulcatus; the mosasaurs Prognathodon rapax, Mosasaurus hoffmanni, a probable pliopterid carpine and the plesiosaur Cleiosauriscus malmgreni. Chondrichthyes include the associated teeth and vertebrae of a large species of the anacondinae, Palaeolaelaps pristodontus, the lamnoid shark Cretalasma appendiculata and Odontaspis sp., the selerosteroch pond sawfish Ichthyobrama mira and thechmaerod Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the autochthonous genus Apateodus. If additional material confirm the occurrence of Apateodus it will expand the geographic range of this taxon to include the Atlantic Coastal Plain. Rare elements from the Spheno Run locality include hollow, thin-wall bone fragments representing the remains of pterosaurs and a partial maxilla from a juvenile hadrosaur. Although associated skeletal elements are found at Spheno Run articulated specimens are not. This is likely due to scavenging of post mortem remains. The evidence for this interpretation lies in the great number of bony elements that display bite and scrape marks from both small and large toothed scavengers.

Technical Session II, Sunday 9:00

A GEOMETRIC MORPHOMETRIC ASSESSMENT OF GONDWANAN LYSTROSARUS AND THEIR RELATION TO LAURASIAN FORMS

CAMP, Jessica, University of Iowa, Iowa City, IA, USA

Lystrosaurus is one of the few terrestrial vertebrate genera to have crossed the Permian-Triassic boundary and the only one to increase greatly in abundance following the faunal turnover. These factors, in conjunction with its cosmopolitan presence in both Gondwana and Laurasian faunas, make it a unique case study for use in tests of the nature of the end-Permian extinction and subsequent ecosystem recovery across Pangaea. This potential has been hindered by oversplitting and a poorly understood taxonomy. Some researchers have questioned whether two of the currently recognized Gondwanan species (L. declivis and L. murrayi) are valid or represent a single, sexually dimorphic species. I assessed morphological variation in Lystrosaurus crania using geometric morphometrics. My results indicate all four currently recognized species are valid. While L. declivis and L. murrayi exhibit the greatest degree of similarity, they also show significant separation in several relative warp analysis plots. These analyses include juveniles of both species, so therefore imply taxonomic separation as opposed to sexual dimorphism. Results of analyses including several Chinese specimens suggest they are taxonomically distinct from Gondwanan species. As the Chinese forms cluster together in a single group separate from their Gondwana relatives, they may represent a single dispersal event into Laurasia. These results have implications for biogeographic patterns in the latest Permian. In addition, this study supports the ability of geometric morphometrics to more precisely distinguish morphological variation than was previously possible.

Technical Session V, Sunday 1:00

AMAZONIAN MAGNETOSTRATIGRAPHY: DATING THE FIRST PULSE OF THE GREAT AMERICAN FAUNAL INTERCHANGE

CAMPBELL, Kenneth, Natural History Museum of Los Angeles County, Los Angeles, CA, USA; PROTHERO, Donald, Occidental College, Los Angeles, CA, USA; ROMERO-PITTMAN, Lidia, INGEMMET, Lima, Peru; HERTEL, Fritz, California State University, Northridge, Los Angeles, CA, USA; RIVIERA, Nadia, Occidental College, Los Angeles, CA, USA

The Great American Faunal Interchange (GAFI) has long been considered a Plio-Pleistocene event, with uplift of the Panamanian isthmus and most interchange of faunal elements between North and South America taking place at that time. However, recent discoveries in China suggest they may represent a single dispersal event into Laurasia. These results have implications for other fossils of North American mammals recovered from basal deposits of the Madre de Dios Formation immediately above the Ucayali Unconformity. These mammals include Lystrosaurus and Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the autochthonous genus Apateodus. If additional material confirm the occurrence of Apateodus it will expand the geographic range of this taxon to include the Atlantic Coastal Plain. Rare elements from the Spheno Run locality include hollow, thin-wall bone fragments representing the remains of pterosaurs and a partial maxilla from a juvenile hadrosaur. Although associated skeletal elements are found at Spheno Run articulated specimens are not. This is likely due to scavenging of post mortem remains. The evidence for this interpretation lies in the great number of bony elements that display bite and scrape marks from both small and large toothed scavengers.

Technical Session I, Sunday 9:45

CRANIAL MORPHOLOGY AND THE DIVERSITY OF LATE CRETACEOUS EDMONTOSAURS (ORNITHISCHIA: HADROSAURIDAE) FROM NORTH AMERICA

CAMPIONE, Nicolas, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; RIVERA, Nadia, Occidental College, Los Angeles, CA, USA; CAMPBELL, Kenneth, Natural History Museum of Los Angeles County, Los Angeles, CA, USA; SCHWARZ-WINGS, Daniela, Museum für Naturkunde, Leibniz-Institut für Evolutions und Biodiversitätsforschung an der Humboldt-Universität zu Berlin, Berlin, Germany; MARPPMANN, Sebastian, Steinmann Institute, Division of Paleontology, University of Bonn, Bonn, Germany; SANDER, Martin, Steinmann Institute, Division of Paleontology, University of Bonn, Bonn, Germany; PABST, Benn, Sauriermuseum, Aathal, Switzerland

Edmontosaurs have long been considered a Plio-Pleistocene event, with uplift of the Panamanian isthmus and most interchange of faunal elements between North and South America taking place at that time. However, recent discoveries in China suggest they may represent a single dispersal event into Laurasia. These results have implications for other fossils of North American mammals recovered from basal deposits of the Madre de Dios Formation immediately above the Ucayali Unconformity. These mammals include Lystrosaurus and Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodus ferox, Anomocestus robustus, Cylindracanthus ornatus, associated scales, fin spines and vertebrae of an as yet unidentified beryciform fish and rare teeth that favorably compare to the aulopiform Edaphodon mirificus. Bony fish are represented by Enchodos...
is being tested at the hominin rich site of Malapa, South Africa. There are several advantages to incorporating a virtual preparation technique. First, this considerably shortens overall preparation time, making more efficient use of a given number of preparation hours. Exact positions of fossils within the hard matrix can be communicated to preparators before extraction begins. Second, this method provides an opportunity to finish particularly delicate preparations virtually, which saves specimens from damage during risky extractions. Copies of specimens can be produced using 3D printing technology. Third, the method removes an additional element of chance from discovery by allowing more systematic searching of matrix for fossils (i.e., fossils buried completely in blocks of matrix are no longer invisible). This procedure also reduces the potential for damaging unknown specimens that are encountered as a surprise during preparation of known specimens. Results are scanner-specific and the choice of scan parameters will produce varying results. Thus, there appears to be no single “best practice”, although similar protocols may be applicable for blocks from similar sedimentary units. Formalizing the process by creating reporting forms to aid in the prioritization of preparation, as well as involving technicians in the process by showing the location, direction and position of fossils within the matrix have produced excellent results. For example, the methods employed have resulted in the discovery and identification of early hominid fossils that were otherwise on the surface of individual blocks, thereby enhancing our search capabilities for typically rare fossils, and by further minimizing destructive extractive and preparation techniques.

Poster Session I, (Sunday)
TAPHONOMY OF THE DOUGLASS QUARRY, DINOSAUR NATIONAL MONUMENT, UTAH
CARR, Kenneth, Denver Museum of Nature & Science, Denver, CO, USA
The taphonomy of the dinosaur quarry is presented using unpublished manuscripts, diaries, notes, quarry maps, and historical photographs, as well as sedimentology, petrography, and analysis of specimens. Three-dimensionally preserved dunes (up to 1.25 m tall), bone distribution and orientation, and poorly sorted gravelly or pebbly quartz sandstone, stacked sandstone beds, and umbrisids in life position indicate repeated episodes (3-4) of deposition in a sandy braided river flowing southeast. Clay drapes separate depositional episodes. Based on movement of the largest femur (Ophthalmosaurus louisae), water velocity during flood stage was approximately 4.2 m/s and discharge was 1181 m³/s. Intensive fieldwork was done in a fault-bounded basin at the Juchipila-Tabasco region (N 21.5°, W 102-103°). The graben-fill sequence consists of river, lake, and overbank deposits interbedded with thin ash-fall layers. The fossil assemblage includes the oldest megalonychid record in Central Mexico, and it is represented by two molariform teeth and the right metatarsal of M? III. Based on the size and facets for MT IV, MT II, and ectocuneiform, it is closely related to Pluometanastes. The first Mexican record of Cosesys is represented by a skull and fragment with reduced premolars. The skull has a fragment of left horn, which has a rounded cross-section and is planted over the orbit. In another skull fragment assigned to Plocerus, there is a flat suture near the orbit. Another horncore is laterally flattened and bifurcates ending in blunt tips, features typical of Plocerus. Equids are abundant in the Juchipila localities, and are crucial for correlation with other late Tertiary mammalian faunas in Central Mexico. An almost complete skull, assigned to Dinohippus mexicanus, has teeth with the characteristic features of this species, including the "wooden-shoe shape" of the protocone. However, the facial region shows critical differences from other late Hemphillian horses of Mexico, such as absence of malar fossa and that the Dorsal Preorbital Fossa (DPOF) is only a faint depression without pocket or well defined boundaries. These features contrast with the well defined and deep DPOF found in specimens from other localities. These differences in the DPOF are not variable enough to be useful for distinguishing the two distinct characters. An almost complete maxilla and isolated upper and lower teeth are assigned to Calippus (Grammippus) hondurensis. The presence of Calippus and lack of Nanippus aztecus are pivotal in the biostratigraphic correlation with other late Tertiary Mexican faunas. A 5.58 ± 0.10 Ma radiometric date (U/Th/Pb, zircon) of the upper volcanic ash layer from El Resbalon locality is consistent with an early-late Hemphillian land mammal age.

Technical Session VIII, Monday 3:45
PLACODERM REPRODUCTIVE STRATEGIES
CARR, Robert, Ohio University, Athens, OH, USA
Among extinct chondrichthyan, internal fertilization results in the production of oviparous egg cases or retained oviparity (viviparity). Oviparous placoderms are substrate dependent for the laying of their eggs, while viviparous taxa range from pelagic births to coastal nurseries. Recent discoveries of in situ placoderm embryos in ptychodonts and arthrodires extends the occurrence of internal fertilization and retained oviparity to basal gnathostomes. The unique single fish fauna of Merrigannowr, Australia (Late Givetian–Early Frasnian), consists of a single species assemblage of Convulaplik melachlanti (a phyllolepid placoderm) that includes a complete range of ontogenetic stages. This unusual assemblage in a restricted basin suggests the presence of a nursery. In contrast, the Cleveland Shale fauna of Famenian) represent an epipelagic fauna isolated from the open basin benthos due to the toxic bottom habitat. A common member of the fauna is Dunkleosteus terrelli, a free-swimming placoderm species (up to an estimated 6 m length). For T. terrelli, a single pup has been discovered. Its estimated body length of less than 5% of the body length of an average adult implies that it represents a prenatal embryo (based on comparisons to extant chondrichthyan birth sizes). A discovery that adds to an understanding of placoderm reproductive strategies is the presence of egg cases in the Cleveland Shale. Three cases, up to 20 cm in length, are known. One case clearly demonstrates the presence of dental bone (confirming its placoderm origin). The cases lack tendrils (necessary for anchorage) and lack evidence for respiratory pores. Based on this anatomy, it can be hypothesized that cases of this type are restricted to the aerated shallow parts of the basin, potentially in near-shore nurseries. This can be argued as it has been shown that dental morphology has a high tendency for homoplasy and that teeth are more often preserved than any other vertebrate skeletal element in the fossil record, thus forming the basis for much taxonomic and phylogenetic analysis. Reconstructions done with phenotypic characters based on parsimony optimization are problematic, however, as it has been shown that dental morphology has a high tendency for homoplasy and that dental traits are not independent from one another. Attempts to use geometric morphometrics as a tool for phylogenetic analysis require no assumptions of character individuation, but have also proven problematic. To circumvent these problems, I argue here for phylogenetic reconstruction of dental characters using tooth occlusion as a functional constraint. Occlusion enacts a strong functional pressure on teeth and the need to occlude significantly constrains both the viable molar morphospace and the shapes of dental evolutionary trajectories. This hypothesis was tested using three-dimensional scans of the upper and lower molars of 4 species of Tarsius: T. tarsius, T. bancanus, T. baryus and T. syrichta. Morphospaces were created and occlusal similarity were generated through analysis of the arbitrary juxtaposition of upper and lower molar morphospaces created from landmark data. Theoretical occlusally viable clusters in this morphospace were quantified and the operational taxonomic units (OTU) were defined using multivariate clustering analyses from the empirical data within the morphospace. After the morphospace has been generated, the number of occlusal steps necessary to progress from one OTU to another was measured. These steps are weighted by develop-

Technical Session XIV, Wednesday 10:45
ONTOGENETIC VARIATION IN TYRANNOSAURUS REX: RESULTS FROM A NUMERICAL CLADISTIC ANALYSIS
CARR, Thomas, Carthage College, Kenosha, WI, USA
Many new specimens of Tyrannosaurus rex have been discovered in the past 20 years, providing the opportunity to thoroughly document variation in this taxon. Several of the new specimens occupy the gap between the smallest juveniles and the largest adults; this is significant because the differences between these ontogenetic stages are so extreme that they have been mistaken for different taxa. Therefore, the present sample provides the opportunity to document the morphological transformation from juvenile to adult with unprecedented completeness and detail. The objective of this project was to reconstitute the growth series of T. rex using a robust sample size and more characters than have been used previously. A cladistic analysis of 20 specimens was executed in PAUP under a branch and bound search with all characters equally weighted. A total of 930 hypothetical ontogenetic characters were analyzed (893 from the skull and jaws, 1 from the axial skeleton, 18 from the pectoral girdle and limb, 20 from the pelvic girdle and limb). The analysis resulted in 6 most parsimonious trees, each with a length of 1,188 steps, and with the statistics: Cr. 97.7, RI: 0.68, RC: 0.66. The lack of resolution pertains to two pairs of subadults, otherwise the topology is nearly pectinate. The results reconstruct a sequence of 15 steps of growth changes, where the most mature specimen is LACM 23844. There are two gaps in the growth series that are between the juveniles and subadults, indicating that this interval of the greatest—and presumably the most rapid—amount of growth change is still incompletely represented by the known fossils. T. rex displays a variety of ontogenetic patterns that pertain to: (1) tooth morphology, (2) tooth number, (3) cranial ornamentation, (4) suture fusion, (5) pneumatization (6) muscle attachments, (7) growth rings, (8) proportions, and (9) joint surface morphology. The results do not support the recent hypothesis of a second species of Tyrannosaurus in the American west.
mental models to accurately capture differential cusp plasticity. Using the methods described above, the phylogeny expected from molecular studies was obtained. This new technique of phylogenetic reconstruction would also be applicable to fossil taxa.

Poster Session II, (Monday)

THE DEVELOPMENT OF CRUSHING PREMOLARS IN THE STAGODONTID, *DIDELPHODON*

CASE, Judd, Eastern Washington University, Cheney, WA, USA

The dentition of the stagodontid marsupial, *Didelphodon*, is distinguished by inflated and bulbous premolars. The premolars have a massive central cusp which is a highly derived condition compared to the more typical gracle and trenchant premolars of most other Late Cretaceous marsupials. The Judithian-aged stagodontid, *Eodelphis*, has the more typical marsupial premolar morphology compared to its highly Lancian-aged relative, *Didelphodon*. The transition between these two morphologies is not well documented. Stagodontid specimens from Red Owl Quarry in South Dakota exhibit intermediate premolar morphologies between *Eodelphis* and *Didelphodon*. The transitional states in premolar morphology culminating in the highly derived, crushing premolars in *Didelphodon*, may be explained through a morphodynamic model of tooth development.

Technical Session XV, Wednesday 11:15

ASCENT WITH MODIFICATION: FOSSIL FISHES WITNESSED THEIR OWN GROUP'S ADAPTATION TO THE UPLIFT OF THE TIBETAN PLATEAU DURING THE LATE CENOZOIC

CHANG, Mee-mann, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; MIAO, Desui, University of Kansas, Lawrence, KS, USA; WANG, Ning, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

The rapid uplift of the Tibetan Plateau during the late Cenozoic changed it into a habitat island isolated from an increasing complexity of less elevated environments. This makes it a laboratory similar to the Galápagos Islands for studying evolution in action. Inspired by studies on the spatial distribution of Recent schizothoracine fishes on the Tibetan Plateau, we report on evolution of Cenozoic fossil schizothoracines and habitat fragmentation against the backdrop of tectonic uplift. Our results show that the earlier fossil schizothoracines have more rows of pharyngeal teeth and lived at lower altitudes than their relatives from younger deposits. They belong to the primitive grade whose living representatives now live in the peripheral area of the Tibetan Plateau at relatively low altitude. These earlier fossil schizothoracines have been uplifted to the present elevation, and some are in the central area of the Plateau, where extant schizothoracines could not presently survive. Thus, the temporal distribution pattern of the fossil schizothoracines approximately mirrors the spatial distribution pattern of their living counterparts, which reflects the biological responses to the stepwise uplift of the Tibetan Plateau. The consistency in independent lines of evidence between extant and extinct fishes illustrates the beauty of Darwinism. Through ascent with modification, the fossil schizothoracine fishes demonstrate how their own group has adapted to the ever-changing environment caused by geological, biological, and climatic interplays.

Technical Session II, Sunday 11:30

NEW STUDY OF THE CRETACEOUS MAMMAL, AKIDOLESTES WITH ITS IMPLICATIONS FOR EARLY THERIAN MAMMAL POSTCRANIAL EVOLUTION

CHEN, Meng, Department of Biology, University of Washington, Seattle, WA, USA; LUO, Zhe-Xi, Carnegie Museum of Natural History, Pittsburgh, PA, USA

Recent study of the postcranial skeleton of the spalacotheriid Akidolestes cefillii, a basal taxon of the trechnotherian clade from the Lower Cretaceous of China, sheds new light on the diversity of locomotory adaptations of basal therian mammals. The postcranial skeleton of *Akidolestes* shows both scapnostral and terrestorial locomotory features. The astragalus and the calcaneus lack the specialized features for a wide range of inversion and eversion at the mid-tarsal joint that is typical of scapnostral didelphid marsupials. This seems to suggest a terrestrial habitat preference. By contrast, other features would favor a hypothesis that *Akidolestes* had a scanorial locomotory function. These include the triangular shape of the scapula, a relatively higher phalangeal index, a more elongate intermediate phalanx to the proximal phalanx, the profile of terminal phalans of the manus, and an asymmetrical knee joint, as indicated by the larger lateral distal condyle than the medial distal condyle of the femur. In these features *Akidolestes* is significantly different from the closely related Zhangheotheriums (*Zhangheotherium* and *Maetherium*) that were interpreted as generalized terrestrial mammals by the characteristics of the scapula, the manual phalangeal proportion, and by a more symmetric knee joint. Additionally, *Akidolestes* is different in having lambar ribs and a hypertrophied parabulbar process of fibula, which are absent in zangheotheriids, although the differences in function by these divergent features remain to be understood. As *Akidolestes* and zangheotheriids both belong to the spalacotherioids, the differences in their scapula, knee, and phalangeal proportion suggest that the known spalacotheriid species are more diverse in locomotory functions than previously thought, and that some degree of ecomorphological diversification occurred within the spalacotheriid clade. Some spalacotherioids (including both *Akidolestes* and zangheotheriids) are basal in the trechnotherian mammalian lineage that includes modern marsupials and placentals. Our new data provide a new understanding that the ecomorphological diversification occurred at the generic or even species level within basal clades leading to therian mammals.

Poster Session III, (Tuesday)

LATE PALEOECENE MICROMOMYID PLESIADAPFORMS (MAMMALIA, EUARCHONTA) FROM BIG MULTI QUARRY, WASHAKIE BASIN, WYOMING

CHESTER, Stephen, Yale University, New Haven, CT, USA; BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, USA

Big Multi Quarry in the upper Fort Union Formation of the Washakie Basin, southwestern Wyoming, preserves a diverse terrestrial fauna and associated flora from the late Paleocene (Clarkforkian Land Mammal Age; C1r or C12). Forty-one species of mammals have been documented from this site, including 11 species of plesiadapiforms. Previously undescribed specimens of micromomyid plesiadapiforms extend the range of morphological variation known for the genera *Tinimomys* (n=36) and *Dryomomys* (n=12), and may represent new species.

*Tinimomys* sp. is similar to *T. graybulliensis* in possessing a continuous lingual cingulum on its upper molars, supporting an attribution to the genus. However, *Tinimomys* sp. is slightly smaller than *T. graybulliensis* in most tooth dimensions, and is more similar to *Chalicoomys antelucanus* in lacking a metacone and having a small protocone lobe on P3. *Tinomys* sp. further differs from *T. graybulliensis*, and is similar to *C. antelucanus* and *Micromomys fremdi*, in featuring a more exodontaenodont parastyle on P4 that is positioned lower relative to the paracone, resulting in a longer preparacrista slope when viewed buccally. Similarities to the most plesiomorphic species of micromomyid, *M. fremdi*, in both the relatively small protocone lobe of P3 and long preparacrista on P4, suggest that *Tinimomys* sp. is more primitive than *T. graybulliensis*.

The presence of *Dryomomys* at Big Multi Quarry extends the range of this genus temporally and geographically. Previously *Dryomomys* was only known from the late Clarkorkian (C3e) of the Clarks Fork Basin, Wyoming, and only represented by the holotype of *D. zayai*. *Dryomomys* sp. is similar in size to *D. zayai*, but differs in possessing a significantly wider P3, a distinct paracristid on M1, a smaller P4 with a less pronounced protocone and smaller protocone lobe, and a slightly longer, yet less lingually expansive P4. Comparisons to other micromomyids suggest that these features may represent plesiomorphic retentions. These new specimens of *Tinimomys* and *Dryomomys* may serve to document evolutionary transitions among known taxa of micromomyids, helping to clarify relationships within the family.

Advances in Paleoecology: Geochemistry, Microwear and Beyond, Sunday 11:45

APPROACHING TRUE DIVERSITY IN FOSSIL COMMUNITIES USING A COMBINATION OF RAREFACTION METHODS AND THE PIE EVENNESS INDEX

CHEW, Amy, Western University of Health Sciences, Pomona, CA, USA

Ecological diversity consists of two inter-related components: richness (number of species) and evenness (species abundances). Richness is usually interpolated by rarefaction, which plots cumulative species richness as a function of number of individuals (individual-based) or average number of individuals per sample (sample-based). Evenness may be quantified by the Probability of Interspecific Encounter index (PIE). Richness tracks evenness: sample richness is higher in communities with high evenness and vice versa. I use both methods of rarefaction and PIE to test the long-term relationship between climate and the diversity of the early Eocene mammal fauna of the central Bighorn Basin, WY. Individual-based rarefaction provides a null richness hypothesis given a random distribution of species. Sample-based rarefaction richness estimates reflect non-randomness in species distributions. PIE indicates whether changes in richness are related to changes in community structure. More than 33,000 specimens from 161 species were grouped into 17 ~100Kyr intervals. Six of the intervals were during a cool period and the remaining intervals were during a subsequent warm period (5-8°C warmer mean annual temperature) divided into early (6 intervals) and late (5 intervals). Individual-based rarefaction interpolated significantly higher richness during the early warm period (80 s, where r=#species/3500 specimens) than during the cool warm periods (65 s), whereas there were no significant changes in sample-based rarefaction estimates (64, 66, and 59 s for cool, early warm and late warm, respectively). The difference between the estimates for the early warm period appears to be related to an under-estimation bias in sample-based rarefaction with the increasing size of individual samples. PIE indicates that the late warm period had low evenness compared with the cool and warm warm periods. However, this shift was only reflected in the sample-based rarefaction curves. These results suggest that 1) individual-based rarefaction is a better richness estimator in most situations; 2) sample-based rarefraction and PIE add important information to the interpretation of diversity.

Poster Session IV, (Wednesday)

THE EARLIEST MICENOcene ROGENT FAUNA OF PAMPA CASTILLO, CHILE

CHICK, Jennifer, Case Western Reserve University, Cleveland, OH, USA; CROFT, Darin, Case Western Reserve University, Cleveland, OH, USA; DODSON, Holly, Sierra College, Rocklin, CA, USA; FLYNN, John, American Museum of Natural History, New York, NY, USA; WYSS, Andre, University of California at Santa Barbara, Santa Barbara, CA, USA

The early Miocene (Sanctacrucian) fauna of Pampa Castillo, Chile is a rich assemblage of 35 mammal species. Of these, the most abundant is a dasyproctid rodent, *Neoreomys australis*, which accounts for more than half of identified specimens. This rodent’s hypsodont cheek teeth make identification challenging, since tooth dimensions and occlusal morphology...
change drastically with wear. This large sample of *N. australis* permitted a detailed wear study, the goal of which was to describe morphological differences in occlusal structures that occur due to wear. We used both intact cheek teeth as well as transverse tooth sections. Up to seven wear stages were identified per tooth position, although some incongruence was evi-
dent between sectioned and intact teeth of the same position. This may be due to limitations of tooth sectioning in mimicking natural wear patterns, or individual variation. Regardless, this study clarified expectations of how morphometry changes with wear in this species and better defined the range of variation for *N. australis*.

A second objective of this study was to refine previously published descriptions of the other rodents of the fauna. Two species of *Pertymys* are abundant; also present is *Prolagostomus*, two genera of eocardids (*Eocardia* and *Luantus*), *Eosteirynmys* (*Erethizontidae*), the echimy-
ids *Stichomys*, *Spaniomys*, and *Acrecimys*, and the ocolodontid *Scamiys*. Three species known previously only from the Pinturas Fm. of Argentina also were identified: *Luantus propheticus*, *Scleromys quadrangularis*, and *Prostichomys bowei*. The presence of these species only in the lower middle sequence (‘Pinturan association’) of the Pinturas Fm. suggests that Pampa Castillo may better correlate with these levels than typical Santacrucian faunas; however, like typical Santacrucian faunas, *N. australis* and chinchillids are abundant at Pampa Castillo. Additional study is needed to clarify the relative roles of habitat, geogra-
phy, and time in determining these patterns of species distributions and abundances.

**Technical Session I, Sunday 10:15**

### THE BONE MICROSTRUCTURE OF THE POLAR HADROSAURS FROM THE NORTH SLOPE OF ALASKA

**CHINASAMY-TURAN**, Amusuya, University of Cape Town, Cape Town, South Africa;
**TUMARKIN-DERATZIAN**, Allison, Temple University, Philadelphia, PA, USA; **DIMITROV**, Daniel, University of Cape Town, Cape Town, South Africa; **FIORILLO**, Anthony, Dallas Museum of Natural History, Dallas, TX, USA

The polar regions of the world today experience dramatic annual changes in temperatures and light. Thus, one of the most pertinent questions with regard to dinosaurs recovered from high latitudinal deposits is how they survived in the polar regions of the Mesozoic. One of the richest high latitudinal dinosaur-bearing deposits is that of the Upper Cretaceous Prince Creek Formation of the North Slope of Alaska. Palaeoenvironmental analyses suggest that the environment at the time was dominated by a coniferous forest and the mean temperature is estimated to range from 2 to 4 °Celsius for the coldest monthly mean to 10 to 12 °Celsius for the warmest monthly mean. The Prince Creek Formation localities in the North Slope of Alaska has yielded skeletal and track assemblages of a wide array of nonavian dinosaurs, including large- and small-bodied theropods, ceratopians, pachycephalosaurs, hypsilophodontids, and hadrosaurs. The most abundant of these faunal remains are hadrosaurs of the genus cf. *Edmontosaurus*, which are represented by thousands of specimens.

Size dimensions of various long bones (e.g., femora, humeri, tibiae, fibulae) of the Alaskan specimens cf. *Edmontosaurus* suggests different growth stages among the individuals recovered, with the majority representative of juveniles. Different sized long bones were sampled for histological analysis. The bone microstructure revealed a well preserved bone tissue. The compacta of the bone wall is inundated with a large number of channels that suggest that the bone was well “vascularized” and was formed relatively quickly. Several of the young individuals show evidence of cycles of growth, and one large individual records eight cycles of growth. These growth cycles are unique in that the bone tissue within the alternating cycles both suggest rapid rates of bone deposition i.e. the tissues in both “cycles” are of the fibro-lamellar type, and differ only in terms of channel orientation. Details of the unusual bone microstructure of these high latitudinal hadrosaurs will be presented, and their possible lifestyle adaptations to living in the high latitudinal environment of the Alaskan North Slope will be discussed.

**Technical Session XVII, Wednesday 3:15**

### ANALYSIS OF HOMOLOGY IN SERIALLY REPETITIVE MORPHOLOGICAL STRUCTURES: THE THEROPOD DIGIT PROBLEM

**CHOINIERE**, Jonah, George Washington University, Washington, DC, USA; **DIETRICH**, Dimitur, University of Copenhagen, Copenhagen, Denmark; **ANTON-FERNANDEZ**, Clara, Virginia Tech, Blacksburg, VA, USA; **XING**, Xu, Key Laboratory of Evolutionary Systematics of Vertebrates, Beijing, China; **CLARK**, James, George Washington University, Washington, DC, USA; **DIMITROV**, Dimitur, University of Copenhagen, Copenhagen, Denmark; **ANTON-FERNANDEZ**, Clara, Virginia Tech, Blacksburg, VA, USA; **XING**, Xu, Key Laboratory of Evolutionary Systematics of Vertebrates, Beijing, China; **CLARK**, James, George Washington University, Washington, DC, USA

The theropod digit problem has been the subject of considerable debate and has been particularly well studied. Developmental studies indicate that the digits of birds are in the 2-3-4 position, while morphological comparisions of theropod digits indicate the 5th and then 4th digits were lost. The developmental studies indicate that the digits of birds are in the 2-3-4 position, while morphological comparisons of theropod digits indicate the 5th and then 4th digits were lost. The frameshift hypothesis was sought to resolve this conflict by positing that the digits of tetanuran theropods underwent a homoeiotic change whereby morphology of the medial three digits of the ancestral theropod five-fingered manus were shifted laterally onto the positions of the second, third, and fourth digits in more derived theropods. The recent discovery of the Jurassic ceratosaur *Limusaurus*, with a vestigial digit I and enlarged digit II, prompted new debate on the “frameshift hypothesis”. Analyzing different scenarios for a shift in digital identity requires the evaluation of alternative sets of primary homology hypotheses for digital corres-
pondences across theropod taxa. These sets of primary homology hypotheses are analogous to different alignments produced from comparisons of homologous molecular sequences.

Unfortunately, current alignment software is not designed to evaluate morphological corre-
respondences. We devised new R scripts and coding strategies to utilize the phylogenetic software POY for analysis of morphological correspondences, and use this approach to test the position of the shift in digital position on the theropod tree. The results demonstrate input parameters such as gap costs and transformation costs have a large effect on the most parsimonious position for the shift in digital correspondence. Additionally, the inclusion of developmental data from extant theropods (i.e. Gallus) influences the position of the shift.

**Technical Session VI, Monday 2:45**

### CONVERGENT MICROWEAR PATTERNS IN EXTANT METAHERIAN AND EUTHERIAN HERBIVORES: A PROXY FOR THE ANALYSIS OF MAMMALIAN DIET IN THE LATEST CRETAEOUS AND EARLY PALEOCENE

**CHRISTENSEN**, Hilary, The University of Chicago, Chicago, IL, USA

As a prerequisite to direct comparison of the metaherian and eutherian mammals that cohab-
ted during the time period encompassing the K/T boundary, the degree to which compatibil-
ity of tooth wear in extant Australian marsupial and worldwide placental herbivores has been assessed. The aim of this study was to determine whether the microwear patterns recorded on their molars are indeed the same among animals of the same dietary niche, or whether the large difference in jaw architecture and chewing strokes between modern metatherians and eu-
therians has an effect on the signal—whether function or phylogeny determines microwear patterns.

Low-magnification microwear analysis has so far been shown to be effective in differen-
tiating between grazers, browsers, and hard-object herbivores in extant ungulates, lemans, notoungulates, xenarthrans, scirids, and macropod marsupials. The present study includes members of the above with the addition of selected rodents and members of the Australi-
delphia superorder (in addition to the Macroopodidae). Because the aim of the study was to examine the degree to which members of the same feeding guild have similar microwear patterns, species were chosen based on their being relatively specialized feeders belonging to grazing, browsing, and hard-object feeding niches; mixed feeders were excluded. No statisti-
cal difference between marsupial and placentals occupying the same feeding niche was found, providing strong evidence for functional convergence in these two groups. These results support the use of microwear as a dietary proxy across the metaherian and eutherian mammals in the fossil record.

**Poster Session II, Monday**

### PRELIMINARY RESULTS OF A COMPREHENSIVE MORPHOLOGICAL PHYLLOGENY OF THE PINNIPEDIA (MAMMALIA: CARNIVORA)

**CHURCHILL**, Morgan, University of Wyoming, Laramie, WY, USA; **BOESSENECKER**, Robert, Montana State University, Bozeman, MT, USA; **CLEMENTZ**, Mark, University of Wyoming, Laramie, WY, USA

Pinnipeds (seals, sea lions, and walruses) are the second most diverse clade of marine mammals alive today (~36 species). Although knowledge of pinniped evolution has grown in recent decades, uncertainty still exists in the relationships of the three extant (Phocidae, Otariidae, and Odobenidae) and two extinct families (paraphyletic, early diverging “enaliarch-
idae”, Miocene Desmatophocidae) to one another, as well as relationships within Otariidae. Molecular phylogenies support a sister group relationship between Odobenidae and Otarii-
dae, and paraphyly of the sea lions (Otariinae). Morphology based studies in contrast have supported walruses as being either close to Phocidae, or to Otariidae, as well as monophyly of sea lions. Many of these studies relied on small character sets, limited taxon sampling, and non-cladistic methodology. A further, more comprehensive examination of Pinnipedia is thus needed, in order to reconcile morphological and molecular analyses, as well as to allow more accurate interpretation of changes in pinniped ecology through time. We here report the preliminary results of a morphological study employing 51 taxa and 278 characters focused on examining the internal relationships within the Pinnipedia, which represents the largest study to date. Results so far find strong support for monophyly of Otariidae, Phocidae, and Odobenidae, as well as a *Pteronarctos* + Pinnipedia clade. A clade including *Pinnarctodon*, Desmatophocidae, Odobenidae, and Phocidae is recovered with-
out strong support, and relationships within the clade are poorly resolved. A monophyletic *Odobenidae*, however, with large differences between the two extant genera *Arctocephalus* was found to be non-monophyletic. Further work will focus on continued revision of characters, addition of taxa and characters, and incorporation of molecular data to produce a total evo-
dence phylogeny of the Pinnipedia.

**Preparers’ Session, Monday 11:45**

### RACING AGAINST DISASTER: THE DEMOLITION, REHABILITATION AND RECONSTRUCTION OF THE QUARRY VISITOR CENTER, CARNegie QUARRY, Dinosaur National Monument

**CHURE**, Daniel, Dinosaur National Monument, Jensen, UT, USA

In August 1909, Earl Douglass, of the Carnegie Museum, discovered eight *Apatosaurus* carcases in a sandstone layer of the Montana Morrison near Jensen, UT. This site, known as the Carnegie Quarry (CQ), proved to be one of the largest Jurassic dinosaur quarries ever found. Many taxa exhibited in the Carnegie Jurassic Hall are from the CQ (Apatosaurus, Diplodocus, Camarasaurus, Stegosaurus, Dryosaurus, Camptosaurus, Mar-
shosauros, Hoplosuchus, Glyptodon). Between 1909 and 1924, excavations by the Carnegie

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the skate tree also supports the evolutionary split of skates from guitarfish relatives in the
neously in a cladistic analysis. The well-supported placement of †
of new evidence that supports the hypothesis that †
a sinuous articulation between the pectoral girdle and vertebral column. These traits among
stantial amount of skeletal autapomorphies including a radially symmetric anterior disc and
members of the crown group, such as a pelvic metapterygial cartilage with naked proximo-
‡ Cyclobatis
is an extinct batoid known from the Cretaceous of Lebanon. It possesses a sub-
rapy, as the sister taxon to a clade formed by the extant
† Torosaurus
is the only chasmosaurine with a P0 midline epiparietal,
‡ Chasmosaurus irvinensis
of movement. In birds, the position of the parapophysis remains ventral to the diapophysis,
for instance locomotion or aspiration breathing. Thoracic kinematics is com-
plicated by the movement between diaphragm muscles and multiple
† Triceratops
is the only chasmosaurine with a P0 midline epiparietal,
‡ Triceratops
and end-Cretaceous mass extinctions. While chondrichthyan diversity decreased slightly
after the Permo-Triassic extinction, morphological diversity was little altered, with many
Paleozoic forms surviving well into the Early Mesozoic. Conversely, relatively rapid chang-
es in tooth morphology occurred after the terminal Cretaceous event. In order to determine
the pattern and processes of the Chondrichthyan response to both extinctions events, two
of analyses were performed. The first analysis focused on the pattern of extinction and
recovery, by examining extinction and origination rates, and standing diversity at the family
and genus taxonomic level, for both the geological epoch and geologic stage-increments. Be-
cause of the general lack of preservation of the cartilaginous elements composing the chon-
drichthyan skeleton, the study focused on fossil dentition, with a concentration on familial
and generic taxonomic ranks due to intraspecies variation of tooth morphology. All data and
faunal lists were acquired through an analysis of the literature. The second component of
this project was to determine how tooth morphology, and hence, nutritional guilds changed
after the extinction events and through the subsequent recovery and diversification. This was
accomplished by examining chondrichthyan teeth from 20 well documented localities world-
wide, that spanned the Devonian – Neogene periods. Once obtained, teeth were assigned
to distinct morphological categories. In order to compare tooth types and numbers at each
locality, the data was statistically analyzed using the Monte Carlo method of bootstrapping.
The preliminary results from this study indicate that the number of tooth types increased
after the Paleozoic Era and that novel morphologies enabled chondrichthyans to inhabit
new ecological niches after the end-Paleozoic extinction. Additionally, chondrichthyan feeding
niches became more specialized after the End-Cretaceous extinction. Thus, it is possible that
new tooth types may be responsible for greater diversity among chondrichthyan throughout
the post-Paleozoic Era.

Museum, US National Museum, and University of Utah, recovered the remains of 500+
individuals, primarily dinosaurs. In 1915 Dinosaur National Monument was established to
protect the QV. In 1957-1958 the Quarry Visitor Center (QVC) was built and enclosed the
unexcavated part of the QV. Since then, 1500+ bones have been exposed and are preserved
in-situ as a public exhibit. Unfortunately, the QVC was built on hydroelectric bentiamic head-
stones and has been plagued by stability issues since its opening. Among these problems are
heaving of the building, extensive cracking of exterior and interior walls, bulging walls,
severely tilting floors, rhombohedral doorframes, huge glass walls hanging only by their
welds, popping windows, floors pulled away from their joists, bowed vertical steel beams,
and extensive replacement, and reconstruction of building components will be done to stabilize the QVC. The major challenge is how to do
this work without damaging the in-situ exhibit of bones. This will involve building a sub-
structure within the QVC that will enclose and isolate the fossil resource from construction
activities. It is expected that the refurbished QVC, with extensive new fossil exhibits, will be
reopened to the public and scientific community in the Fall of 2011.

Technical Session XV, Wednesday 9:30
ANALYSIS OF CHONDRICTHIAN FAMILIAL AND GENERIC RICHNESS,
DIVERSIFICATION OF DENTAL MORPHOLOGIES, AND ECOSPACE
DIVERSITY ACROSS THE PERMIAN-TRIASSIC AND CRETACEOUS-
PALEOGENE BOUNDARIES
CIAMPAGLIO, Charles, Wright State University, Dayton, OH, USA; CLAYTON, Angela,
Wright State University, Dayton, OH, USA
Chondrichthyan were one of the key taxonomic groups that survived both the end-Permian
and end-Cretaceous mass extinctions. While chondrichthyan diversity decreased slightly
after the Permo-Triassic extinction, morphological diversity was little altered, with many
Paleozoic forms surviving well into the Early Mesozoic. Conversely, relatively rapid chang-
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niches became more specialized after the End-Cretaceous extinction. Thus, it is possible that
new tooth types may be responsible for greater diversity among chondrichthyan throughout
the post-Paleozoic Era.

Technical Session XV, Wednesday 9:45
THE FIRST PHYLOGENY OF RAJIDAE TO INCLUDE EXTINCT AND EXTANT
TAXA SIMULTANEOUSLY
CLAESON, Kerin, The University of Texas, Austin, TX, USA
†Cyclobatis is an extinct batoid known from the Cretaceous of Lebanon. It possesses a sub-
stantial amount of skeletal autapomorphies including a radially symmetric anterior disc and
a sinuous articulation between the pectoral girdle and vertebral column. These traits among
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Poster Session II, (Monday)
A REEVALUATION OF EPIPARIETAL HOMOLOGY WITHIN CHASMOSAURINE
CERTATOPSIS (ORNITHISCHIA) BASED ON NEWLY DISCOVERED TAXA
CLAYTON, Katherine, University of Utah, Salt Lake City, UT, USA; LOEWEN, Mark,
Utah Museum of Natural History, Salt Lake City, UT, USA; FARKE, Andrew, 2Raymond
M. Alf Museum of Paleontology, Claremont, CA, USA; SAMPSON, Scott, Utah Museum of
Natural History, Salt Lake City, UT, USA
Unique combinations of hooks, spikes, horns, and other processes ornamenting the parieto-
squamosal flail of ceratopsian dinosaurs are often used to diagnose species and distinguish
Evolutionary Relationships. These frill ornamentations develop from accessory ossifications
along the margins of the squamosal and parietal (episquamopals and epiparietals, respecti-
ves). Although both chasmosaurine and centrosaurine ceratopsians have episquamosal ossifica-
s, we suggest that it is presently impossible to homologize ossification positions between the
do other taxa due to the lack of basal taxa for both. Thus, we propose a unique classification
of parietosquamosal ossification follows epistrapals numbered sequentially from the
midline (P1-Pn), with a midline process (when present) designated as P0. An epiparietals are
for instance locomotion or aspiration breathing. Thoracic kinematics is com-
plexified by the movement between diaphragm muscles and multiple
† Torosaurus
is the only chasmosaurine with a P0 midline epiparietal,
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of movement. In birds, the position of the parapophysis remains ventral to the diapophysis,
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binding of antibodies against proteins associated with extant blood vessels, and sequences obtained by high-resolution, bottom up (i.e., digestion with trypsin) proteomic techniques support the preservation of original molecules consistent with extant vessel proteins. Furthermore, analytical transmission electron microscopy performed on vessels sectioned to 90 nm showed an intimate association between vessel walls and iron bearing minerals. We hypothesize that this iron-organic association provides a mechanism resulting in preservation.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 8:45

STABLE ISOTOPE EVIDENCE OF SEMIAQUATIC HABITS AND DIETARY NICHES DIFFERENCES FOR FOUR SYMPATRIC SPECIES OF ANTHRACOTHERII FROM WADI MOGHIRA, EARLY MIocene, EGYPT

CLEMENTZ, Mark, University of Wyoming, Laramie, WY, USA; MILLER, Ellen, Wake Forest University, Winston-Salem, NC, USA; EL-BARKOOGY, Ahmed, Cairo University, Cairo, Egypt; HAMDAN, Mohamed, Cairo University, Cairo, Egypt; GAWAD, Mohamed Adel, Cairo University, Cairo, Egypt

Wadi Moghira, Qattara Depression, Egypt, is an Early Miocene fossil locality that preserves a diverse array of mammals (ca. 27 species). Anthracotherii are especially abundant at this locality with at least four species identified so far (Brachydus depereti, Afromeryx africanus, Sivameryx monevi, and an unidentified species). This high diversity of anthracothertiids is unusual and suggests that the diet and habitat preferences of these species were sufficiently distinct as to reduce competition among them. These species may have accomplished this by adopting varying degrees of semiaquatic habits, which may have expanded the habitat range and dietary resources available to these species. Identification of semi-aquatic species in the fossil record has largely been based on the morphological similarities with present-day hippopotamids, but these morphological characters may not always be diagnostic of aquatic habits. Here, we examine the stable isotope composition of tooth enamel carbon (13C, 15C) and associated fauna (n = 30) sampled in order to reconstruct the ecological preferences of each as well as the paleoenvironmental conditions in which they lived. Using a linear regression developed from published hippo oxygen isotope data, the semi-aquatic habits for each species of anthracotherii were evaluated and then combined with dietary evidence from enamel 13C values. Enamal 13C values for most species of anthracotherii were consistent with semiaquatic habits, whereas one species (Afromeryx africanus) had higher values that were indistinguishable from those of terrestrial species in the fauna. No significant differences in enamel 13C values were detected among anthracotherii species, suggesting that habitat preferences may have been a more important means of ecological separation of species.

Technical Session VIII, Monday 4:00

A NEW DEVONIAN FISH LAGERSTÄTTE FROM NEW YORK STATE: TAPHONOMY, PALEOENVIRONMENT AND PALEODIVERSITY

CLOUTIER, Richard, Université du Québec à Rimouski, Rimouski, QB, Canada; POTVIN-LEDUC, Daniel, Université du Québec à Rimouski, Rimouski, QB, Canada; LANDING, Ed, New York State Museum, Albany, NY, USA; STEIN, William, Binghamton University, Binghamton, NY, USA; VANALLER HERRICK, Linda, New York State Museum, Albany, NY, USA

Since the mid-1800, numerous Devonian fish localities have been discovered in the north-eastern USA. Most localities primarily yield disarticulated remains of Late Devonian chondrichthyans and placoderms associated with the Devonian Catskill Delta complex of the central Alleghanian basin. New Givetian fish horizons in a quarry in the Catskill Mountains, New York State Museum, Albany, NY, USA; STEIN, William, Binghamton University, Binghamton, NY, USA; VANALLER HERRICK, Linda, New York State Museum, Albany, NY, USA

The richness of the new fossil Lagerstätte is higher than the average richness for Devonian fish localities worldwide.

Technical Session VIII, Monday 2:30

ABOUT THE EARS: ACANTHODES RE-EXAMINED AND GNATHOSTOME ORIGIN RE-ANALYZED

COATES, Michael, University of Chicago, Chicago, IL, USA; DAVIS, Samual, private individual, Stang Korven, France

Discoveries of Devonian and Silurian osteichthyans and chondrichthyans have focused attention on the base of the gnathostome crown, and the memberships of their respective stem groups. Acanthodes from the Lower Permian of Germany has been re-examined because conditions in this exceptionally well preserved taxon (relative to knowledge of other ‘acanthodians’) influence early gnathostome tree topologies. New silicone rubber peels expose existing reconstructions as incomplete and in need of considerable revision. Acanthodes skeletal anatomy is unexpectedly shark-like: the braincase roof has a central ridge and endolymphatic fossa; otic capsule and semicircular canal arrangements resemble those of Cladosoides; there is a prominent lateral otic ridge; the hyomandibula articulates with the otic capsule rear; the palatoquadrate articulates with the postorbital process; there is no passage through the otic capsule for the glossohyaline nerve. The combined presence of these features suggests that Acanthodes might, in fact, be a stem-chondrichthyan. However, the results of a new, large-scale phylogenetic analysis signal otherwise: Acanthodes branches from the base of the osteichthyan stem group. Furthermore, these data and this analysis deliver a new hypothesis of anatomical conditions close to the gnathostome crown-node. Cranial characters of early osteichthyan and chondrichthyan branches are re-polarized, and the new phylogeny provides further means for exploring ‘placoderm’ and ‘acanthodian’ paraphyly.

Of perhaps broader relevance, this study also highlights the reorganization of the gnathostome head after the origin of jaws but before the origin of the crown group. This provides a new phylogenetic framework for understanding the diversity of otic capsule related conditions across the basic divisions of all extant gnathostomes.

Poster Session II, (Monday)

MORPHOLOGICAL EXAMINATION OF AN ARTICULATED CARNIVORE ANKLE AND MID-FOOT USING VIRTUAL PREPARATION AND DISARTICULATION OF THE SPECIMEN

COLLINS, Kerri-Ann, Institute for Human Evolution; Bernard Price Institute, Johannesburg, South Africa; CARLSON, Kristian , Institute for Human Evolution, Johannesburg, South Africa; KUHN, Brian, Institute for Human Evolution, Johannesburg, South Africa; BERGER, Lee, Institute for Human Evolution, Johannesburg, South Africa

Malapa is a recently discovered Plio-Pleistocene hominin bearing site in the Cradle of Humankind, South Africa. In addition to its well-preserved, articulated and associated hominin fossils, it has produced numerous equally well-preserved, articulated fauna. Here we show the results of a morphological study of an articulated carnivore ankle and mid-foot discovered during preparation of one of the calcified elastic sediment blocks from the site. Using a combination of techniques, we provide a taxonomic assignment of the specimen as well as make some inference to body size and functional morphology. Instead of traditional mechanical or chemical preparation techniques, which might damage the intimately articulated joint surfaces, we use computed tomography scanning and commercial software (e.g., Avizo 6.1) to virtually deconstruct the specimen. After segmenting individual elements and producing 3D renderings of each, we used standard osteometric measurements as a basis for a traditional comparative morphological analysis. We tentatively assign the specimen to the genus Dinofelis, primarily based on morphological analyses and comparative analysis with existing southern African Dinofelis specimens. We also demonstrate that a virtual approach can be applied successfully in order to describe fossils and assign taxonomic affiliations. Achieving this allows us to study each bone and its association individually, without risking damage to this rare articulated specimen. An approach such as this is will be of certain use in future studies involving similar fossils where traditional preparation is not desirable.

Technical Session IV, Sunday 3:45

A FOSSIL JESUS LIZARD (SQUAMATA, CORYTHOPHANIDAE) FROM THE EOCENE OF NORTH AMERICA

CONRAD, Jack, Stony Brook University, Stony Brook, NY, USA; SIDOR, Christian, University of Washington, Seattle, WA, USA

Corythophanidae (basilisks/Jesus lizards and casquehead lizards) is a small clade of lizards from Central America and northern South America. Modern forms are notable for their cranial and axial crests and their ability to run across the surface of water. We describe the first North American corythophanid—a likely oldest member of the clade. The new specimen comes from the Bridger Formation (Eocene) of Wyoming and consists of an incomplete skull (lacking premaxilla, frontal, parietal, and supraoccipital) with articulated lower jaws and atlas-axis complex. An initial morphological phylogenetic analysis of 451 lepidosaur morphs coded for 701 characters, and a follow-up combined-evidence analysis of 42 plesuroidian iguanians, 424 morphological characters, and 1838 molecular characters demonstrate a sister-group relationship between Basiliscus and the new form (supported by nasal and sphenoid morphology). Our analysis recovers polyphyly of ‘mesourosaurines’ (e.g., Geiseltaliellus, Cadurciguana, Cypreasaurus, Holmantisaurus) and non-corythophanid status for Suzanniwana (supported by open Meckel’s canal, placement of the pinel foramen, and absence of a prefrontal-lacrimal groove). Geiseltaliellus (Eocene of Germany) and the new form are the only fossil squamates with demonstrable corythophanid affinity. The distribu-
tion of extant lizards conforms to the latitudinal diversity gradient commonly observed for many extant organisms, with observed diversity increasing toward the equator. Although the geologic antiquity of this pattern is poorly understood, the fossil record documents terrestrial animals that are currently confined to the tropics in the mid-to-high latitudes during warm periods in Earth history. The Eocene crocodylomorph record from the northern mid-latitudes during the early Eocene. Although Eocene crocodylomorphs are strictly tropical, they ranged much farther northward during the Eocene, supporting the hypothesis that the modern latitudinal diversity gradient is steepened by relatively recent range movements toward the tropics in response to climatic shifts.

Poster Session I, (Sunday)

ESTIMATED AGE AND SIZE OF THE LATE CRETACEOUS SHARK ARCHAEOLAMNA KOPINGENSI S

COOK, Todd, University of Alberta, Edmonton, AB, Canada; NEWBREY, Michael, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; MURRAY, Alison, University of Alberta, Edmonton, AB, Canada; WILSON, Mark, University of Alberta, Edmonton, AB, Canada; SHIMADA, Keshu, DePaul University, Chicago, IL, USA

Previous descriptions of the lamniform shark Archaeolamna kopingenensis consisted only of isolated teeth, but the exact dental pattern for the species remained controversial, and the adult size of the shark was not known. A partial skeleton of this species in the Natural History Museum of Los Angeles County was recovered from the Sharan Springs Formation of the Pierre Shale Group, early middle Campanian, of western Kansas. The fossil includes portions of the upper and lower jaws with articulated teeth, revealing a large section of the dental pattern of this species. Also recovered was a portion of the neurocranium as well as multiple vertebral centra. A sagittal section through a centrum shows that this adult shark had reached an estimated age of 18 years. Although an accurate estimation of total length of this specimen is not possible because the total number of vertebrae is unknown, the recovered upper jaw allows us to infer the approximate size of this shark. Using measurements obtained from the partially complete palaquadrate and comparing with jaw circumference values for modern lamniform sharks, we suggest this specimen had a jaw circumference larger than that of a 3.2 m Isurus oxyrinchus (shortfin mako) and a 3.5 m Isurus paucus (longfin mako). The largest tooth from the jaws of the specimen is approximately 83% the height of the largest tooth reported for this species, suggesting an even larger size was reached by some individuals.

Romer Prize Session, Monday 8:00

THE EVOLUTION AND DEVELOPMENT OF HYPERPHALANGY AND HYDROPOIDS IN CETACEANS

COOPER, Lisa, University of Illinois, Urbana, IL, USA

The evolution of aquatic cetaceans (whales, dolphins and porpoises) from a terrestrial ancestor involved dramatic changes to the standard mammalian limb during the Paleogene. Cetaceans are the only mammals in evolutionary history to increase the number of phalanges per finger (hyperphalangy). In dolphins, the standard number of three phalanges per finger form during early embryonic development, but this process persists into the fetal period until between nine and thirteen phalanges are generated in some digits. Developmental data indicate that dolphins continue synthesizing those proteins that allow for digit elongation (Fgf) and joint formation (Wnt) into the fetal period via a recapitulation of signaling, while other mammals terminate phalanx formation during the embryonic period. Like many marine mammals, cetaceans also encase the digits with a soft tissue flipper. Computed tomography and experimental data generated in a windtunnel showed that a cambered cetacean flipper is shaped like a hydrofoil and functions to generate lift and counteract body torque. Developmental evidence also showed that cetaceans recruit two proteins that typically function in digit and limb formation (Fgf, Gremlin) to act within the interdigital tissues and stop programmed cell death, thereby creating a soft-tissue flipper. Asymmetric signaling in the ectoderm and interdigital mesenchyme generated the cambered hydrofoil essential for aquatic locomotion. Molecular evidence shows dolphins alter duration (heterochrony) and location (heterotopy) of proteins essential to mammalian limb development. Combined molecular and fossil evidence lays the foundation for pinpointing when in geological time these novel developmental patterns evolved, and that the appearance of a soft-tissue flipper may have been a necessary precursor to the origin of cetacean hyperphalangy.

Poster Session I, (Sunday)

FIRST RECORD OF A VALANGINIAN (EARLY CRETACEOUS) DINOSAUR ASSOCIATION FROM SOUTH AMERICA

CORIA, Rodolfo, CONICET-Museo Carmen Funes-IHPG, UNRN, Plaza Huiracul, Neuquén, Argentina; CURRIE, Philip, University of Alberta, Edmonton, Alberta, Canada; KÖPPHELUS, Eva, University of Alberta, Edmonton, Alberta, Canada; BRAUN, Andreas, Gondwana - Das Prachtistorium, Schifflweier, Saarland, Germany; CERDA, Ignacio, CONICET-Museo Paleontologia UNCOMA, Neuquén, Neuquén, Argentina

A new and varied dinosaur association, represented by ornithopod, theropod and sauropod remains, has been discovered in the coarse, terrestrial sandstones of the Mulichino Formation (Upper Valanginian, Early Cretaceous) exposed in Neuquén Province, Patagonia, Argentina. All skeletal remains come from a single stratum with sedimentologic characteristics that suggest it represents a catastrophic alluvial event. Two semi-articulated skeletons already-have been collected, and several more have been located for future collection. Some of the fossils have been heavily weathered by dissolution action of plant roots. However, in certain areas, the fossil remains are well preserved in hard, cemented, concretionary sandstones. Associated fossil plants include conifers and ferns. This new locality brings information about a key moment in the evolution of the Cretaceous dinosaur faunas of Patagonia. Despite information from the terminal levels of the Jurassic and the rich dinosaur assemblages identified in different levels of the post-Hauterivian Cretaceous, the diversity of Valanginian dinosaurs was completely unknown in South America, and is scarce worldwide. Certain anatomical features of the collected specimens suggest abelisaur affinities in the theropods, advanced hadrosauroid conditions in the ornithopods, and basal titanosauriform characters for the sauropods. So far, none of the identified species is particularly large, in comparison with the giant theropods and sauropods that subsequently dominated this region. Although preliminary taxonomic identification of both theropods and sauropods matches with what could be expected, the presence of an hadrosauroid ornithopod more advanced than those recorded in younger levels, encourage revisiting the phylogeny of this clade as well as reviewing current hypothesis about their paleogeography.

Poster Session III, (Tuesday)

FIRST DROMAEOSAUR TRACKWAYS FROM NORTH AMERICA: NEW EVIDENCE FROM A LARGE SITE IN THE CEDAR MOUNTAIN FORMATION (EARLY CRETACEOUS), EASTERN UTAH

COWAN, John, Moab Institute for Mesozioc Studies, Moab, UT, USA; LOCKLEY, Martin, University of Colorado Denver, Denver, CO, USA; GIERLINSKI, Gerard, Polish Geological Institute, Warsaw, Poland

Although six small dinosaur tracksites have been reported from the Cedar Mountain Formation, most reveal very little useful information. The newly discovered site reported herein, is much larger than any previously reported, covering an area of several acres, already partly excavated or under very thin overburden. Most tracks are exceptionally-well preserved, and indicate a diverse dinosaur-dominated fauna representing at least three theropod, one sauropod and two ornithischian trackmakers. Additional traces are tentatively attributable to crocodilians. These well-preserved footprints occur in clear, recognizable trackways including two distinctive tridactyl theropod morphotypes (cf. Dromaeosaurus, and a new ichnotaxon indicating a short metatarsal IV). A distinctive didactyl dromaeosaurid trackway (cf. Dromaeopus) is the first reported from North America. The site also reveals well preserved manus-only sauropod trackways which show a prominent postero-lateral trace in the presumed position of digit V. This morphology may also indicate a new ichnotaxon. Ornithopod trackways indicate an iguanodon-size trackmaker, and Apollosaurus-like trackways suggest an ankylosaurian trackmaker. Enigmatic traces tentatively attributed to swimming vertebrates, probably crocodilians, include presumed manus, pes and body or tail traces. The paleoenvironment indicates a pond, or small lake setting, with undulating, irregular topography. Most trackways indicate walking progression on an emergent but wet (or very shallow, subaqueous) substrate. Manus only sauropod trackways, probably represent penetration of footprints from a higher layer, not swimming. However, probable crocodile traces and a high incidence of enigmatic ‘slide’ marks could indicate vertebrate activity in shallow water, or in a slurry-like medium overlying the main track bearing surface.

Poster Session I, (Sunday)

VERTEBRATE FAUNAL ANALYSIS OF THE LATE CRETACEOUS BLACK CREEK GROUP, BLADEX COUNTY, NORTH CAROLINA

CRANE, Cynthia, East Carolina University, Greenville, NC, USA; RIGSBY, Catherine, East Carolina University, Greenville, NC, USA; CULVER, Stephen, East Carolina University, Greenville, NC, USA; ROUSSELL, Dale, North Carolina State Museum of Natural Sciences and Department of Marine, Earth, and Atmospheric Sciences, North Carolina State University, Raleigh, NC, USA

Research on the late Cretaceous (Campanian) vertebrate fauna of the Black Creek Group in North Carolina has a long but sporadic history. A local- and regional-scale understanding of this fauna can be derived from a new vertebrate site near Elizabethtown, Bladen County, North Carolina. Bulk sampling was conducted at this locality and a faunal analysis was performed. Specimens were identified to the family and, where possible, to the genus level. This new site has produced a wealth of Campanian vertebrate fossils that reveals new taxonomic, paleoecologic, and biogeographic information about the Black Creek Group. The Elizabethtown fauna is dominated, in order of decreasing abundance, by chondrichthysans, chelonians, crocodylians, and osteichthyans; it also contains dinosauarid, squamate, and amphibian material. The Elizabethtown fauna is similar in taxonomic composition to vertebrate faunas from other Campanian age localities such as the Black Creek Group at Phoebus Landing, North Carolina, the Aguja Formation in Big Bend, Texas and the Marshalltown Formation of New Jersey.
The evolutionary relationships of lungfish have long been a subject of debate. To provide more data for use in phylogenetic analyses, I developed a comparative atlas to document the morphology of extant lungfish. Here, I extended the scope of my atlas to incorporate an extinct taxon, *Tranodis castrensis*. *Tranodis* is an Upper Mississippian lungfish that is known from the Buffalo Wallow Formation in Hancock County, Kentucky, and is the oldest lungfish taxon known in which specimens were found preserved inside their burrows. *Tranodis* is represented at other sites from pectoral elements and skull roofing material; however, many elements are still unknown, and the intracranial anatomy is unstudied. I scanned Cincinnati Museum Center (CMC) specimen 82/97 using High Resolution X-Ray Computed Tomography (HRXCT). The HRXCT scan has a total of 1,125 slices and a 0.0836 slice thickness and interslice spacing. This skull previously was mechanically prepared, leaving many of the skull roof and orbital bones visible. The operculum, pterygoid and prearticular tooth plates, vomerine teeth, and remaining mandibular elements were also exposed. Many elements, however, are only partially visible from the exterior of the fossil. In order to study the bones embedded in matrices, I isolated each recognizable skull bone and digitalized the skull. This method of preparation eliminated the uncertainty of additional manual preparation, and left the specimens intact for future study. I examined the articulations of the pterygoids and prearticulars within the skull as well as the inner surfaces of the skull roof bones. Previously unknown elements that I examine include the ceratohyal and cranial rib. The ceratohyal has a similar morphology to those of the Permo-Carboniferous lungfish *Sagenodus* but possesses a distinct notch in the posterior margin. The cranial rib is more uniform in thickness than in other taxa and flares less at either end. By studying elements of *Tranodis* that were digitally prepared with HRXCT data, I added valuable morphological data to a growing comparative atlas of lungfish skeletal anatomy that I used to elucidate relationships of extant lungfish.

Technical Session XIII, Tuesday 1:45
MORPHOLOGICAL DIVERSITY IN EXTINCT SOUTH AMERICAN SPARASSODONTS (MAMMALIA: METATHERIA)
CROFT, Darin, Case Western Reserve University, Cleveland, OH, USA; DOLGUSHINA, Tatiana, Case Western Reserve University, Cleveland, OH, USA; WESLEY-HUNT, Gina, Montgomery College, Rockville, MD, USA

The distinctiveness of South America’s Tertiary mammal communities has been recognized for well over a century. Not only was the plant-eating guild filled exclusively by endemic groups for most of this interval, so too was the meat-eating one; a clade of metatherians known as sparassodonts (borhyaenoids) were the primary carnivores. Despite their lock on the mammalian predatory niche for 50+ million years, sparassodonts apparently never were as successful as members of the Carnivora on other continents in terms of number of species (taxonomic diversity) or abundance (commonness in the fossil record). Proposed explanations for the lack of carnivorous diversity with crocodilians and/or large, terrestrial, carnivorous birds (phorusrhacids, also known as terror birds), and developmental constraints on metatherian dentitions. To test these explanations, we compared morphological diversity of South American sparassodonts to North American carnivornans and creodonts over the same interval, based on a data set of estimated body masses plus 16 discrete, taxon-independent characters (phorusrhacids, also known as terror birds), and developmental constraints on metatherian dentitions. To test these explanations, we compared morphological diversity of South American sparassodonts to North American carnivornans and creodonts over the same interval, based on a data set of estimated body masses plus 16 discrete, taxon-independent characters summarizing functional aspects of the dentition. We included all currently recognized Eocene (Ibabaroin South American land mammal ‘Age’) and younger sparassodonts. Taxa were coded primarily based on the literature. Morphological diversity was assessed using: (1) mean pairwise dissimilarity between species, and (2) volume of occupied morphospace. We predicted that: (1) sparassodonts would be less disparate morphologically than carnivores if constraint were a significant factor; and (2) sparassodonts would mostly plot outside of hypercarnivore morphospace if competition with non-mammalian meat-eaters (generally assumed to be hypercarnivores) were a significant factor. Our results support the constraint hypothesis and do not support the competition hypothesis. Assuming our taxon-independent characters apply as well to sparassodonts as to carnivorans and creodonts, these results suggest that habitat may have been a more important factor in dietary partitioning among Tertiary South American meat-eaters than diversity of food resources and/or percentage of meat in the diet.

Romer Prize Session, Monday 8:15
COMPETITIVE RELEASE OR ECOLOGICAL RETREAT: ECOLOGICAL RAMIFICATIONS OF EXTINCTION AND HABITAT TRANSFORMATION FOR MADAGASCAR’S LEMURS
CROWLEY, Brooke, University of Toronto, Toronto, ON, Canada

Lemurs and Asian dromaeosaurs from the Maastrichtian of the Transylvanian Basin, Romania
CSIRK, Zoltan, Department of Geography and Paleontology, University of Bucharest, Bucharest, Romania; BRUSATTE, Stephen, American Museum of Natural History, New York, NY, USA; VREMIR, Matyas, Transylvanian Museum Society, Cluj-Napoca, Romania; NORELL, Mark, American Museum of Natural History, New York, NY, USA

Islands faunas are frequently characterized by highly unusual taxa, which are often endemic, relictual, and/or substantially larger or smaller than mainland relatives (the ‘island rule’). The fossil assemblage of the Maastrichtian ‘Hateg Island’ (Romania) has long been considered an abnormal island fauna, based on the occurrence of basal turtles and cimolodontan multituberculates, the presence of dwarfed and basal dinosaurs, and high overall endemism. However, little is known about the predatory dinosaurs that inhabited this island, and it is unclear whether theropods were also affected by the island rule. We describe an articulated partial skeleton representing a new dromaeosaurid from the uppermost Cretaceous deposits of the Transylvanian Basin, which allows, for the first time, a detailed understanding of the anatomy and phylogenetic relationships of an island-dwelling theropod. The new taxon is highly autapomorphic and characterized by over 20 peculiar morphological traits, including extensive fusion in the manus and hindlimb, a shortened distal hindlimb, a stocky pelvis with increased femoral extensor muscle insertions, and a modified foot with two hyperextension claws, as the result of an enlarged, fully functional first digit. Phylogenetic analysis places the new taxon as a derived velociraptorine dromaeosaurid, closely related to contemporary Laurussian taxa such as *Velociraptor*, its sister taxon. Sauropod and ornithopod dinosaurs from the Hateg Island, on the contrary, usually occupy basal positions within their respective clades, and their closest relatives are often considerably older taxa. The close relationship between the new taxon and Asian dromaeosaurs suggests that faunal interchange between Asia and the European islands persisted late into the Cretaceous, contrary to previous suggestions of marked isolation of the European faunas. Finally, as shown by slightly larger referred specimens from the Hateg Basin, the new taxon is approximately the same size as its closest relatives. In sum, the new taxon indicates that some island-dwelling dinosauromorph predators were morphologically aberrant, but not dwarfed, primitive, or geographically endemic.
Technical Session XVI, Wednesday 3:00

NON-DIETARY ABRASIVES AND THE DENTAL EVOLUTION OF PLIO-PLEISTOCENE SUIDAE (ARTIODACTyla: MAMMALIA)

CUDDAHE, Rebecca, Duke University, Durham, NC, USA; MADDEN, Richard, Duke University, Durham, NC, USA; CHURCHILL, Steven, Duke University, Durham, NC, USA; BOBE, Rene, University of Georgia, Athens, GA, USA

Hypotheses concerning morphological differences in the dentitions of suid genera, as well as other ungulates, usually invoke differences in either dietary composition or the quality and properties of food. Our work on living herbivores suggests that non-dietary abrasives from ingested exogenous grit play an important role in excess tooth wear and thereby constitute a potential selective agent in the evolution of tooth morphology. We suggest that to prolong the functional longevity of teeth subject to excess tooth wear, suids responded in several ways including the evolution of hypsodonty and increasing the crown area of molar teeth. We hypothesize that: (1) if non-dietary mineral grit selects for the structural properties of teeth, they will become better resistant to wear, and if a larger worn tooth surface by which suids resist tooth wear, then the marine record of the changing intensity of soil erosion should correlate with a change in the rate of the evolution of molar tooth size and (2) non-dietary abrasives in the form of mineral grit directly influence the evolution of enamel volume on tooth crowns. From the literature, we collected M. tooth size measures (n = 545) from Plio-Pleistocene suid genera (Nyanzaeochoreus, Notochoerous, Meridiochoerus, and Kolpochoerus) and aeolian dust data from the Arabian sea floor. Using time series analysis, we compare plots of M. area with aeolian dust by constructing smoothing spline fits at various lambda values. We find temporal coincidence between accelerations of evolutionary rates in suid M. crown area and peaks in the export of aeolian dust to the Arabian sea floor. Results of this study demonstrate that non-dietary abrasives may have played a significant role as a directional selective agent in the dental evolution of Plio-Pleistocene suids.

Poster Session IV, (Wednesday)

TITANOSAUR OSTEODERM ONTOGENY, ANATOMY AND FUNCTION:
NEW DATA FROM RAPETOSAURUS KRAUSEI (MAEVARANO FORMATION, MADAGASCAR)

CURRY ROGERS, Kristina, Macalester College, St. Paul, MN, USA; D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA; CAGAN, Amanda, Macalester College, St. Paul, MN, USA

At least 10 species of titanosaur sauropods are known to have possessed osteoderms. Because titanosaur osteoderms are typically recovered in isolation and dissociated, their anatomy and functional/phylogenetic significance remains unresolved. Here we report on two osteoderms that occur with associated and articulated skeletons of Rapetosaurus krausei, a titanosaur from the Upper Cretaceous Maevarano Formation of Madagascar. The specimens are significant because they allow referral of two osteoderm morphotypes to R. krausei and because they provide insight on the ontogeny, anatomy, and potential functions of titanosaur osteoderms. Two distinctive bonebeds preserve the remains of R. krausei and its associated osteoderms. The first preserves a single skeleton of an adult (femur length = 146 cm) that includes the most massive sauropod osteoderm yet discovered. It is ellipsoid, exhibits a characteristic bulb and root morphology, and measures 57 x 26.7 x 19.2 cm. In addition to interesting external textures (e.g., cross-hatched internal surface typical of other vertebrate osteoderms), it is also comprised of metaplastic bone. The second preserves an adult skeleton of R. krausei that exhibits no duplication of elements and some instances of articulation (e.g., foot, ribs, hindlimb, and forelimb in anatomical position), as well as direct association with an osteoderm. The osteoderm measures 14 x 9 x 8 cm, and is characterized by thin, disorganized bony spicules externally and cancellous bone with deep excavations for the transmission of vascular canals internally. Vascular canals in this specimen can be traced from internal surface to external surface via CT scans.

These specimens, particularly in light of the debris-flow depositional setting in the Maevarano Formation, indicate that Rapetosaurus likely possessed only a few osteoderms in its skin. Osteoderm morphology is related to anatomical location and/or ontogeny. Large osteoderms may result from the fusion of multiple, smaller dermal elements. External morphology, bone histological analysis and CT-scans help restrain possible functional interpretations for osteoderms in Rapetosaurus.


THE ROLE AND FUNCTION FOR CRANIAL SUTURES IN REPTILES: A FINITE ELEMENT ANALYSIS OF THE SKULL OF SPHENODON (DIAPSIDA: LEPIDOSAURIA: RHYNCHOCEPHALIA)

CURTIS, Neil, University of Hull, Hull, United Kingdom; JONES, Marc, UCL, University College London, London, United Kingdom; EVANS, Susan, UCL, University College London, London, United Kingdom; O’HIGGINS, Paul, University of York, York, United Kingdom; FAGAN, Michael, University of Hull, Hull, United Kingdom

The skull comprises numerous bones united by sutures, and although still a topic of discussion, it is generally thought that these bone joints allow the skull to grow. However, in many taxa cranial sutures remain open in adults, suggesting that they still play a role in skull function during feeding and other everyday activities. Strain gauging experiments can provide some information on the role of sutures, but this information is limited to select localised regions of the skull and direct measurement is not possible in extinct taxa. An alternative approach involves computational modelling in which deformations, stresses, and strains within the skull can be predicted. Here we perform such a study on the skull of the extant Sphenodon (Rhynchocephalia), where bite, joint, and muscle force data are derived from a multibody dynamics analysis and applied to a finite element model of the same skull. This extant taxon was chosen because the model can be validated using previously obtained muscle activity data, and because in some respects (no obvious kinesis, extensive quadrato-pterygoid overlap) the skull architecture is somewhat analogous to the plesiosauric condition for diapsid reptiles. Understanding the function of this relatively ‘rigid’ skull will provide a foundation onto which hypotheses relating to other, more kinetic skulls can be tested. Results show that localised, peak strains are reduced in some areas of the skull, possibly preventing bone damage under specific bites, but the strains predicted over multiple

Poster Session III, (Tuesday)

DESCRIPTION OF THE FIRST ORNITHOMIMID (DINOSAURIA) BONEBED FROM NORTH AMERICA WITH IMPLICATIONS FOR THE DISCRIMINATION, ONTOGENY AND BEHAVIOR OF ORNITHOMIMIDS

CULLEN, Thomas, Carleton University, Ottawa, ON, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; SCHRÖDER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada; KOBASHAYI, Yoshihugo, Hokkaido University, Hokkaido, Japan; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada

Bonebeds can provide important anatomical, taphonomic, and ontogenetic information about relatively poorly known taxa, and provide evidence for behavioral inferences. Such accumulations of large vertebrates are well-documented in the Late Cretaceous fossil record, but the tholnoporous bonebeds are rare, with less than 10 being known worldwide. Three partial postcrania from the Upper Cretaceous Horseshoe Canyon Formation of Alberta, Canada, represent the first known bonebed of ornithomimidines in North America, and only the third documented ornithomimid bonebed in the world, the others being found in China. The specimens were collected in 1926 from a partially eroded locality that may have once been larger and contained more individuals; it is now believed to have been completely eroded away. The three individuals recovered are in varying stages of completeness, with little material preserved anterior to the pelvic girdle (probably lost through erosion). All three specimens are morphologically similar, with one being 7% larger and close to the size of the largest ornithomimid recovered from the formation. Although no cranial or manual elements were preserved, the material probably represents either Struthiomimus or Ornithomimus; both genera have been recovered from the formation as skeletons with skulls, and individual elements, especially numerous pedal phalanges. The pes of two individuals are well preserved. Selected pedal elements from these and other ornithomimid taxa were used in a limited principle component analysis, but were not found to vary significantly between taxa, confirming that pedal phalanges have limited taxonomic utility for this group. Histological analyses from the fibulae and more proximal elements from these and other ornithomimid taxa were used in a limited principle component analysis, but were not found to vary significantly between taxa, confirming that pedal phalanges have limited taxonomic utility for this group.

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Several ways including the evolution of hypsodonty and increasing the crown area of molar teeth. The postcranial elements from these and other ornithomimid taxa were used in a limited principle component analysis, but were not found to vary significantly between taxa, confirming that pedal phalanges have limited taxonomic utility for this group. Histological analyses from the fibulae and more proximal elements from these and other ornithomimid taxa were used in a limited principle component analysis, but were not found to vary significantly between taxa, confirming that pedal phalanges have limited taxonomic utility for this group.
bites do not support the general rule that sutures reduce strain. Thus it appears that sutures do not reduce strains within the skull, as is often suggested, but instead distribute strains more uniformly over the entire skull. A larger proportion of the skull therefore experiences a moderate level of strain from each bite position. This has important implications with regard to our understanding of how bone adaptation, remodelling, and overall skull shape are influenced by loads due to feeding in other diapsids and possibly amniotes in general.

Poster Session II, (Monday)

NEW INFORMATION ON THE CRANIAL ANATOMY OF A JUVENILE ICHTHYOPTERYGIAN FROM THE VEGA-PHROSO SILSTONE MEMBER (EARLY TRIASSIC) OF BRITISH COLUMBIA, CANADA

CUTHERBERTON, Robin, University of Calgary, Calgary, AB, Canada; RUSSELL, Anthony, University of Calgary, Calgary, AB, Canada; ANDERSON, Jason, University of Calgary, Calgary, AB, Canada

Tetrapoda underwent a broad radiation in the Triassic that gave rise to many new clades. One of the most notable was the secondarily aquatic Ichthyopterygia that diversified to occupy a broad paleogeographic range by the Early (E.) Triassic. Fossil material collected from these regions is fragmentary and poorly preserved, but phylogenetically significant. TMP 89.127.3 represents a relatively well-preserved ichthyopterygian collected from the Vega-Phroso Silstone Member (E. Triassic) of British Columbia, Canada. The presence of rounded, well-sculpted carapals identifies this specimen as osteologically immature. Based on shared geologic occurrence and similar forelimb morphology, TMP 89.127.3 was interpreted previously to be Parvinatator sputinisus. The nearly complete skull (~87 mm long) is newly available for study and preserved in lateral and dorsal views. The left maxilla is rotated into a horizontal plane, but remains in contact with an external nares that is visible in dorsal aspect. The left nasal is separated from contact with the postfrontal and parietal by the frontal that partially forms the dorsal orbital margin. It is not possible to calculate a reliable tooth size to skull width ratio, but general dental observations reveal that the anterior teeth are slender, with the exposed crowns at least five times taller than wide in labial aspect; the posterior teeth are conical and robust, with the more visible maxillary crowns ~1 to 1.5 times taller than wide in labial aspect and ending in broad, blunt tips; and the bases of the well-exposed maxillary crowns are closely spaced (<1 mm apart) and occur in different planes, providing evidence for multiple maxillary tooth rows. Based on these new data, TMP 89.127.3 is tentatively reidentified as a grippidian ichthyopterygian closely related to Grippus and Chaoshaurus. This marks the first Canadian occurrence of Grippida, expanding the known palaeogeographic range of the clade that had been limited to Svalbard and China. This shows grippidians had achieved a far broader distribution by the E. Triassic than previously thought, and adds new data to understanding the early evolutionary history of Ichthyopterygia.

Poster Session IV, (Wednesday)

A MESODONT DIPODID RODENT FROM THE MIDDLE MIOCENE OF THE GREAT BASIN OF NORTH AMERICA

CZAPLEWSKI, Nicholas, Oklahoma Museum of Natural History, Norman, OK, USA; SMITH, Keith, Oklahoma State University Center for Health Sciences, Tulsa, OK, USA; BROWNE, Ian, Oklahoma State University Center for Health Sciences, Tulsa, OK, USA

Jumping mice (Dipodidae) are a Holarctic group of rodents spanning the Eocene to Holocene. At least nine genera are known from the Miocene in Eurasia. However, dipodid diversity in North America is more modest, with only five Miocene genera in two subfamilies, Sicistinae and Zapodinae, all of which have brachydont molars. Not until the Pliocene and Pleistocene do two of the North American genera of Zapodinae (Zapus and Javanzapus) exhibit mesodont molars. Our screenwashing efforts in the Mud Hills outcrops of the middle Miocene Barstow Formation near the town of Barstow, California, yielded a small new mesodont dipodid, the first recorded occurrence of the family in the formation. The new taxon is named by a single m1 from a single early Barstovian (Ba1) locality, so no assessment of variability is possible yet. Nevertheless, the molar is distinctive in several characteristics including its relative hypsodonty, cuspidate cusps with a lack of accessory lophs, strong anterocoonid and hypoconulid, lack of a mesoconid and posterior cingulum, and strong mesostylid. We suggest that the species’ relatively tall cuspidate tooth is in contrast with the general dipodid trend for lophodonty and might reflect increased insectivory in its diet.

Poster Session IV, (Wednesday)

AUGMENTATION OF THE HOLOTYPE OF NEUQUENSARUS AUSTRALIS: IMPLICATIONS FOR THE TAXONOMY OF SALTASAURINE SAUROPOD DINOSAURS

D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA; WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA

Saltasaurus sauropods radiated in the Cretaceous to become the predominant herbivores in many ecosystems. Our understanding of this radiation is hindered by a currently labile phylogeny for the group, which is partially due to taxonomic problems with many genera. For example, the Late Cretaceous South American saltasaurines Neuquensaurus australis and Saltasaurus loricatus are represented by well-preserved and abundant materials whose hypodigm spans most of the skeleton, but whose homotypic materials are limited to a few bones that do not overlap between the taxa. Both taxa were found within bonebeds for which demarcation of individuals is difficult, complicating referrals of bones to the holotypes from other regions of the skeleton. We present a collections-based discovery that enables us to augment the holotype of Neuquensaurus australis with a partial sacrum that was preserved in articulation with one of the original holotype caudal vertebrae, but not recognized as such at the time. We document this association via the presence of a broken contact of bones on the posteriormost sacral vertebral centrum that has a snap-fit onto the rim of the condyle of the holotypic biconvex vertebra. Based on comparisons with a more complete sacrum and ilium of a referred specimen of Neuquensaurus australis, we interpret this biconvex vertebra to be the seventh sacral vertebra. The situation in Neuquensaurus australis raises the possibility that the biconvex “first caudal” vertebrae of other titanosaurians may be part of the sacrum as well. Augmentation of the Neuquensaurus australis holotype to include a sacrum makes it comparable to the holotype of Saltasaurus loricatus. Morphological differences in the number, shape and proportion of sacral vertebrae allow discrimination between Neuquensaurus and Saltasaurus, confirming their generic separation. The El Brelte quarry, which preserves the holotypic sacrum and abundant referred specimens of Saltasaurus loricatus, also preserves a sacrum consisting of seven vertebrae that closely resembles that of Neuquensaurus australis, suggesting that these two saltasaurines coexisted in the Late Cretaceous of South America.

Technical Session XV, Wednesday 12:00

INVESTIGATING THE DIET OF EXTANT AND FOSSIL FISHES THROUGH MICROTEXTURAL ANALYSIS OF TEETH

DARRAS, Laurent, University of Leicester, Leicester, United Kingdom; PURNELL, Mark, University of Leicester, Leicester, United Kingdom; HART, Paul, University of Leicester, Leicester, United Kingdom; TURNING, Ralph, Florida institute of technology, Melbourne, FL, USA

Hypotheses of diet and feeding in fossil fishes rely heavily on anatomical comparison and mechanical modelling. However, recent evidence indicates that in some species of fishes level dietary specializations in feeding structures correlate poorly with diet, and that diet can even occur in similar morphologically similar populations within a species. These observations undermine the assumptions of the functional morphology approach. Here we adopt an engineering approach to quantification of tooth microwear based on microtextural analysis of high-resolution three-dimensional data. Data were acquired with a focus variation microscope (Alicona IFM) and tooth surface roughness was quantified through several industry standard amplitude, volume and texture parameters. These data allow statistical comparison of textures developed on molluscan teeth of extant herbivorous, durophagous and specialised shell-crushing populations of fishes (Achetaurus probatosephalus and Anarhichas lupus, Teleostei), and comparison with teeth from fossil and modern fishes. Analysis of extant taxa reveals that dental microtextures reflect differences in diet both within- and between-species. Results were validated through blind testing of data from pharyngeal jaw teeth of cichlids (Astatoreochromis alluaudi) with known diets. Application of microtextural analysis to fossil fauna from fishes of fossil pycnodontids, assumed to be specialised shell-crushers, shows that previous dietary hypotheses, based primarily on functional morphology, are incorrect. Microtextural analysis therefore offers a new and powerful tool to test hypotheses of the diet in both extant and fossil organisms.
A SIMPLE MICROVERTEBRATE MOLDING AND CASTING TECHNIQUE: A 20-YEAR RETROSPECTIVE

DAVIES, Kyle, Sam Noble Oklahoma Museum of Natural History, Norman, OK, USA; CIFELLI, Richard, Sam Noble Oklahoma Museum of Natural History, Norman, OK, USA; DAVIES, Brian, University of Oklahoma, Norman, OK, USA; GORDON, Cynthia, University of Oklahoma, Norman, OK, USA

Molding and casting of microvertebrate fossils (such as mammal teeth) has become increasingly common with the advent of silicone molding compounds and a variety of new, high-resolution casting resins. Obvious advantages to the methods include deposition of replicates at sister institutions and distribution to researchers lacking easy access to the original fossil(s), archival backup in the event of damage or loss, ease of study, and safeguarding of delicate original fossils. Moreover, casts made with modern materials show sufficiently high fidelity to be studied and photographed at high magnification under light microscopy or SEM, even showing such features as wear striations. Given the large numbers of specimens and the fact that many replicates are made of each, mass production and standardization of procedures are essential. Clay platforms are cut from rolled-out plastalina clay using appropriately-sized vials from series used by museums, yielding uniform bases of standard sizes. Microvertebrates are commonly mounted on pins for study and storage; an advantage of the technique is that dismounting is unnecessary: pins can simply be stuck into the platforms. Specimen data are inserted into bases using a needle; the setup is then walled with rolled clay and filled with catalyzed silicone. Completed molds are partly filled with casting resin, centrifuged, and subsequently filled. Molds and replicates are flat-bottomed, allowing easy storage in trays. In the past 20 years, we have used this technique to safely and successfully mold and cast over ten thousand microvertebrate fossils, mostly belonging to mammals and many of which are extremely delicate, ranging downward to less than 1 mm in maximum dimension.

Physical Drivers and Marine Tetrapod Evolution, Monday 11:00

USING THE HIGH FIDELITY OF CETACEAN STRANDINGS TO REVEAL THE SPATIOTEMPORAL SCALES OF CETACEAN MACROELOCUTION


Stranded cetaceans have intrigued naturalists for centuries. For coastlines with archived stranding records, these occurrences have been generally interpreted through the lens of temporal sampling. Our analyses revealed that decadal-scale sampling regimes (e.g., disease, climatic and oceanographic changes) and human population changes, which serve as a proxy for observer effort. Our analyses have revealed that decadal-scale sampling regimes (>10 years) across medium-large counties (>100 km coastline) accumulate higher richnesses than a single year sampling across the entire US Pacific coast (~2300 km). Thus, temporal and spatial sampling in the cetacean stranding record are not related in a simple linear fashion: time is more important than space for sampling richness. Coupled with the high fidelity of the cetacean stranding record, these results imply that: 1) such fossil assemblages sample ecologically relevant features of community structure; and 2) the stranding record provides a baseline for measuring cetacean diversity in fossil assemblages, where temporal sampling often exceeds spatial sampling.

NEW DATA ON THE SMALL ARCTOCYOND PROLATIDENS WAUDRUAI FROM THE EARLY PALEOECENE OF HAININ, BELGIUM, AND ITS RELATIONSHIPS WITH NORTH AMERICAN OXYCLAENINES

DE BAST, Eric, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SIEG, Bernard, Université Claude Bernard, Lyon, France; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

One of the few species described from the early Paleocene of Hainin, Belgium is the very small arctocyonid Prolatidens waudruai. The species was described soon after the discovery of the deposit, based on only 3 lower molars. New material from Hainin, including premolars and upper teeth, allows us better comparison with the North American taxa. Prolatidens waudruai seems particularly primitive in its small size and tooth morphology. The paracynid is well-developed and occupies a lingual position; the crown is moderately low, with cusps broad but sharp; the enamel is smooth, unlike in many arctocyonids. The p4 has a more simple morphology with no paraconid, posterior cristae delimiting a relatively deep gutter on the lingual side and a much reduced metaconid. The P4 is also simple, relatively short due to the much reduced paracone, and with a large protocone. The subfamily Arctocyninae (including Arctocyon, Arctocynoides, Colpolaecus, Anacodon and Mentalaenodon) differs from Prolatidens in almost all its derived characters. In Prolatidens indeed the enamel is not cremutated, the paraconid of the lower molars is not fused to the metaconid and the crown is higher than in most genera of the subfamily. The iloxalpine arctocyonids, generally considered as a subfamily (including Loxalpis, Mimotricentes, Baisconodon, Deuterogodont, Desmatolaecus and Lambtoctyon), also differ from Prolatidens in their shared derived characters such as the hypoconulid-entoconid closeness. The oxyclaenine arctocyonids, regroup the so-called “primitive” genera (Oxyprimus, Protungulatum, Chiricus, Prohyptodont, Thryptodon and Oxyclaenus). Among these genera, Oxyprimus was suggested as the closest arctocyonid species to Prolatidens. However the shape of p4 is very different with a large paraconid, well separated protocodon and metacodon and a single posterior crest. Prohyptodont from the Torrejonian compares the best with Prolatidens. The simple molar morphology, and the posterior gutter and absence of paraconid on p4 are shared characters that bring these genera together. Differences mainly consist in higher crown and more septate morphology in Prohyptodont.
evolutionary history. Because of this, an examination of fossil bone microstructure may help us understand the physiology, biomechanics and phylogenetic history of extinct organisms. These three factors do not act independently however. The influence of interactions between the three factors further shapes bone microstructure and makes interpreting fossil data more challenging. In this study, I endeavored to use living species to determine the importance of these three factors and their interactions on shaping bone microstructure. A variety of bone microstructure characteristics from seven living species of the Order Carnivora were quantified. Data regarding the physiology, biomechanics and phylogenetic relationships of these seven species were collected. Then, using a variance partitioning method, the variances in the bone microstructure characteristics were then partitioned among the three influencing factors – physiology, biomechanics and phylogenetic relationships. This gives a measure of the relative effects of these three factors on the shaping of bone microstructure. As expected, it was found that all three factors had a significant effect on bone microstructure. However, what was more surprising was the degree to which this effect was through interactions. In all cases interactions between two or all three of the factors explained more of the variance than any one factor alone. In general, of the three, phylogenetic history explained the greatest proportion of the variance either alone or through interactions with the other two factors. These results emphasize the complexity of this system and suggest that future studies that study any one factor also consider the confounding effects of the other two.

Poster Session I, (Sunday)

DINOSAUR FOSSIL SITES INSIDE INCISED CHANNELS, AN EXAMPLE FROM THE ARCILLAS DE MORELLA FORMATION (LOWER CRETACEOUS, SPAIN) DE SANTISTEBAN, Carlos, Universitat Valenica, Burjasot, Spain; SANTOS-CUBEDO, Andrés, Grup Guix, Vilareal, Spain; SÚNER, Maite, Universitat Valenica, Burjasot, Spain; POZA, Bego, Consorci Ruta Minera, Cerces, Spain

The Arcillas de Morella Formation (Lower Cretaceous) is widely known by specialists because it has delivered an abundant and diverse collection of dinosaur remains. This formation forms part of the Maestrazgo Basin which in part fills the northern margin of the Tethys and was placed in the eastern sector of the Iberian plate during the Lower Cretaceous. The Arcillas de Morella Formation has a maximum thickness of 90 meters and it is early to middle Aptian in age. It is formed by red clays, sandstones, conglomerates, grey marls, and limestones. These red clays have intercalations of grey marls forming cycles of marine (marls) and continental (red clays) materials. The sandstones are present in large channel bodies or form laterally extensive units. The clays have a thickness of 700 meters in cross section and up to 25 meters in depth. In them, besides the sandstones, there are conglomerates, grey marls, and carbonates that contain a marine fauna (foraminifers, oysters, and echinoids) and remain of tree trunks with marine bivalve borings. Locally the channels include very thin lamination facies, with alternations of silt and dark grey lime, rich in organic matter without bioturbation traces.

Most of the localities with dinosaur fossils in this formation are in the infilling parts of the channels. In these sites remains in anatomical connection have been discovered, but also sites with reworked bones that, in some cases, also contain autochthonous marine fauna. Due to the presence of dinosaur footprints in the deposits of the base of the marine infill we suggest that the incision of these channels was developed under subaerial conditions, and that later they became flooded to settle down in estuarine environments. Rare earth elements studies in dinosaur bones placed in the marine deposits indicate that in some locations there are mixtures of bones of different origins. Only some remains found among the materials with estuarine facies, in the upper part of the infilling sequence of the channels, are of organisms contemporary with the formation of the fossil sites.

Technical Session I, Sunday 12:00

MODELLING AND RECONSTRUCTION OF THE FEEDING BIOMECHANICS OF THE BASAL CERATOPSIAN PSITTACOSAURUS GOBIENSIS AND ITS IMPLICATIONS FOR CERATOPSIAN EVOLUTION

DEAN-CARPENTER, Matthias, University of Chicago, Chicago, IL, USA; PORRO, Laura, University of Chicago Dept of Organismal Biology, Chicago, IL, USA; SERENO, Paul, University of Chicago Dept of Organismal Biology, Chicago, IL, USA

The ceratopsian clade of dinosaurs (Ceratopsia) is a diverse clade with the earliest members of the middle Cretaceous of central Asia. A biomechanical reconstruction of the cranial mandibular adductor musculature was done on the new ceratopsian species Psittacosaurus gobiensis. The specimen, from deposits assessed to be Maastrichtian in age, is the uncashed distal end of a right humerus with well preserved muscle scars. Based on the weakly developed strap-like distal condyles it is referred to Enantiornithes, while the following characters support its placement with the proposed subclade Euenantiornithes: (1) a dorsal condyle oriented at a high angle with respect to the humeral shaft; (2) the anterior-posterior compression of the humerus; and (3) a wide olecranon fossa with inconspicuous scapulotricipital and humerotricipital grooves. The specimen is differentiated from most other Enantiornithes by the development of a ridge on the dorsal edge of the ventral condyle, which extends across the distal surface of the humerus, and a thin crest on the ventral margin of the humerus that is interpreted as a raised margin of the m. brachialis insertion. The ridge present on the edge of the ventral condyle is proposed to be possibly synapomorphic of a Eu- enantiornithine subclade while the position and demarcation of the m. brachialis scar by the thin ventral crest is recognized as a potential autapomorphy. The new specimen expands our understanding of South American Enantiornithine diversity and, with recovery of new material, may be recognized as a new species. The unique position of the m. brachialis attachment in this specimen is strikingly reminiscent of the condition seen in extant Passeriformes and may have potential functional implications.

Poster Session II, (Monday)

DEVELOPING A PILOT PALEONTOLOGICAL RESOURCE MONITORING PROGRAM FOR THE NATIONAL PARK SERVICE AT GLEN CANYON NATIONAL RECREATION AREA, UTAH DEBLIEUX, Donald, Utah Geological Survey, Salt Lake City, UT, USA; SANTUCCI, Vincent, National Park Service, McLean, VA, USA; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; MADSSEN, Scott, Utah Geological Survey, Salt Lake City, UT, USA; MADSSEN, Margaret, Utah Geological Survey, Salt Lake City, UT, USA

Through the enactment of the Paleontological Resource Preservation Act (PRPA) of 2009, the United States Congress directed the National Park Service (NPS) to manage and protect paleontological resources using scientific principles and expertise and establish appropriate plans for the inventory, monitoring, and scientific and educational use of paleontological resources. In 2009, the Utah Geological Survey partnered with the NPS to develop a pilot paleontological resource monitoring program targeting fossiliferous exposures along the shores of Lake Powell in Glen Canyon National Recreation Area (GLCA). Initial fieldwork focused on Upper Triassic through Lower Jurassic strata in GLCA because these rocks are highly fossiliferous and accessible to the public, and therefore fossil sites are subject to theft, vandalism, and inadvertent damage. Also, these rocks are exposed to accelerated erosion by being subjected to wave action and repeated submersion and desiccation as water levels fluctuate seasonally along the shore of Lake Powell. The Upper Triassic Chinle Formation has the greatest potential to produce scientifically significant body fossils (bones, petrified wood, etc.) and the Lower Jurassic Glen Canyon Group has previously documented, scientifically significant trace fossils (tracks and burrows). We systematically collected data using protocols developed by us and others working on public lands to formulate a strategy for long-term monitoring of in situ fossils at GLCA. We chose, as a test monitoring site, an area highly fossiliferous and accessible to the public. We then sampled for bone microstructure characteristics from seven living species of the Order Carnivora, with the bite force of Psittacosaurus gobiensis found to be closer to those seen in extant taxa such as smaller crocodilians, omnivorous mammals and small bodied carnivores. As Psittacosaurus is known to be an herbivorous dinosaur, this large bite force was most likely necessary to process plant material which was too tough to be consumed by leaf-eating taxa. This specialized mode of herbivory is supported by the oblique wear facets present on the tooth crowns which are similar to those found in larger herbivorous dinosaurs with highly kinetic skulls. The early specialization in dietary habit present in Psittacosaurus could well have been a key morphological catalyst for the evolution and diversification of the ceratopsian clade.
Technical Session XIV, Wednesday 11:30

A RE-ANALYSIS OF THE “COELOUSAURIAN PIT-BULL” YIXIANOSAURUS LONGIMANAUS WITH IMPLICATIONS FOR THE THEROPOD DINOSAUR DIVERSITY OF THE JEHOL BIOTA

DECECCHI, T. Alexander, McGill University, Montreal, QB, Canada; HONE, David, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LARSSON, Hans, McGill University, Montreal, QB, Canada; SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

The theropod diversity of the Lower Cretaceous Jehol Group of Liaoning Province in northeastern China consists primarily of small bodied, lightly built feathered coelurosaurs. However the Jehol theropod *Yixianosaurus longimanus*, though known only from a partial skeleton, shows a combination of primitive (e.g. expansion of the distal scapula, posteromedially directed glenoid, undivided proximal surface of ulna) and derived (e.g. scapula shorter than ilium, large contour feathers) coelurosaurian pectoral and limb characters thus making its phylogenetic affinities important to resolving the evolutionary history of the maniraptarian forelimb. Here we offer a re-analysis of the type specimen, focusing on its phylogenetic position and the ecological implications of its unique morphology. Purported affinities to either Deinonychosaurus or Scansoriopterygidae are not supported, and results indicate a more basal position for *Yixianosaurus*. Allometric analysis indicates that *Yixianosaurus* was a small to medium sized theropod (estimated snout to vent length (SVL) between 410-450 mm) possessing forelimbs that were both long and robust, though not as elongated as in paravians. The manus is large, relative to both humeral length and SVL, and possibly one of the highest phalangeal index values known in theropods, indicating highly developed grasping ability. The combination of thick limb elements and an elongated yet robust manus with large raptorial claws showed enlarged flexor tendons indicates that *Yixianosaurus* was a powerful animal. The phylogenetic placement of *Yixianosaurus* indicates that limb elongation occurred multiple times within Coelurosauria, while the differences in limb structure between *Yixianosaurus* and other Jehol theropods, in terms of both element robustness and intra-limb proportions, hints at potential niche separation.

Poster Session I, (Sunday)

AMPHIBIANS INDICATE ECOSYSTEM INSTABILITY PRIOR TO AND AFTER THE K-PG BOUNDARY: FOSSIL EVIDENCE FROM GARFIELD COUNTY, NE MONTANA

DEMAR, Jr., David, University of Washington, Seattle, WA, USA; WILSON, Gregory, University of Washington, Seattle, WA, USA

The Hell Creek and Tullock Formations of Garfield County, NE Montana represent an ideal study system for investigating trends in vertebrate evolution, extinction, and recovery across the Cretaceous-Paleogene (K-Pg) boundary. From this study system, we assembled a fossil database of >1800 amphibian specimens (exclusive of Anura) from a temporally-constrained sequence of well-sampled vertebrate microfossil localities from the Hell Creek and lower Tullock Formations. Using this database, we documented high-resolution temporal patterns in amphibian taxonomic diversity, community structure, and survivorship during the K-Pg interval. Ten families and salamander-like amphibian species, representing the Batrachosaurusidae, Scapherpetontidae, Sirenidae, and Ambilapertontidae, were recognized in the local section. We recorded the occurrence of *Habrosaurus prodilatus*, a temporal and paleobiogeographic range extension for the taxon, as well as a new genus and species of salamander from the Hell Creek Formation based on several distinctive atlases. Preliminary results indicate that amphibian richness is relatively stable preceding the K-Pg boundary, whereas relative abundances of the most common taxa (Opisthotriton, Scapherpeton) undergo significant fluctuations. Heterogeneity values are high in the lower part of the Hell Creek Formation and much lower in the middle of the formation. The decrease in heterogeneity and the apparent local extinction of *H. prodilatus* occurred ~700-600 kyr before the K-Pg boundary, possibly coincident with a cooling trend that preceded the Late Maastrichtian warming event. In the upper part of the Hell Creek Formation, heterogeneity returns to prior levels only to decrease significantly across the K-Pg boundary. Likewise, amphibians suffered local extinction of ~30% of species at or near the K-Pg boundary. The earliest Paleocene survival fauna is numerically dominated by the ‘bloom taxon’ *Opisthotriton*, which represents ~85% of all individuals. The high-temporal resolution and quantitative approach of this study sheds new light on patterns of amphibian extinction and survivorship across the K-Pg boundary.

Technical Session V, Sunday 3:30

A DENSELY CONCENTRATED EARLY PLIOENE MAMMALLIAN FAUNA FROM THE LINXIA BASIN IN GANSU, CHINA

DENG, Tao, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; HOU, Xukui, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

The lower Pliocene of the Linxia Basin in Gansu Province is one of only a few representative sections for the early Pliocene sedimentary records in northern China, and even in East Asia. Recently, a 45 m long fossil lens was discovered from the red clays of the early Pliocene Hewanqia Formation at Duikang in Guanghe County within this basin. The whole lens was successively excavated by cutting it into many 1 meter longblocks. Previously, Pliocene mammals were sparsely found in China, and most were collected from fluvial and lacustrine deposits in the eastern Loess Plateau. Mammals from the widely distributed Pliocene Hipparion red clays are less in number. The known fossils from Duikang include 20 species, such as Hystrix guanensis, Alilepus sp., Sinictis dolichognathus, Parataxisa sinensis, Hyacineditherium wongi, Adrocuta eximia, Chasmapothetes kani, Felis sp., Hipparion hippididas, H. playdios, H. licenti, H. (Probocebippidipar) pater, Shanrhiurnus ringstomni, M. hesperorhinus sp., M. antilophorhinus sp., Cervarvus novorossiae, Palaeotragus minimus, Seltameryr sp., Simnotherium sp., and Gazella micr. Their faunal components are similar to that of the early Pliocene Gaozhuang fauna from Yushe, Shanxi. On the other hand, some taxa from Duikang have not been found in the Gaozhuang fauna, are slightly more primitive in evolutionary level, and known mainly in the late Miocene. As a result, the age of the Duikang fossils may be slightly earlier than that of the Gaozhuang fauna and closer to the lower boundary of the Pliocene. The Duikang fossiliferous bed is 0.8 m above the top of the late Miocene Lishau Formation, and the first occurrence of the three-toed horse *Hipparion pater* can be regarded as a biostratigraphical marker of the Miocene/Pliocene boundary. In conclusion, Duikang is an ideal candidate locality to establish as the stratotype for the lower boundary of the Chinese terrestrial Pliocene. Two giraffids and two chalicotheres were found from Duikang. All of these herbivores are typical taxa. The components of the Duikang fossils indicate that the environment of the Linxia Basin was a subarid steppe during the early Pliocene.

Poster Session II, (Monday)

A NEW STAGONDONTID METATHERIAN FROM THE CAMPANIAN OF NEW JERSEY, AND ITS IMPLICATIONS FOR A LACK OF EAST-WEST DISPERSAL ROUTES IN THE LATE CRETACEOUS OF NORTH AMERICA

DENTON Jr., Robert, New Jersey State Museum, Trenton, NJ, USA; O’NEILL, Robert, New Jersey State Museum, Trenton, NJ, USA

The Ellisdale Site of New Jersey has produced the most diverse assembly of terrestrial vertebrates from the Cretaceous of Eastern North America, including amanar and caudatan amphibians, squamates, avian and non-avian dinosaurs, and mammals. Preliminary studies of the Ellisdale land fauna suggest affinities with the Campanian faunas of the western interior of North America; however subsequent comparisons have indicated a high degree of endemism among nearly every element of the Ellisdale terrestrial assemblage identifiable to the generic level. Three mammalian taxa were initially recognized at Ellisdale: a cimolodontid and possible cimolomiyid multituberculate, and a metatherian based on an isolated M3 which was described as identical to *Alphadon* (*Protalpodon*) *lulli*, a characteristic taxon of the Judithian fauna of western NA. Subsequent collection obtained other metatherian teeth that exhibited possible stagodontid affinities.

More recent analysis has now demonstrated that the M3 originally ascribed to *A. lulli* may belong to a previously undescribed taxon of stagodontid. The Ellisdale stagodontid appears to be more advanced than *Paraisodon* of the Campanian of Utah; however is less derived than the stagodontid taxon *Eodelphis* and *Didelphis* from the Campanian and Maastrichtian of western North America. It has been purported that land animals may have dispersed across eastern North America, and possibly into Europe, throughout the Late Cretaceous; however the presence of an endeminc “Ellisdalean” land fauna does not support this hypothesis. The Ellisdale fauna together with geological data suggest that eastern North America was an isolated continent from the Turonian onward, and thus became a refuge for relatively undervier Early Cretaceous taxa that underwent vicariant speciation. If dispersion to the Euroarapipelago did take place via a North Atlantic route, it could not have happened until the latest Maastrichtian, based on paleogeographic and paleontologic studies.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 10:30

THE COMBINED USE OF STABLE ISOTOPES AND DENTAL MICROWEAR TEXTURE ANALYSIS TO DECIPHER THE PALEOECOLOGY OF AUSTRALIAN MARSUPIALS

DESANTIS, Larisa, Vanderbilt University, Nashville, TN, USA; SCHUBERT, Blaine, Eastern Texas State University, Johnson City, TN, USA

Clarifying the paleoecology of Australian marsupials has primarily focused on traditional morphological methods with an increasing number of stable isotope studies. Recently, stable isotopes and 3-D dental microwear texture analysis (DMTA) have been combined to assess the paleoecology of Pleistocene kangaroos. The independent use of carbon isotopes can be used to infer the consumption of C3 vs. C4 vegetation while DMTA can assess the consumption of browse vs. grass, in addition to other dietary categories (e.g., bone consumption). The integration of these tools allows herbivorous marsupials to be identified as C3 browsers, C4 grazers, C3 browsers, and/or C4 grazers. Regions where C3 grasses and/or C4 browse are prevalent (e.g., Australia) require the use of multiple paleoecological methods. Here, we present two case studies that highlight: 1) the use of DMTA to infer relative bone consumption in the marsupial lion *Thylacoleo carnifex*, and 2) the combined use of stable isotopes and DMTA to assess dietary resource partitioning in a population of Pleistocene kangaroos (*Macropus culens*, *Procapra priscens*, *Procapra putidus*, *Procapra ruphia*). Specifically, *T. carnifex* was compared to carnivorous taxa ranging from the bone avoiding cheetah *Acinonyx jubatus*, the generalist African lion (*Panthera leo*), and the opportunistic bone consuming spotted hyena (*Crocuta crocuta*). Most notably, *T. carnifex* is significantly different from *A. jubatus* in anisotropy and *C. crocuta* in complexity. These data indicate that *T. carnifex* may be more similar to its convergent namesake the African lion, in bone consumption. Next, the combined use of stable isotopes and DMTA in Pleistocene kangaroos reveals that the taxa with the greatest complexity also have the greatest and most variable (13)C values.
ues, indicating the inclusion of C₃ browse in the diets of P. pustio and P. goliah. The converse is also true, with M. titan and P. rulphi indicating the consumption of primarily C₄ grasses. Collectively, the integration of geochemical and DMTA tools can clarify the paleoecology of Australian marsupials and taxa in regions with complex vegetation and/or prior to the expansion of C₃ grasslands.

Technical Session XVIII, Wednesday 1:45

FIRST RECORD OF CHIGUTISAURIDS (STEREOSPONDYL, TREMATOSAURIA) IN THE SANTA MARIA FORMATION (UPPER TRIASSIC OF SOUTHERN BRAZIL)

Dias-Da-Silva, Sérgio, Universidade Federal do Pampa, São Gabriel, Brazil; Sengupta, DhritiJai, Indian Geophysical Institute, Kolkata, India; Cabreira, Sérgio, Universidade Luterana do Brasil, Canoas, Brazil; Da Silva, Lúcio, Universidade Luterana do Brasil, Canoas, Brazil

Chigutisaurids are the longest-lived trematosaurian clade (from Early Triassic to Early Cretaceous). They are recorded in Argentina, Australia, India, and South Africa. This contribution reports a new chigutisaurid in the Carnian of southern Brazil (Santa Maria Formation, Paraná Basin). The material comprises two skull fragments, a mandibular fragment, a clavicle, and a humerus. Osteological features, such as thin dorsal skull bones and wide open sutures, point to an early developmental stage of the specimen. The presence of a long, straight and pointed tabular horn, which runs parallel to the skull midline towards its tip, and a distinctive projection in the posterior border of the postparietal suggest a close relationship of the Brazilian chigutisaurid with the Indian Compsognathus praecursor. Three distinctive characters, however, show that the Brazilian chigutisaurid is a different taxon: presence of an alar process of the jugal in the ventral margin of the orbit; jugal does not extend well beyond the anterior margin of the orbit; and tabular does not contact the parietal (this last character is shared with the other Indian chigutisaurid, Kuttycephalus triangularis). Argentinean and Indian occurrences are dated as Norian, so the presence of a Carnian chigutisaurid in southern Brazil is supported. Among the Carnian occurrences of the Paraná Basin, and later migrated towards west (to Argentina) and east (India). However, the presence of ghost chigutisaurid taxa cannot be dismissed, because their long temporal range contrasts with their short (in comparison to other temnospondyls) geographic distribution. Hence, they might have been more geographically widespread than their fossil record suggests.

Poster Session III, (Tuesday)

DENTAL EMERGENCE SEQUENCES IN THE EUARCHONTA AND A POTENTIAL SYNAPOMORPHY OF EUPRIMATES

Dirks, Wensley, Newcastle University, Newcastle upon Tyne, United Kingdom; Anemone, Robert, Western Michigan University, Kalamazoo, MI, USA; Beard, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, USA; Nachman, Brett, University of Texas at Austin, Austin, TX, USA; Tafforeau, Paul, European Synchrotron Radiation Facility, Grenoble, France

Phylogenetic relationships within the Euarchonta remain contentious, but recent molecular evidence suggests that the Dermoptera are the sister group to Primates, corroborating the monophyly of the Primatomorpha. Much of the basic biology of the colugo remains unknown, however. The sequence of dental emergence is used in both phylogenetic and life history reconstruction and although dental emergence sequences are available for some tree shrews, plesiadapiforms, and primates, information on dental emergence in the colugo is lacking. In this study, we determined the sequence of dental emergence in the Malayan colugo, Galeopterus variegatus, and compared it to published sequences for plesiadapiforms, tree shrews, and primates. We also re-examined published specimens of Callobatrachus sanyanensis, Notothorax tembrosae, as well as the extant pen-tailed tree shrew, Ptilocercus lowii. Twelve juvenile colugo specimens were seriated and teeth scored as a fraction of erupted crown height to determine the emergence sequence. Four G. variegatus specimens and one P. lowii were CT scanned to determine the state of development in the premolars. The sequence of emergence in the maxilla of Galeopterus variegatus is (DP4 – DP3 – M1-D2-Z-D3-D12-M2-M3-C1-P1-P2-P4-I3) and in the mandible it is dl1-d2-d3-(dp4+dp1+M1)-dl2-m2-m3-11-2-3-p4-p1-i3. Premolar emergence appears to be almost simultaneous, but with one specimen of the colugo, P3 was in occlusion, while P4 had not yet reached the occlusal plane. CT scans also suggest simultaneous development of p3 and p4. In plesiadapiforms, the third premolar precedes the fourth in emergence. The emergence of the fourth premolar before the third may be a synapomorphy of Euprimates, as this is the sequence in those Eocene primates for which information is available, as well as tarsiids, lorisids, galagids, most lemuroids, and some platyrhines. In tree shrews, p4 precedes p3 in Tapirus glis, but in the more pleisiomorphic Ptilocercus, p3 precedes p4, suggesting that any resemblance of tapirs to Euprimates is convergent.

Poster Session III, (Tuesday)

RECORD OF THE EARLY AND MIDDLE MIocene CLIMATIC EVENTS ON MAMMALIAN TOOTH ENAMEL: "C" VALUES FROM EUROPE


The Miocene witnessed two important global climatic events: the Miocene Climatic Optimum (MCO; 17-15 Ma), characterized by high temperatures and an enhancement in humidity; followed by the Mid Miocene Cooling (MMC; 15-13.5 Ma) characterized by a sudden drop in global temperatures and an increase in the aridity, linked to the reestablishment of the icecap in the East Antarctic. Our study tracks the shift from a humid period during the MCO towards drier conditions in the MMC, pinpointed in four European terrestrial paleontological sites (Sandelzhausen, Somosaguas, Steinheim, Paçalar) spanning a range of time from 16.5-16.0 Ma to 13.6-13.0 Ma, by comparing "C" values analyzed in the tooth enamel from herbivorous mammals. The Sandelzhausen site shows the lowest "C" values (-11.4 ± 1.0% VPDB) agreeing with its age coinciding with the humid MCO. The Somosaguas mass site records the MMC trend and its mammalian tooth enamel shows significantly higher "C" values (mean = -9.9 ± 1.2% VPDB) when compared to the other sites (F = 24.713, p < 0.001), indicative of the increase in aridity patterns. Tooth enamel from the Steinheim site furnished "C" values (-11.1 ± 1.1% VPDB) resembling those supplied by Sandelzhausen, despite its age being similar to the one showed by Somosaguas and thus, coinciding with the arid MMC period. This fact, supported by palynological and paleoecological studies, may be explained by the existence of a strong latitudinal gradient in precipitation during the important periods of the Miocene. Higher resolution isotopic studies on European terrestrial sites will enhance the understanding of these climatic events.

Evolution of the modern African Fauna, Wednesday 9:00

A REVIEW OF THE AFRICAN FOSSIL SIRENIA

Doming, Daryl, Howard University, Washington, DC, USA; Gingerich, Philip, University of Michigan, Ann Arbor, MI, USA; Zalmout, Iyad, University of Michigan, Ann Arbor, MI, USA

The African fossil record of the Order Sirenia is best known from the middle Eocene to early Oligocene of North Africa, where the families Protosirenidae (two species of Protosiren and an unnamed genus and species) and Dugongidae (four species of Euphrades and possibly four of Eosiren) are recorded. Another middle Eocene Eosirenides is also known from Madagascar. In the North African Miocene, the dugongids Rhytiodus and Metaxytherium have been identified. Indeterminate Eocene to Miocene sirenian remains are recorded from several other parts of the continent. Reports of Halitherium in Africa and Madagascar have not been substantiated. The latest African Tertiary sirenian, a supposed "Felsinotherium" from the Pliocene of Morocco, may actually represent a dugongine of New World affinities. The living sirensians found in Africa (Trichechus senegalensis and Dugong dugon) have no fossil record there, and may both be Pliocene or later immigrants from the New World also. Sirensians evidently arose along the shores of the Tethyan Seaway, probably in the Old World; but whether they and the other Paenungulata belong phylogenically with the Ungulata or with the Artiodactyla remains unsettled. Present evidence suggests that Eocene sirenian fossils on the north and south shores of Tethys were distinct at the generic level. Although the African sirenian record provides some of the best fossils to document the reduction and loss of hind limbs of Eocene marine mammals following their return to the sea, the later evolutionary history of the group must for now be traced mostly on other continents. Fossil Sirenia from Africa have been collected from shallow marine, lagoonal, estuarine, deltaic, and riverine environments. The African landmass was changing during the early and middle Cenozoic; the closure of the Tethyan Sea in the north, continued growth in precipitation in the Siwalik or Middle Miocene when considering a west Mediterranean South-North transect. At the end of the sudden cooling when a change towards more humid conditions occurred, the Paçalar site displays "C" values (-11.2 ± 1.0% VPDB) statistically indistinguishable from Sandelzhausen and Steinheim. A sub tropical forest landscape has been deduced for the Paçalar site, which supports the appearance of two hominoid species. Our results offer a preliminary view of the distribution of the isotopic values in different environments in western Eurasia during these important periods of the Miocene. Higher resolution isotopic studies on European terrestrial sites will enhance the understanding of these climatic events.

A STEM-GROUP ANURAN FROM THE LOWER CRETACEOUS OF WESTERN LIAONING, CHINA

Dong, Liping, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; Wang, Yuan, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

A nearly complete skeleton of a new archaic anuran is described from the Early Cretaceous Yixian Formation, western Liaoning Province, China. This is the third frog from the Sihetun locality, where Callobatrachus sanyanensis and Liaobatrachus graubai are found. The skull of this new frog is wide and the quadratojugal is present to complete the maxillary arch. It has nine presacral vertebrae with three pairs of free ribs on the second to fourth presacrals, and their centra are amphiocoealous probably with an incoherent notochordal canal. Theurostyle with one pair of transverse process is monodelphous. Like in Callobatrachus sanyanensisthe end of the scapula is overlain by the clavicle, and the ilium has weak dorsal crest and no dorsal protuberance. The tibiafibula is also much longer than the femur as in Mesophyne beipiaoensis. However, the new taxon differs from the other Mesozoic anurans from China by the following combination of characters: maxilla with no contact with squamosal, amphicoelous presacral centra, the anterior presacrals with free ribs, monodelphous sacro-utosary
articulation, no intermediate, and the proximal end of the coracoid larger than the distal one. A phylogenetic analysis with the inclusion of all reported Mesozoic anurans from China is presented here, and the result suggests that the new anuran is a primitive archaeobatrachian more basal than Mesophryne beipiaosensis, which is the sister taxon of crown-group anurans.

Poster Session II, (Monday)

NEW LATEST CRETACEOUS MAMMALS FROM THE LANCE FORMATION NEAR BLACK BUTTE STATION, SOUTHWESTERN WYOMING
DONOHUE, Shelly, B.S. University of Washington, Seattle, WA, USA; WILSON, Gregory, University of Washington, Seattle, WA, USA; BREITHAUP, Brent, Bureau of Land Management, Wyoming, Cheyenne, WY, USA

The Cretaceous-Paleogene (K-Pg) mass extinction event was one of the most critical points in the evolutionary history of mammals. In North America, it is represented by fossil localities spanning the Lancerian and Puercan land mammal ‘ages’, which occur largely in continental deposits of the northern Great Plains region. These deposits represent coastal lowland palaeoenvironments, adjacent to the Western Interior Seaway. The early Lancerian deposits contain a small number of local survivors of the K-Pg extinction event, as well as a substantial influx of immigrants that seed the ensuing recovery and radiation of mammals. The immigrants have been proposed to originate from exotic areas, such as Asia and Baja California, and from upland refugia. Due to sparse fossil data, testing of these hypotheses has been limited. Here, we present a preliminary systematic paleontological study of more than 200 mammalian fossils from a Lancerian-age local fauna from the Lance Formation of southwestern Wyoming. The specimens are from two independent collections made in the 1970s by the University of California Museum of Paleontology and the University of Wyoming Geological Museum. Deposits of the Lance Formation in this region are on the eastern flank of the Rock Springs Uplift near Black Butte Station; thus, this local fauna was farther west and palaeo-environmentally distinct from most other known Lancerian local faunas. Preliminary analysis of the assemblages indicates that the Black Butte Station local fauna includes some common Lancerian mammal taxa as well as several new multibeterminate taxa. These results suggest that explorations in under sampled regions and palaeoenvironments are critical to a more complete understanding of the K-Pg transition.

Poster Session IV, (Wednesday)

PRELIMINARY BIOGEOGRAPHICAL AND SYSTEMATIC ANALYSIS OF AN EARLY PLEISTOCENE AVIFAUNA IN THE ROLLING PLAINS REGION OF WEST TEXAS
DOYLE, Julie, Sam Houston State University, Huntsville, TX, USA; JOHNSON, Eileen, Museum of Texas Tech University, Lubbock, TX, USA; MORETTI, John, Museum of Texas Tech University, Lubbock, TX, USA; LEWIS, Patrick, Sam Houston State University, Huntsville, TX, USA

The Pleistocene is characterized by extreme climatic oscillations producing intermittent glacial conditions in North America. This climatic variability is responsible for the periodical restructuring of affected ecosystems resulting in modern avian biodiversity and biogeographical distribution patterns seen today. These Pleistocene glacialization events reduces species diversity from a Pliocene peak of over 20,000 to fewer than 10,000. At present, North American avian systematics and biogeography lacks resolution due to a paucity of relevant data in the form of described avifaunal assemblages. This research is focused on a systematic and paleoenvironmental analysis of the avifaunal component of a fossil assemblage from the Roland Springs Ranch of Snyder, Texas. This locality, RSR1, is in the Rolling Plains region of West Texas. Overall, the entire fauna from this locality is diverse. Coupled with characteristic stratigraphic features, this compositional diversity indicates a lack of taxonomic bias suggesting that deposition occurred in a low-energy fluvial environment. Preliminary biostratigraphic dating using non-avian taxa suggests this assemblage represents a transitory period between the Blancan and Irvingtonian North American Land Mammal Ages (ca. 1.8 mya). If this assessment is accurate, the composition of the RSR1 avifauna should differ significantly from published Blancan-age, as well as Irvingtonian-age North American avifaunas. This avifaunal assembly numbers over 100 specimens and consists of various elements representing at least six orders. This assemblage fills an important spatial gap in the avifaunal record and will help to resolve avian systematic and biogeographic issues from the important period just prior to the Pleistocene.

Poster Session IV, (Wednesday)

THE INFLUENCE OF BONE HISTOLOGY ON FOSSILIZATION: INSIGHTS FROM LASER ABLATION ANALYSES OF LATE EOCENE BRONTOTHERES
DREWicz, Amanda; Temple University, Philadelphia, PA, USA; TERRY Jr., Dennis, Temple University, Philadelphia, PA, USA; GRANDSTAFF, David, Temple University, Philadelphia, PA, USA; ASH, Richard, University of Maryland, College Park, MD, USA

Three associated brontotheres (Perisodactylia) bones (metapodial, distal femur, and rib) were collected from an overbank mudstone in the Peanut Peak Member of the Late Eocene Chadron Formation near Crawford, Nebraska. The three bones were analyzed for lanthanide (REE) and other trace elements (TE) using conventional solution inductively-coupled plasma-mass spectrometry (ICP-MS) and Laser-Ablation-ICP-MS (LA-ICP-MS) to detect REE and TE variations within bones, compare results of the two methods, and determine whether biomechanical or histological factors affect post mortem uptake of REE and TE. Concentrations of most REE and TE were highest at the bone surface and decreased with depth into the trabecular bone. REE signatures from the outer circumferential layer (OCL) and the uppermost 1–2 mm of cortical layers of the three bones were light-REE enriched whereas signatures from deeper cortical and trabecular bone were middle-REE depleted. The bones were from different localities, and should have the same REE signatures. Averaged REE signatures from LA-ICP-MS analyses of the OCL and outer cortical layers of the three bones were very similar; more similar than in previous solution ICP-MS analyses, possibly due to addition of bone from deeper cortical layers in solution ICP-MS samples. Preliminary data suggest that biomechanical functions of bone have little to no effect on the incorporation of REEs. However, bone histology may affect incorporation. REE concentrations in individual osteons are greater than surrounding bone but decrease toward the center of the osteon, which should have been an open channel prior to fossilization. Uranium gradients are used to calculate fossilization durations. However, U concentrations in two of the bones increased with depth into the inner cortical bone, possibly due to remobilization or redox variations, hindering its usefulness for interpreting fossilization time. REE signatures have also been used to determine fossil provenance and combat fossil poaching. These results suggest that LA-ICP-MS analyses provide higher quality data for REE comparisons to determine provenance.

Poster Session II, (Monday)

AN UPPER TRIASSIC (NORIAN) ICHTHYOSAUR WITH GUT CONTENTS FROM THE OTUK FORMATION, WESTERN BROOKS RANGES, ALASKA
DRUCKENMILLER, Patrick, University of Alaska Museum, Fairbanks, AK, USA; WHALEN, Michael, University of Alaska Fairbanks, Fairbanks, AK, USA; KELLEY, Neil, University of California Davis, Davis, CA, USA

The partial skeleton of a large ichthyosaur, discovered in 1950 and collected in 2002, is the first specimen of this clade documented in Alaska. The specimen was collected in the western Brooks Range, approximately 55 kilometers northwest of Howard Pass. The ichthyosaur was discovered within the Limestone Member of the Otuk Formation, although its stratigraphic position remains uncertain. The specimen is preserved in precisely detailed fractures and broken Peak Formation ranges in age from Early Triassic to Early Jurassic and consists of the Shale, Chert, Limestone and the Blankenship members. The Limestone Member is Norian in age and consists dominantly of rhythmically interbedded silicic acid mudstone, shale, and chert. All are laminated to thin bedded, with a paucity of sedimentary structures and most body fossils indicating deposition below storm wave base in an outer neritic to inner bathyal setting. The preserved portion of the semi-articulated skeleton measures four meters representing approximately one-third to one-half total body length. The specimen includes fragments of the skull, most of the dorsal ribs and gastralia, portions of the pectoral and pelvic girdle, three proximal forelimb elements, and a nearly complete femur. Significantly, the presence of numerous small (less than one centimeter maximum dimension) bone and invertebrate fragments in the abdominal region are interpreted to be partially digested food remains within the alimentary canal. Based on its stratigraphic occurrence, large size, and available skeletal remains, the specimen is tentatively referred to the Shastasauridae, a clade of large (up to 20 meters) ichthyosaurs well known in the Middle to Late Triassic successions of western North America. The Howard Pass ichthyosaur is the most complete ichthyosaur known from Alaska and considerably extends northward the geographic range of this clade in North America.

Technical Session VII, Monday 4:00

OPPORTUNISM, ACOUSTICS AND MASS: EXTAPTATION AND PATTERNS OF MIDDLE-EAR EXPANSION IN ARCHOSAURIA
DUFEAU, David, Ohio University, Athens, OH, USA; WITMER, Lawrence, Ohio University, Athens, OH, USA

Archosaurs generally have large middle-ear volumes. In some lineages (crocodilo-morphs, pterosaurs, theropods), this expanding volume results in extensive intraspecific pneumaticity, whereas other groups (Psittacosaurus, some sauropods) exhibit apomorphic extraosseous pneumatic expansions. Adaptive hypotheses (mass reduction, acoustic performance) have been advanced to explain this middle-ear expansion. We mapped expanded middle ears onto a phylogenetic framework and suggest instead that non-adaptive opportunistic expansion is the plesiomorphic backdrop on which the exaptation of apomorphic functions could occur. We focused on two hypotheses: that, in some clades, construtional constraints (jaw-muscle configuration, brain volume) govern the manner in which middle-ear expansion proceeds. Lineages that exhibit extreme extraosseous pneumaticity generally had basal members occupying the small-bodied predator niche. Lightly built, fast moving predators with extraosseous pneumaticity would have had the expedited benefit of reduced head mass, decreasing inertial momentum and allowing for higher turning velocities and improved prey tracking and pursuit. A trend in crocodilo-morphs toward increased jaw adductor muscle mass led to a more robust pala-toquadrate complex, which in turn, constrained the middle-ear space such that any expansion would intersect and excavate the bones of the suspensorium and braincase. In theropods, small size in concert with trends for increasing brain volume led to the intersection of the middle-ear space with the bones of the braincase; selection for decreased head mass, coupled with opportunistic expansion, led to extensive pneumatization of the braincase. Taxa with expanded extraosseous middle-ear pneumaticity, such as some sauropods, may have been exapted for either mass reduction or acoustics. Exaptation for both. The Oniros-like structure seen in Psittacosaurus may have had an exapted acoustic function. Non-adaptive opportunistic expansion of the middle ear due to some intrinsic mechanism seems to have been the rule for archosaurs. Constructional constraints govern the style of pneumatic expansion, which in turn may influence the exaptive potential.
EVALUATION OF EARLY EOCENE PALAEOSTINOPA (MAMMALIA, PANTOLESTIDAE) IN THE BIGHORN BASIN, WYOMING

DUNN, Rachel, Center for Functional Anatomy & Evolution, Johns Hopkins University, Baltimore, MD, USA; ROSE, Kenneth, Center for Functional Anatomy & Evolution, Johns Hopkins University, Baltimore, MD, USA;

Palaestinopa is a late Paleocene to early Eocene Holarctic genus belonging to the semi-aquatic, phylogenetically enigmatic family Pantolestidae. Pantolestids are usually grouped with cimolestids as the superfamily Palaestinoidea as recent molecular phylogenetic studies have recognized their close relationship with palaestinids and palaeomonids. At least six species of Palaestinopa have been recognized during the early Eocene in North America, four of which have been reported from the Willwood Formation in the Bighorn Basin. Historically, the systematics of Palaestinopa have been complicated due to small sample sizes and the primitive dental morphology of the genus, as well as the inadequacy of some holotypes. Continuing fieldwork in the Bighorn Basin has resulted in a significantly improved sample of Palaestinopa, which allow us to reassess the generic and biological variation in a stratigraphic context. Based on this new sample (n=146), we confirm the presence of at least three and possibly four species of Palaestinopa in the Bighorn Basin: P. lutreola, P. veterrima, a new species, and possibly P. incerta. P. dipleidophyes is distinct from P. veterrima based on minor differences in paracodon morphology and, as maintained by previous researchers, occurs in the Wind River Basin but not the Bighorn Basin. P. incerta is problematic and may comprise specimens from the extremes of P. lutreola and P. veterrima size distributions. P. veterrima is the most common species of Palaestinopa in the Willwood Formation. Its molar morphology evolves from the more “crestiform” type (in earlier Wasatchian strata) that resembles other species of Palaestino- sha to a more bunodont morphology (the new species) characterized by exodaenodonty. This change in the molar morphologies is consistent with the interpretation of a more open environment. Isotopic values also suggest resource partitioning and lowered competition in a more open environment. Isotopic values also suggest resource partitioning and lowered competition in a more open environment. Isotopic values also suggest resource partitioning and lowered competition in a more open environment.

EASTHAM, Laura, University of Toronto, Toronto, ON, Canada; BÉGUI, David, University of Toronto, Toronto, ON, Canada; KORDOS, László, Geological Institute of Hungary, Budapest, Hungary;

In Europe, the Vallesian Crisis marks the extinction of many mammalian taxa characteristic of previous Middle Miocene faunas, including most of the hominids that settled successfully in Europe during the Middle and early Late Miocene. It is suggested that the extinction of Late Miocene Western and Central European hominids was not related to the spread of open environments, but to a significant increase in climatic seasonality and subsequently to a more bunodont morphology. The new sample thus provides evidence for gradual evolution within the genus Palaestinopa, as has been documented in other lineages of mammals from the Bighorn Basin.

POSTER SESSION III, (TUESDAY)

PALEOECOLOGY OF A LATE MIOCENE HOMINID LOCALITY IN NORTHERN CENTRAL HUNGARY: PRELIMINARY STABLE ISOTOPE ANALYSIS OF THE RUDÁBANYA FAUNA

We report a discovery of an amphicyonid from the lower part of Irrawaddy Sediments in central Myanmar. The age of the fauna has been estimated as the late Miocene based on their diagnostic infrared spectra. Key results from this study represent comparative FTIR analysis of an extinct geomorphus mant derived from organic functional groups (amide I and II) are present within individual scale structures. Comparative maps resulted from fossils show the presence of the same functional groups also within each individually preserved scale. These remarkable spatial correlations suggest that these are not modern contamination but the remnants of organic compounds that were present in the living organism. This is an unprecedented result that shows endogenous organic molecules can be preserved in-situ for over 50 million years.

POSTER SESSION I, (SUNDAY)

CLIMATIC AND FLORAL LATITUDINAL GRADIENTS BETWEEN LATE CRETACEOUS SOUTH AMERICA AND ANTÁRCTICA: PALEOBIOGEOGRAPHICAL IMPLICATIONS FOR SOUTHERNMOST GONDWANA

EGERTON, Victoria, Drexel University, Philadelphia, PA, USA; WILLIAMS, Christopher, Franklin and Marshall College, Lancaster, PA, USA; LACOVARA, Kenneth, Drexel University, Philadelphia, PA, USA;

Extensive exposures of Cretaceous (144-65 Ma) strata in Argentina have yielded most of the known dinosaur taxa from the Southern Hemisphere. However, little is known about their environment. The Pari Aike Formation, in southernmost Patagonia (Argentina), yields unique dinosauria (“Telkenausa santucruzensis, Puertasaurus ruellii, Orokoptus burkei” and an unnamed Titanosauria), elasmobranch (Cretetalia appendiculata), testudine, and dipnoan fauna. The Pari Aike Formation is notable because it is the southernmost Late Cretaceous site with both floral and faunal components preserved. Throughout the Cretaceous, South America and the Antarctic Peninsula shared a continental-continental plate boundary. It is not clear whether this connection was substantial, covered by an epeiric sea, or whether it alternated between these states. Limited terrestrial vertebrate data is available to examine the paleobiogeographic relationship between Late Cretaceous Antarctica and South America. However, fossil wood spans both of these locations and provides a potentially useful tool for understanding vertebrate paleoenvironments and paleobiogeography.

To assess the usefulness of fossil wood, we collected and sectioned samples from the Pari Aike Formation (Argentina). All of the fossil wood samples have distinct growth rings, providing strong evidence for seasonal growth regimes. The relative abundance of gymno- SRS-XRF is rarely used in soft-tissue regions. Two of these techniques are relatively new to paleontological studies, cation and quantification of soft-tissues in the fossil record, such as mass spectrometry, the polymerase chain reaction, scanning electron microscopy and electron microscope analysis. However, many of these techniques require destructive sampling and are unable to provide information regarding large scale spatial distribution of chemistry, including organic molecules within fossil organisms. This research takes a multiple-technique approach to examine a range of fossilised and modern organisms in order to map and compare the chemistry of soft-tissue regions. Two of these techniques are relatively new to palaeontological studies, synchrotron rapid scanning x-ray fluorescence (SRS-XRF) and Fourier Transform Infrared (FTIR) spectroscopy. SRS-XRF non-destructively provides highly sensitive, in-situ and large scale 2D elemental maps, which reveals the distribution of elements present in concentrations below the detection limits of conventional techniques. SRS-XRF is rarely used in palaeontological groups as the greater expense and limited number of synchrotrons in existence restricts accessibility. FTIR spectroscopy is also relatively new to palaeontological studies, and is useful as it can identify and spatially map the presence of organic functional groups by detecting their diagnostic infrared spectra. Key results from this study represent comparative FTIR analysis of an extinct geomorphus mant derived from organic functional groups (amide I and II) are present within individual scale structures. Comparative maps resulted from fossils show the presence of the same functional groups also within each individually preserved scale. These remarkable spatial correlations suggest that these are not modern contamination but the remnants of organic compounds that were present in the living organism. This is an unprecedented result that shows endogenous organic molecules can be preserved in-situ for over 50 million years.

POSTER SESSION II, (MONDAY)

NEW AMPHICYONID (MAMMALIA: CARNIVORA) FROM THE LOWER IRRAWADDY SEDIMENTS (MYANMAR) WITH COMMENTS ON AMPHICYON SPECIES FROM THE MIOCENE OF ASIA

EGI, Naoko, Kyoto University, Inuyama, Aichi, Japan; SEIN, Chit, Ludwig Maximilians University, Munich, Germany; MAUNG-THEIN, Zin-Maung, Kyoto University, Inuyama, Aichi, Japan; HTIKE, Thuang, Kyoto University, Inuyama, Aichi, Japan; TAKAI, Masanaru, Kyoto University, Inuyama, Aichi, Japan;

We report a discovery of an amphicyonid from the lower part of Irrawaddy Sediments in central Myanmar. The age of the fauna has been estimated as the late Miocene based on a biostatigraphic correlation with the Swiálik fauna. The materials consist of a maxillary fragment with P-M* and two mandibular fragments with incomplete M*. The Irrawaddy amphicyonid is similar to Amphicyon in enlarged second molars relative to first ones, a crenulated lingual cingulum that surrounds the protocone, a wide talonid on M1-2, and a ves-
conid on M₁, and a buccolingually wide m₁, indicating that it belongs to a new genus of the family Confinoidea. The condition in China and Siwalik. Most of Asian amphicyonids have been assigned to the genus Amphicyon, although they have been suggested to belong to different lineages from the Amphicyonidae species from other continents (Europe, North America, and Africa). Our reexamination of Asian “Amphicyon” suggests that some of the Chinese and Siwalik forms may relate more closely to other amphicyonine genera such as Yenengrini than to Amphicyon. On the other hand, the Irawaddy amphicyonid shows more similarities to European and North American Amphicyon species and one of the Siwalik “Amphicyon”, suggesting that some of Asian amphicyonids actually have an origin in the Amphicyon lineage. Although most of Asian amphicyonid materials are fragmentary, our reappraisal revealed their taxonomical diversity, which seems to have resulted from multiple immigration events from other continents and endemism in each part of Asia.

Technical Session XV, Wednesday 10:30

MACROEVOLUTION OF LARGE BODY SIZE IN MEGATOOTHED (LAMNIFORMES: OTODONTIDAE) SHARKS

EHBRET, Dana, Florida Museum of Natural History, Gainesville, FL, USA

Sharks in the family Otodontidae (i.e. Odontas and Carcharocles) include some of the largest elasichthyes species to have ever lived. Based mainly on tooth dimensions, it has long been reported that total length (TL) of these related species has increased throughout the Cenozoic. It is generally accepted that Odontas obliquus gave rise to the genus Carcharocles, which includes Carcharocles megalodon, during the early to middle Eocene. Total length estimates for O. obliquus are comparable to if not larger than adult modern white sharks (Carcharodon carcharias), which can attain lengths up to 7 meters. Meanwhile, published total length estimates for C. megalodon are upwards of 18 meters. Using a heterochrony model, we should expect C. megalodon to exhibit one of two modes of growth to attain its large size: 1) an accelerated growth rate compared to O. obliquus to become large relatively quickly or 2) a growth rate similar to but maintained longer than O. obliquus. The vertebral centra of these species can be found on rare occasions and can preserve a record of ontogeny in growth bands or “annuals”, which are truly annular in many species of modern lamniform sharks. Vertebral centra were sampled from several modern otodontid sharks including: O. obliquus from the early Eocene of Morocco, Carcharocles auriculatus from the Eocene of Belgium, Carcharocles angustidens from the Oligocene of Belgium, and C. megalodon from the Miocene of Belgium. Growth bands were analyzed using a combination of x-radiography and high resolution x-ray computed tomography (CT) scans to avoid specimen destruction. Centrum diameter at birth increased in each species through time with Odontas specimens being the smallest falling into the range of the extinct white shark (~16 – 20 mm). All species of Carcharocles had centrum diameters at birth that were larger than C. carcharias, with the largest being C. megalodon at 31.9 mm. Growth rates for O. obliquus samples appear to be equal to or slightly greater than C. auriculatus. However, growth rates for C. angustidens and C. megalodon appear to accelerate through time suggesting an early ontogenetic increase in body size.

Technical Session XVI, Wednesday 4:00

PHYLOGENETIC IMPLICATIONS OF THE PETROTYMPANIC COMPLEX OF BALEEN WHALES (CETACEA, MYSTICETI)

EKDALLE, Eric, San Diego Natural History Museum, San Diego, CA, USA; BERTA, Annalisa, San Diego State University, San Diego, CA, USA; DEMÉRÉ, Thomas, San Diego Natural History Museum, San Diego, CA, USA

We compare the anatomy of the petrotypanic complex (petrosal bone plus tympanic bulla) across 14 species of extant mysticetes in order to explore the phylogenetic significance of the region. Although the petrotypanic complex is a common source of phylogenetic information for extinct and extant cetaceans, there are few anatomical studies comparing the complex across a broad range of mysticete taxa (as exists for odontocetes). We identify 48 characters from the region and employ them in parsimony analyses of mysticetes using different data partitions including and excluding petrotypanic characters from combined morphological data sets. Our results confirm that the ear region is an important source of phylogenetic characters in mysticetes. Using petrotypanic characters alone, monophyly of major groups (Balaenopteridae, Balaenopteridae, and Balaenidae) are recovered with strong support. The same groups are recovered by morphologic analyses excluding all petrotypanic characters (although resolution is reduced within Balaenoptera), and by previous molecular analyses. Contrary to results consistently obtained from molecular data, B. musculus and B. physalus within Balaenoptera are united, and Cephalorhynchus marginata groups with balaenids within a monophyletic Balaenidae. Monophyly of Balaenidae is consistent with other morphologic results, but differs from molecular analyses, which place C. marginata within the balaenopterid lineage. Within Balaenoptera, B. borealis and B. edeni are grouped together when only petrotypanic characters are included, which is consistent with molecular analyses, but differs from morphologic studies. The relationship between those taxa is lost when the petrotypanic characters are combined with morphologic data from other regions of the skeleton. Given the phylogenetic importance of the petrotypanic complex, which preserves well in the fossil record, future studies will focus on the ear region of mysticetes in order to elucidate relationships among extinct taxa, as well as discrepancies between morphologic and molecular results.

Technical Session VII, Monday 2:45

A COMPLETE SKULL AND SKELETON OF A LONG-NECKED PLEURODIDE (PELORIDIIDA: ARARIPEMYIDAE) FROM NIGER

ELSHAFIE, Sara, University of Chicago, Chicago, IL, USA

A well preserved, articulated skull and postcranial skeleton of a small pleurodide was discovered beneath a skeleton of the spinosaurid dinosaur Suchomimus tenerensis in the Elrhaz Formation (Aptian-Albian) in Niger. CT scans of the skull documents the morphology of the endocranial and the base of basilarial canals. Many features distinguish the Nigerien turtle as a new taxon. Skull length is twice its width, and the sagittal crest is particularly long. The cheek emargination is deep and bordered distally by a maxillary prong. The peripheral series reaches the boomerang-shaped macial plate. Other distinctions include a ventrally curved dentary ramus with squared chin, unfused postzygapophyses on cervical vertebra 8, an incomplete neural series that does not contact the suprapygal, lack of carapacial vacuities, a reduced mesopleuron, and a divergent distal condyle on the first metacarpal. The Nigerien turtle is closely related to the unusual pelomedusid Araripemys barretoi from similar age sediments in the Santana Formation of northeast Brazil, exhibiting several synapomorphies that characterize Araripemys, such as the posterior extension of the internal carotid canal, elongate cervical vertebrae with postzygapophyses on cervical vertebrae 2-7 that join in the midline, a flat carapace with a granular sculptured texture, anteriorly prominent epiplastra, and three plastral vacuities. The new araripemys may help to resolve the affinities of Araripemys and, thus, basal divergences within Pleurodira. Primate character states such as reduction in the relative size of the mesoplastra suggest a basal relationship of the African species to the Pelomedusoides. Conversely, derived characters such as an incomplete neural series may place the African species higher within Pleurodira. The presence of closely related species in Brazil and Niger in sediments of approximately 110 Ma provides additional evidence of prolonged faunal exchange between South America and Africa prior to the opening of the Atlantic Ocean.

Technical Session VI, Monday 3:00

CHANGES IN MOLAR FUNCTIONAL MORPHOLOGY OF EARLY HIPPOMORPHA

BARKER, S, Sandra, Universität Bonn, Bonn, Germany; VON KOENIGSWALD, Wihgart, Universität Bonn, Bonn, Germany; MARTIN, Thomas, Universität Bonn, Bonn, Germany

During the well documented evolution of Hipparionomorpha a significant change from brachydont to hypsodont teeth occurred. The change in the brachydont to hypsodont bioclastic teeth are the brachydont to hypsodont teeth of the Lophodont to the Eocene and Oligocene represents an essential modification in mastication and diet. Measurements on 3D surface models of upper tooth rows demonstrate that in both Equidae and Palaeotheriidae the efficiency of cutting and shearing is increased on the buccal side, whereas on the lingual side two different functional paths are taken. In the primate genera Hyracotherium and Propalaeotherium cutting and shearing on the buccal side is slightly increased compared to the functional precursor Phenacodus and this tendency is even more strongly expressed in the more derived Anchitherium and Palaeotherium. The inclination angle of the developing mesostyle is steepening, displaying an enhanced efficiency for cutting and shearing. The relative surface of the buccal facets and length of the mesostyle is even more strongly expressed in the more derived Anchitherium and Palaeotherium. In the primate genera Hyracotherium and Propalaeotherium cutting and shearing on the buccal side is slightly increased compared to the functional precursor Phenacodus and this tendency is even more strongly expressed in the more derived Anchitherium and Palaeotherium. The inclination angle of the developing mesostyle is steepening, displaying an enhanced efficiency for cutting and shearing. The relative surface of the buccal facets and length of the mesostyle is even more strongly expressed in the more derived Anchitherium and Palaeotherium.
steep inclination of the facets the shearing forces can be drained off diagonally and no high lingual tooth base is needed. Anchitherium apparently has a one phase power stroke, such as the modern horses with hypsodont cheek teeth, and has a well expressed shearing and cutting function buccally and lingually. Palaeotherium has no lingual facets, but classical phase II facets that are relatively flat, indicating a two phase power stroke. Palaeotherium and Phenacodus have a high lingual tooth base, capable to absorb high vertical forces that occur in crushing. Anchitherium probably mainly fed on food that could be processed by cutting and chewing such as leaves. In contrast to Anchitherium, Palaeotherium was able to break up harder food items, such as hard fruits. Therefore it can be deduced, that Palaeotherium had a wider diet breadth, but was not as efficient in cutting and chewing as Anchitherium.

Poster Session IV, (Wednesday)

A PORTUGUESE SPECIMEN OF CAMPITOSAURUS APHANOCECTES (ORNITHOPODA: CAMPITOSAURIDAE) INCREASES THE DINOSAURIAN SIMILARITY AMONG THE UPPER JURASSIC ALCOBACA AND MORRISON FORMATIONS

ESCAFO, Fernando, Facultad de Ciencias UNED, Madrid, Spain; SILVA, Bruno, Laboratorio de Historia Natural daAssociacion Leonel Trindade, Torres Vedras, Portugal; ORTEGA, Francisco, Facultad de Ciencias UNED, Madrid, Spain; MALAFAYA, Elíssabete, Museu Nacional de Historia Natural (Universidade de Lisboa), Lisboa, Portugal; SANZ, Jose Luis, Depto Biologia UAM, Madrid, Spain

The ornithopod dinosaur fauna from the Upper Jurassic Lusitanian Basin (Central-West Portugal) is poorly known and mainly represented by isolated bones and teeth. At present, just occasionally, some partial skeletons are found, but the incompleteness of the available specimens does not allow a robust interpretation of the composition of the ornithopod assemblages from these ecosystems. In this context, the discovery of a new and, so far unknown ornithopod species is noteworthy for the European record. The specimen consists of a partial skeleton from the upper Kimeridgian beds of the Alcoaça Formation in Praia da Corva’s cliffs (Torres Vedras Municipality, Portugal). The possession of a slightly arched scapula with the distal end of the blade posteroventrally sloped, and a humerus with a low and rounded deltopectoral crest, are some of the features exclusively shared, among the camptosaurids, by Campitosaurus aphanocectes, previously recognized in the North American Morrison Formation. The extension of this North American camptosaurid to southwestern Europe corroborates the high similarity between the dinosaur fauna of these two coeval Laurasian land-masses. That indicates some degree of geographical relationships and ecological similarity between them. Prior to this discovery, the Alcoaça Formation had already yielded remains of three dinosaur species, the plated dinosaur Stegosaurus armatus and the carnivorous Allosaurus fragilis and Torvosaurus tanneri. Thus, the Portuguese Alcoaça Formation contains a unique Upper Jurassic European record of four intercontinental dinosaur species.

Technical Session IX, Tuesday 8:00

RAPID EVOLUTIONARY RATES OVER GEOLOGICAL TIMESCALES IN MAMMALS

EVANS, Alistair, Monash University, Melbourne, Australia; JONES, David, Monash University, Melbourne, Australia; IMPPS RCN: INTEGRATING MACROECOLOGICAL PATTERN AND PROCESSES ACROSS SCALES, University of New Mexico, Albuquerque, NM, USA

Quantifying evolutionary rate is fundamental to understanding the processes underlying evolution. Most recent work has focused on calculating evolutionary rates on short timescales (<100 years or generations). These studies have demonstrated that evolution can proceed relatively rapidly over such brief intervals. Fewer studies have quantified evolutionary rate in fossil organisms, and the perception remains that evolution over geological timescales is always very slow; published measurements of mammal evolution over longer than 10^6 years or generations tend to reveal very low rates (<10^-5 haldanes, <10^-1 InSD change, <1 dawkins, <1 factors of e). Previous rate estimates focused on analysing the central tendency of single lineages, which will underestimate the maximum potential rate of evolution. Instead we calculate rates for clade maxima rather than the means of single lineages. We compiled the maximum body size within 28 mammal orders on the four largest continents (Africa, Eurasia, and N. and S. America) and the ocean basins for all sub epochs during the last 70 million years, covering the well-documented mammalian radiation following the K-Pg mass extincion. Here we show that rates of macroevolution (>10^-6 years or generations) can be an order of magnitude faster than previously reported: in the mammalian radiation following the K-Pg mass extincion, body size evolved at up to 10^5 haldanes or 10^1 SD change over 10^7-10^10 generations. This demonstrates the presence of sustained directional selection upon component lineages of the mammal clade over very long timescales.

Technical Session I, Sunday 10:30

ASANTAÑON-AGED PACHYCEPHALOSAURID FROM NORTH AMERICA AND THE EVOLUTION AND DIVERSITY OF PACHYCEPHALOSAURIA

EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; SCHOTT, Ryan, University of Toronto, Toronto, ON, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; BROWN, Caleb, University of Toronto, Toronto, ON, Canada; LARSON, Derek, University of Alberta, Edmonton, AB, Canada

Pachycephalosaurus (Ornithischia: Marginocephalia) is a clade of small- to medium-sized herbivorous dinosaurs characterized by a prominent thickening of the skull roof. The evolutionary history of this group is one of the most poorly understood aspects of dinosaurian evolution due to limited knowledge of their anatomy and their poor fossil record. New fronti-

toparalogs from the Santonian-aged Milk River Formation of Alberta reveal the anatomy of the earliest known North American pachycephalosaurid. This material includes a complete well-preserved frontoparietal that is remarkable for having a fully developed dome. The morphological distinctiveness of the new taxon was tested quantitatively using bivariate and multivariate landmarked-based morphometric analyses performed on a dataset of 15 complete pachycephalosaurid domes representing most named taxa. Bivariate plots reveal that the new taxon is distinct in the proportion of its large supraorbitals, and has a well-expressed shearing and cutting function in the dome, loss of supratemporal fenestrae, and loss of a prominent parietoquadrangular shelf, predate the Campanian and the occurrence of named putatively basal flat-headed and incompletely domed taxa. A species-level phylogenetic analysis of Pachycephalosaurus using a new character matrix results in a strict consensus tree in which the new Milk River taxon occurs in an unresolved polytomy with the membranifrons and pachycephalosaurid taxa. Phylogenetic diversity metrics, calculated through time calibration of the phylogenetic results, suggest considerable undiscovered pachycepha-

Poster Session IV, (Wednesday)

THE USE OF SEARCH AND RESCUE AND TECHNICAL (ROPE) RESCUE TECHNIQUES IN THE AID OF PALEONTOLOGICAL FIELDWORK

EVANS, Thomas, Montana State University, Bozeman, MT, USA

Working in steep terrain or moving heavy jackets are common hazards and difficulties encountered during paleontological fieldwork. Normally these conditions are accepted and a brute force approach to overcoming them is adopted, even though this often exposes personnel and fossils to hazardous conditions. The search and rescue (SAR) community has developed techniques that can be used to overcome the hazards of steep terrain and moving a heavy fragile package (injured person) over rough terrain efficiently and safely. Conse-

sequently SAR methods can be used without training or the use of trained volunteers. Normally seven functions can be performed by ropes: Equipment transport, work safety, work positioning, rope access, raises, lowers, and lateral movement. Equipment transport is simple and in-

volves minimal training, while work safety and work positioning are methods of protecting an investigator from potential fall when working around steep or rugged terrain. Rope access allows the investigator to access locations that would otherwise not be accessible without ropes (cliffs, etc.) Rises, lowers, and traverses are ways of moving large fragile masses over terrain features, doing so safely, gently, and efficiently. These techniques require signifi-

antly more training, but are more useful. All methods will be illustrated naturally and with pictures in training or practice, when possible. This presentation is not intended as a rope techniques or rescue training course, so the depicted methods should not be used without training or the use of trained volunteers. Consequently, information concerning where to gain training will be provided as well as initial contact information for sources of trained volunteers.

Poster Session IV, (Wednesday)

CHEWING MOVEMENT AND TOOTH FUNCTION IN BASILOSAURUS ISIS (MAMMALIA, CETACEA) BASED ON DIGITAL ANALYSIS OF WEAR FACETS

FAHLKE, Julia, University of Michigan Museum of Paleontology, Ann Arbor, MI, USA; WOOD, Aaron, University of Michigan Museum of Paleontology, Ann Arbor, MI, USA; GINGERICH, Philip, University of Michigan Museum of Paleontology, Ann Arbor, MI, USA

Modern whales swallow their prey whole (Odontoceti) or filter-feed (Mysticeti), but they evolved from Eocene Archaeloceti that have complex cheek teeth with wear facets that indicate chewing movements. To determine jaw movement and tooth function in archaeocetes, we analyzed the orientation of wear facets and striations in Basilosaurus isis, one of the best known archaeocete species. Cranial remains studied here are part of a virtually complete skeleton, WH-74, collected from the late Eocene Birket Qarun Formation of Wadi Hitan, Egypt. We constructed a 3D surface model of the skull and mandibles from CT scans, and recalculated the surface of the plastically deformed skull to remove twisting and shearing deformation. High-resolution surface scans of individual teeth were digitally aligned to the consensus tree in which the new Milk River taxon occurs in an unresolved polytomy with Protocyon and pachycephalosaurid taxa. Phylogenetic diversity metrics, calculated through time calibration of the phylogenetic results, suggest considerable undiscovered pachycepha-

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and flanking cuspules were likely caused by forceful tooth-food contact during orthal crush, which resulted in breakage of the apices. 3) Large flakes of enamel and dentine were spalled from both lateral sides of the cheek teeth, probably also due to high forces applied to the tips. This explains areas of open dentine exposed on the buccal sides of the upper cheek teeth. These areas were further eroded by tooth-food contact. Left molars and premolars are worn more heavily than right ones in WL-74 and show different patterns of facet orientation, implying an individual preference for chewing on the left side. Further quantification of striation directions combined with facet data of upper and lower cheek teeth will yield precise information on the directions and distances of jaw movement throughout the chewing cycle.

Technical Session X VI, Wednesday 2:00
THE FOSSIL RECORD OF EXTINCTION: THE DEMISE OF THE BLUE ANTELOPE (HIPPOTAGOS LEUCOPHAEUS) IN SOUTHERN AFRICA
FAITH, John, The George Washington University, Washington, DC, USA

The extinction of southern Africa’s blue antelope (Hippotragus leucophaeus) in the early 19th century marks the first large African mammal to become extinct in historic times. Because the blue antelope disappeared before scientists could observe live populations, the fossil record is the primary source of information regarding the ecology of the blue antelope and its processes responsible for its demise. This study provides new data on the blue antelope’s fossil history and evaluates the causes of its extinction. Examination of fossil occurrences over time shows that blue antelope became increasingly rare within a steadily shrinking geographic range since the terminal Pleistocene (24–12 ka). Revised specimen counts from Nelson Bay Cave (NBC) show this trend to be associated with declining abundances of graving ungulates, suggesting that suitable grasslands were disappearing. The demographic structure of the NBC blue antelope, reconstructed from dental crown height, shows a reduction in median and maximum age not seen in other ungulates. This age profile is consistent with increased mortality rates and declining population densities. Previously proposed extinction mechanisms include resource competition and habitat degradation associated with the arrival of pastoralists 2,000 years ago and overhunting by European settlers. However, the observed time-depth of the decline in blue antelope range and abundance predates the arrival of both by thousands of years. Although they may have been incidental contributors to the extinction, they are unlikely to have been the primary drivers. Rather, the extinction of the blue antelope is best explained as the result of long-term environmental change operating through the Holocene. Southern Africa’s late Quaternary extinctions have been previously characterized as a synchronous event taking place at the Pleistocene/Holocene transition. Recent evidence, however, shows the extinction chronology to be increasingly complex, with a number of extant ungulates surviving well into the Holocene. The extinction of the blue antelope can be viewed as the most recent of a long-term extinction process spanning the last 18,000 years.

Poster Session I, (Sunday)
MUDDYING THE WATER: TRACK FEATURES TYPICAL OF LIMB KINETEMAS FORMED THROUGH NORMAL SUBSTRATE DEFORMATION, AS SHOWN BY FINITE ELEMENT ANALYSIS EXPERIMENTATION
FALKINGHAM, Peter, University of Manchester, Manchester, United Kingdom; MARGETTS, Lee, University of Manchester, Manchester, United Kingdom; MANNING, Phillip, University of Manchester, Manchester, United Kingdom

The fossilized tracks of vertebrates present the only direct evidence of locomotor mechanisms and other aspects of the paleobiology of extinct animals available from the fossil record. Track morphology, specifically variations in track depth and features associated with the base of the track, has traditionally been used to infer peak under-foot pressures or varying ground reaction force vectors associated with limb kinematics (e.g., touch down, weight bearing, and kick off phases). However, a track represents the interface between animal and substrate, resulting from the effects of both biomechanics and soil mechanics. Virtual experiments carried out using finite element analysis have shown that features at the base of a track, superficially similar to those hypothesized to result from limb kinematics, can be formed through pure substrate mechanics irrespective of the limb motion or loading. Displacement of the substrate beneath a vertically loaded indentation ridge is typical (though not always）to the formation of three-phase limb movement) in undruckts. Asymmetric indents, such as those used here to represent theropod pedes, produce tracks deeper at the posterior when loaded vertically and uniformly. These experiments show the importance of fully characterising a substrate, and reproducing tracks in the lab experimentally, before interpreting limb kinematics from fossil tracks.

Poster Session IV, (Wednesday)
A COMPARISON OF THE TAXONOMIC COMPOSITION OF MEDIAL MIOCENE EQUIDS (MAMMALIA: PERISSODACTyla) FROM THE MISSION PIT, SOUTH DAKOTA AND ASHFALL FOSSIL BEDS, NEBRASKA
FELICE, Ryan, Ohio University, Athens, OH, USA; O’CONNOR, Patrick, Ohio University, Athens, OH, USA; FLEAGLE, John, Stony Brook University, Stony Brook, NY, USA

The Cabeza Blanca locality (Sarmiento Formation) in Chubut Province, Argentina, is one of the most productive fossil-bearing localities of Oligocene age in Argentina. The fossiliferous Desadanagen (29–21 Ma) unit of the formation represents channel-fill deposits. Several mammalian clades have been recovered to date, including a number of rodent, palaecothentid marsupial, and notoungulate taxa. The fossils described herein provide a glimpse of the Cabeza Blanca avifauna and include several isolated, fragmentary limb elements. Nonetheless, character information contained within the preserved morphology allows for preliminary nomenclatural inferences. The majority of the avian remains are designated to the tribes Coryphini and Columbiformes with the exception of a possible Pelecaniform taxon. Because the avifauna is described from a single locality, it is important to consider the possible implications for understanding the taphonomy and paleoecology of the area. The presence of a large number of isolated avian remains suggests that the Cabeza Blanca avifauna is part of a drop-down association, and may represent the remains of a single avian species that inhabited the region during the Oligocene.

Poster Session IV, (Wednesday)
NEW FOSSIL BIRDS FROM THE DESEANAN (LATE OLIGOCENE) OF ARGENTINA
FELICE, Ryan, Ohio University, Athens, OH, USA; O’CONNOR, Patrick, Ohio University, Athens, OH, USA; FLEAGLE, John, Stony Brook University, Stony Brook, NY, USA

The Cabeza Blanca locality (Sarmiento Formation) in Chubut Province, Argentina, is one of the most productive fossil-bearing localities of Oligocene age in Argentina. The fossiliferous Desadanagen (29–21 Ma) unit of the formation represents channel-fill deposits. Several mammalian clades have been recovered to date, including a number of rodent, palaecothentid marsupial, and notoungulate taxa. The fossils described herein provide a glimpse of the Cabeza Blanca avifauna and include several isolated, fragmentary limb elements. Nonetheless, character information contained within the preserved morphology allows for preliminary nomenclatural inferences. The majority of the avian remains are designated to the tribes Coryphini and Columbiformes with the exception of a possible Pelecaniform taxon. Because the avifauna is described from a single locality, it is important to consider the possible implications for understanding the taphonomy and paleoecology of the area. The presence of a large number of isolated avian remains suggests that the Cabeza Blanca avifauna is part of a drop-down association, and may represent the remains of a single avian species that inhabited the region during the Oligocene.
Poster Session III, (Tuesday)

A METRIORHYNCHID CROCODYLIFORM BRAINCASE FROM NORTHERN CHILE

FERNÁNDEZ, Marta, Museo de La Plata, La Plata, Argentina; PAULINA CARABAJAL, Ariana, Museo Carmen Funes, Av. Córdoba 55 (8318), Plaza Huincul, Argentina; GASPARINI, Zulma, Museo de La Plata, La Plata, Argentina; HERRERA, Yanina, Museo de La Plata, La Plata, Argentina; CHONG, Guillermo, Departamento de Ciencias Geológicas, Universidad Católica del Norte, Antofagasta, Chile

Metriorhynchids were a group of Mesozoic crocodyliforms completely adapted to a marine lifestyle. Although there are a large number of metriorhynchid skulls, mainly from the Middle and Upper Jurassic from the European margins of the Western Tethys, most of them have collapsed into a single layer. This has confounded accurate braincase descriptions. A three-dimensional metriorhynchid braincase of Metriorhynchus cf. westernmanni from the Oxfordian of northern Chile has excellent preservation and shows details of the sutures. X-ray computed tomographic (CT) scanning provides internal anatomical details. The general pattern of the orbitotemporal region is consistent with that described by others in the basal thalattosuchian Pelagosaurus typus. The specimen from northern Chile shares with other metriorhynchids (Cricosaurus araucanensis, Metriorhynchus westermanni, M. casamiquelai and Dakosaurus undiniensis) a dorsally exposed laterosphenoid-prootic suture that forms a blunt crest separating the dorsoventral fenestra into two muscular fossae, and a quadrate that is incompletely sutured to the braincase. The main difference in the orbitotemporal region is that in the Chilean specimen, and the other metriorhynchids examined, the trigenimal fossa is mostly positioned caudal to the trigenimal foramen, whereas in Pelagosaurus typus it is rostral and caudal to the trigenimal foramen. The CT scans reveal the presence of enlarged dorsal dural venous sinuses overlying the brain, a paired tube-like cavities connecting the cranioquadrate passage to the dorsal dural venous sinus, and a well developed sinus within the quadrate. The large foramen ventrolateral to the occipital condyle, characteristic for metriorhynchids, is confirmed as the opening for the internal carotid artery.

Poster Session II, (Monday)

THE FIRST TERTIARY POSTCRANIAL CARNIVORE SKELETON FROM SOUTH CENTRAL MEXICO: DESCRIPTION AND PALEOBIOLOGICAL SIGNIFICANCE

FERRUSQUÍA-VILLAFRANCA, Ismael, Instituto de Geología, Universidad Nacional Autónoma de México, México, Mexico; AFA-GUARDIOLA, Santiago, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México, México, Mexico; RUIZ-GONZÁLEZ, José, Instituto de Geología, Universidad Nacional Autónoma de México, México, Mexico; MARTÍNEZ-HERNÁNDEZ, Enrique, Instituto de Geología, Universidad Nacional Autónoma de México, México, Mexico; ALVAREZ-REYES, Gerardo, Instituto de Geología, Universidad Nacional Autónoma de México, México, Mexico

A nearly complete postcranial skeleton was recovered from the Arroyo Atopoltitlan, ~6.6 km south of Tehuitzingo, Puebla (north-central Sierra Madre del Sur Morphotectonic Province). The bearing strata belong to the Tehuiztungo Formation, a ~40 m thick, 15°-20° NE dipping fluvios-lacustrine sequence, which records clastic sedimentation in a narrow (~15 km wide) basin (graben?) developed on the Early Paleozoic Acatlán Complex. Estimates on the former unit’s age vary from Late Miocene to Pleistocene, however its structural dip and the carnivore it bears date it to pre-Pleistocene.

The specimen, a fairly complete, articulated skeleton includes the vertebral column, eight right ribs, both right and left fore and hind limbs, and several small, disarticulated fragments. The appendicular skeleton is that of a cursorial, ~45-50 cm shoulds, high mammal. The manus and pes are fully digitigrade, i.e., with long and slender metacarpals/metarsals and phalanges, the third ones are acute and clawed; the well developed sesamoid bones are related to an effective toe flexion system, common in fast running digitigrade carnivores.

The skeleton is that of a generalized mammal, save the manus and pes which are remarkably like those of canids, a fact used to refer the fossil to this family. Further, the lack of an entepicondylar foramen in the humerus, the relatively long radius/tibia compared to the humerus/femur, and metatarsal I respect to metatarsal II, within the Caninae. Most North American Caninae are known from the Late Miocene onward.

Taphonomically, this canine probably died on or close to an edge shore of a flood plain, got adrift, thus avoiding scavenging, rotted there, and became inflated by decomposition gases; the head being heavier became separated from the carcass, whose limbs eventually adopted unusual flexing position, and eventually come to rest on the bottom, becoming buried by subsequent fine clastics sedimentation. Much later on, erosion uncovered the burrial place, and partly “peneplaned” the specimen, thus eliminating most of the thorax left half, exposing only a series of small spool-shaped whitish squares that contrasted with the pale red embedding rock.

Poster Session II, (Sunday)

AN EXAMPLE OF UNDICHA, THE FISH SWIMMING TRACE, FROM THE DEVONIAN CATSKILL FORMATION, EASTERN PENNSYLVANIA

FILLMORE, David, Kutztown University, Kutztown, PA, USA; LUCAS, Spencer, New Mexico Museum of Natural History, Albuquerque, NM, USA; SIMPSON, Edward, Kutztown University, Kutztown, PA, USA; SZAJNA, Michael, State Museum of Pennsylvania, Harrisburg, PA, USA

We document the first record of Undicha from the Catskill Formation in eastern Pennsylvania, strata of Devonian age near Trout Run, Lycoming County, Pennsylvania. Reports of Undicha specimens from the Devonian are rare, and we are aware of only four such reports from Europe and the British Isles. Therefore, these Undicha trails are the oldest reported examples from North America. The Undicha specimens are preserved in concave hyporelieve (part and counterpart were recovered) on a fine-grained mudstone. This record of Undicha from the fluvial deposits of the Catskill Formation occurs on the crests of mud-flapped ripple bedforms, in association with a diverse assemblage of other lithologic features, including fossil fish remains (bones, scales), invertebrate ichnotaces (e.g., Diplichnites, Planolites), sedimentary exposure features (raindrop impressions, mudcracks), and frequent examples of fluvial ripples. The Undicha traces consist of isolated, solitary, well-defined, narrowly incised, sinuosoidal wave lines that have a wave length of 28 mm, wave amplitude of 5.0 mm, and a wave line width of approximately 0.1 mm. The ichnogenus Undicha is the swimming trace of a fish that usually consists of a series of sinuosoidal waves made on soft sediment at the bottom of standing water by the fins of a fish swimming by angulariform locomotion. The single sinuosoidal waves of the Catskill Formation specimens justify assignment to the ichnogenus Undicha. The Catskill Formation record of Undicha indicates the presence of a small fish with a caudal fin that touched the sediment during periods when subaerial surfaces were subaqueous. The length of the fish is estimated at 2.0 cm (4 times the wave amplitude of the trail).

Poster Session III, (Tuesday)

DIVERSIFICATION OF MIOCENE MAMMALS IN NORTH AMERICA, WITH RESPECT TO TECTONIC AND CLIMATIC HISTORY

FINARELLI, John, University of Michigan, Ann Arbor, MI, USA; BADGLEY, Catherine, University of Michigan, Ann Arbor, MI, USA

Modern biodiversity displays striking regional- to continental-scale geographic gradients in species richness. One such gradient is the increase in species richness in topographically complex regions (e.g., active tectonic provinces) as compared to tectonically pass- sive lowlands. Ecological mechanisms that could potentially explain higher richness in topographically complex regions include niche partitioning among heterogeneous habitats across elevational gradients, which would increase potential species accommodation and, consequently, regional diversity. Here, we investigated evolutionary processes contributing to the elevational diversity gradient. If topographic complexity is responsible for increased regional diversity, then we should observe greater species richness in the fossil records of tectonically active regions than of tectonically passive settings. We analyzed 418 rodent species from fossil localities in western North America spanning 25 to 5 Ma, comparing diversification histories for the tectonically active montane West and quiescent Great Plains. Although diversification histories did differ between regions, neither per million-year species richness, origination rates, nor extinction rates were systematically biased over this interval. Rather, there were periods during the Miocene, when species richness in either region was greater than in the other. In addition, instances occurred in which rates of origination, extinct- ion and net diversification for either region were significantly greater than the other. This pattern suggests that the modern elevational diversity gradient is a transient feature, arising during particular episodes of Earth history. In the montane region, the greatest increase in both origination and species richness coincided with a Middle Miocene episode of intensi-
fied tectonic activity and global warming. Subsequent global cooling resulted in dramatic species-richness decline in the montane region and increased richness on the Great Plains. These results suggest that an interaction between tectonic activity and climate change was mediating mammal diversification.

Poster Session II, (Monday)

**BLOCK 124: A LOOK INTO THE HISTORY OF A 100-YEAR-OLD FIELD JACKET FROM THE CARNEGIE QUARRY, DINOSAUR NATIONAL MONUMENT, UT**

FINLAYSON, Heather, Utah Field House of Natural History State Park Museum, Vernal, UT, USA; TEMME IV, Thomas, SWCA, Vernal, UT, USA; GRAY, Dale, Utah Field House of Natural History State Park Museum, Vernal, UT, USA

The Utah Field House of Natural History State Park Museum has had in storage for 30 years, a field jacket (Block 124) from the original Carnegie Museum excavation at Dinosaur National Monument, UT. Upon the 100th anniversary of Earl Douglass’ 1909 discovery of the monument, staff at the Utah Field House decided it would be appropriate to open Block 124, to see what was left within. After preparation, a Sarcosaurus caudal vertebra was revealed. The fossil was wrapped in layers of plaster and burlap bandages, however, no separator between the bandages and bone was used. This jacketing technique is still used today with little variation. It has proven over time to be a tried and true method for protecting fossils as indicated by the condition of Block 124 after 100 years. Working on this fossil prompted several questions: Who was the first paleontologist to use plaster jacketing as a way to package fossils and who was the first person to use toilet paper or other paper products as a separator? These and many other questions prompted the bigger question: How have fossil excavation techniques evolved throughout the history of paleontology and what techniques were used during the excavation of the Carnegie Quarry? Using mainly hammers, chisels, shovels and picks, the removal of over 350 tons of fossils and rock from the quarry occurred from 1909 to 1924. All of the bones, including Block 124, were shipped in wooden crates via horse-drawn wagons and trains back to the Carnegie museum. Because technology lagged behind out west, the low-tech but dependable method of jacketing allowed these valuable resources to be transported safely back east where the proper resources existed to prepare and display these fossils. Today, in addition to using the same tools and techniques as the paleontologists of the past, we now use tools like hammer drills and jackhammers powered by gas and smaller pneumatic tools run on compressed air to facilitate excavation and fossil preparation. Furthermore, new methods and techniques are constantly being developed and tested to further improve the safe recovery of fossils.

**Poster Session I, (Sunday)**

**A NEW DINOSAUR ICHNOFAUNA FROM THE LATE CRETACEOUS OF WRANGLER-ST. ELIAS NATIONAL PARK AND PRESERVE, ALASKA**

FIORILLO, Anthony, Museum of Nature and Science, Dallas, TX, USA; ADAMS, Thomas, Southern Methodist University, Dallas, TX, USA; KOBAYASHI, Yoshitsugu, Hokkaido University Museum, Sapporo, Japan

An unnamed nonmarine sedimentary package of rocks in southeastern Alaska in Wrangell-St. Elias National Park and Preserve, the largest national park in the United States, has provided the first evidence of dinosaurs for this vast region. The rock unit is contained within the Wrangellia Terrane and exposures are of limited geographic extent. Sections are overwhelmingly dominated by intraformational conglomerates. Fine to medium grained light colored sandstones are common and medium gray shales occur as minor components to the sections. Field parties found evidence of a small theropod and ornithopods. The theropod impression is approximately 12 cm long and 10 cm wide. Attribution to the Theropoda was based on the sinusoidal shape of the impression of the middle digit. Ornithopod impressions, identified by clearly blunt and rounded digit impressions, are approximately 21-28 cm long and 23-30 cm wide. All impressions were undertracks. Pollen samples failed to produce diagnostic pollen but kerogen and charcoal were abundant. The abundance of charcoal suggests that fire was prevalent in this ancient ecosystem. The abundance of conglomerate and sandstone in the sections, combined with the abundance of charcoal suggest that this area during deposition was tectonically dynamic and prone to ecological disturbance. Megafossil specimens indicate an abundance of horsetails, ferns and gymnosperm wood. The rock unit is mid Late Cretaceous in age, which ranges from approximately 99 Ma to 65 Ma. The lack of angiosperm pollen and megafossil remains suggest that fossil flora composition is mapped as Late Cretaceous in age, which ranges from approximately 99 Ma to 65 Ma. The present study aims at replacing the extinction of ichthyosaurs within the global context of changes in marine ecosystems during the ‘middle’ Cretaceous. The ‘middle’ Cretaceous (Aptian-Turonian) is indeed punctuated by numerous and profound global climatic and oceanic changes, as well as intense underwater volcanism. These factors led to recurrent anoxic events, sometimes of worldwide extension. Interestingly, the peak of changes in the geosphere, taking place during the Cenomanian, coincides with major biological changes within the marine realm: the rise of polycotylid plesiosaurs, marine squames, teleost fishes and chondrichyans, the onset of the ‘Chalk sea’, and an extinction within marine invertebrates communities. Ichthyosaurs disappeared during this profound reorganization of the marine ecosystems. However, the precise mechanisms that lead to the sudden extinction of these successful marine reptiles cannot be understood in the current state of our knowledge given the multitude of possible causes occurring at the same time.

**Technical Session IX, Tuesday 11:45**

**IMPACT FRACTURING OF MAMMOTH LIMP BONE DIAPHyses (LATE PLEISTOCENE, MICHIGAN, USA)**

FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA; BELLD, Scott, University of Michigan, Ann Arbor, MI, USA

A recently reported site near Saranac, Michigan has yielded mammoth (Mammuthus sp.) remains, including a variety of dental, cranial, and postcranial material. Bones occur within sediments deposited near the margin of a late Pleistocene lake basin. No date is yet available, but the context is consistent with other late Pleistocene occurrences for which age estimates range from 12,000-10,400 RYBP. The site is well-preserved and minimally biofractured. Most interesting are limb bone diaphysis fragments showing green-bone fracture, producing bone flakes with sharp edges. Among these fragments, a partial femoral diaphysis shows a series of three, stacked, concentric, cortical fractures diagnostic of heavy percussion. Such fractures form as the energy of a blow radiates through the anisotropic, but still relatively homogenous medium of dense cortical bone. Experiments with bone breakage have demonstrated that this pattern can be produced with a boulder wielded with sufficient force, but observation of trampled bone or bone modified by freezing or other agency of ice has shown no comparable features. Impact features such as those observed at this site are thus indicative of human association, probably related to production of sharp flakes for use as cutting implements (and other activities related to carcass processing). At the surface where a county drain intersects site stratigraphy (leading to discovery of the site) a large (ca. 7.5 kg; 22 cm major axis), bifacially flaked quartzite boulder was found. This boulder was juxtaposed with in situ bone, its surface exposure and adjacent context indicating it was deposited, the Madygen freshwater environment may have formed a nursery area similar to that of recent sharks. Another similarity is the availability of hard-shelled benthos on which the young may have fed until they left the nursery. The continuous occurrence of eggs in the Madygen profile suggests a persistent use of the nursery through time. Furthermore, as indicated by the xenacanth egg capsule form type Fyolayia in Madygen strata, a second shark species shared the Madygen area. There was probably some degree of temporal partitioning, as is seen in several recent species of the same geographic area.

**October 2010—PROGRAM AND ABSTRACTS**

89A

Physical Drivers and Marine Tetrapod Evolution, Monday 8:45

RECONSIDERING THE EXTINCTION OF ICHTHYOSAURS

FISCHER, Valentin, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

Despite their extreme adaptation to life in the open sea, ichthyosaurs were one of the first major groups of post-Triassic marine reptiles to disappear, at the end of Cenomanian, where-as plesiosaurs, mosasaurs and numerous families of marine crocodiles and sea turtles disappear during the Cretaceous/Paleocene Extinction Event. It has been proposed that unique biological factors drove ichthyosaurs to extinction, namely a break in the food chain at the level of belemnites or a progressive ecological replacement by teleost fishes since the Middle Jurassic. However, new discoveries in France and Russia turn both these hypotheses unsatisfactory because ichthyosaur diversity remained high during the Early Cretaceous both from taxonomic and ecological points of view, with the persistence of several Late Jurassic genera into the Early Cretaceous and the colonization of various feeding guilds. The extinction of ichthyosaurs during the Cenomanian was therefore more sudden than previously described. The present study aims at replacing the extinction of ichthyosaurs within the global context of changes in marine ecosystems during the ‘middle’ Cretaceous. The ‘middle’ Cretaceous (Aptian-Turonian) is indeed punctuated by numerous and profound global climatic and oceanic changes, as well as intense underwater volcanism. These factors led to recurrent anoxic events, sometimes of worldwide extension. Interestingly, the peak of changes in the geosphere, taking place during the Cenomanian, coincides with major biological changes within the marine realm: the rise of polycotylid plesiosaurs, marine squames, teleost fishes and chondrichyans, the onset of the ‘Chalk sea’, and an extinction within marine invertebrates communities. Ichthyosaurs disappeared during this profound reorganization of the marine ecosystems. However, the precise mechanisms that lead to the sudden extinction of these successful marine reptiles cannot be understood in the current state of our knowledge given the multitude of possible causes occurring at the same time.
Koaliella continuous zygapophyseal crests characteristic of the genera is new and presents high neural spines, ornamented dermal plates, and antero-posteriorly Palaeobratrachidae and Pelobatidae. The presence of Discoglossidae and Bufonidae is not They are here described based on the new material from Boutersem and are compared with ards. However, amphibians are still poorly known and were only briefly mentioned in 1962. Scale for the European Paleogene. This level directly following the “Grande Coupure” is kilograms of a very rich fifteen centimeters thick layer were screenwashed. The mammals Richard, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMITH, Thierry, Poster Session I, (Sunday)

Marymus also presents key records in ctenohystrican evolution: it is the type locality for the diatomyid of European-Asiatic Oligocene muroids, such as Spanocricetodon Rodentia, are two distinctive genera. Z-113 records trees. Of principal significance in the evolution of Muroidea, the dominant group of modern delphinoids (~30 Ma), and later in the Neogene with the origin of Platanistoidea, the Namba platanistoids inhabited a humid drainage system that was part of a larger network of river and lake basins across inland Australia: a drained area equivalent to that of the Amazon Basin. We hypothesize that platanistoid invasion of central Australian basins was facilitated by rising epicontinental seas across southeast Australia during the Late Oligocene. Despite a last appearance datum being unknown, the fate of the Namba platanistoids would have been sealed by mid-Miocene onset of aridification in central Australia. This highlights the impact of sustained continental-scale environmental shifts on the evolution of marine tetrapods that have invaded freshwater.

Technical Session V, Sunday 2:00

Z-113 FLYNN, Lawrence, Peabody Museum, Harvard University, Cambridge, MA, USA

Locality Z-113 of the Zinda Pir Dome section on the western border of the Punjab, Pakistan, provides a key small mammal fossil record relevant to the evolution of several groups of rodents. Hereforefore considered early Miocene, current biochronologic understanding and available magnetostratigraphy correlate it as late Oligocene in age. The magnetostratigraphy, not fully resolved, yields two correlations: Chron C28r, latest Oligocene, about 23.5 Ma, or C29r about 26.5 Ma. Recognizing greater age is relevant for understanding the timing of evo-lution and durations of ghost lineages in diverse rodents, and for constraining molecular time trees. Of principal significance in the evolution of Muroidea, the dominant group of modern Rodentia, are two distinctive genera. Z-113 records Spanocricetodon, which plays a pivotal role in the initial radiation of the modern cricetid-murid group. It is advanced over the array of European-Asiatic Oligocene muroids, such as Eucricetodon, and is the oldest record of the genus. The basal muroid clade Spalacidae is also represented at Z-113 by Eumuricrus kowalskii. This rodent demonstrates appearance of the group by the late Oligocene, and with Spanocricetodon presents an earliest record for all crown muroids other than placentalomy- ids. This is a new minimum paleontological age to anchor molecular trees in time. Z-113 also presents key records in ctenohystrican evolution: it is the type locality for the diatomyid Marymus and for the ctenodactylid Proaspymys. Recognizing the antiquity of the latter is important because at present, Proaspymys stands as outgroup to all other ctenodactylines, including several early Miocene genera. At present Z-113 demonstrates great age of key lineages that is consistent with emerging data from Anatolia to the Junggar Basin in China. Poster Session I, (Sunday)

AMPHIBIAN DIVERSITY FROM THE EARLY OLIGOCENE BOROGLION FORMATION AT BOUTERSEM, BELGIUM

FOLIE, Annelise, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMITH, Richard, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

The localities of Hoogbult and Hoedelen in the area of Tienen, known for about five years, have yielded the oldest Oligocene terrestrial vertebrates of Belgium. A third site was excavated in 1999 in Boutersem five kilometers away from Hoogbult. Six thousand kilograms of a very rich fifteen centimeters thick layer were screenwashed. The mammals of the three sites belong to the MP21 reference-level of the mammalian biostratigraphic scale for the European Paleogene. This level directly following the “Grande Coupure” is especially interesting as the localities of this age are generally scarce in Europe. Several species have recently been described or reassessed among mammals, birds, snakes and lizards. However, amphibians are still poorly known and were only briefly mentioned in 1962. They are here described based on the new material from Boutersem and are compared with those from Hoogbult and Hoedelen conserved at the Royal Belgian Institute of Natural Sciences. Among the thousands of amphibian specimens, frogs are represented by vertebræae, ilia, urostyles, humeri and cranial bones attributed to new species of only two families, the Palaeoatrauchidae and Pelobatidae. The presence of Discoglossidae and Bufonidae is not confirmed. Salamandrids are mainly represented by vertebrae of three species. One of these is new and presents high neural spines, ornamented dermal plates, and antero-posteriorly continuous zygopophyseal crests characteristic of the genera Nototophalus, Taricha and Koaliella. Such morphology has already been reported from the early Paleocene MP1-5 of Hainin and the earliest Eocene MP7 of Dormaal, both in Belgium. The two other species that can easily be distinguished by size, present a more common morphology resembling the genus Salamandra. Despite the numerous amphibian specimens, the anurans seem thus not very diversified. Salamandrids with dermal plates are well distributed all along the Paleo- gene in Europe. Today, this group of salamandrids has disappeared from Europe but is still present in North America.

Physical Drivers and Marine Tetrapod Evolution, Monday 8:00


FORDMAN, Brady, University of Wyoming, Laramie, WY, USA; ROBERTS, Eric, James Cook University, Townsville, Australia; TAPANILA, Leif, Idaho State University, Pocatello, ID, USA; RATIGAN, Deirdre , Macauley College, St. Paul, MN, USA

The Kaiparowits Formation represents a rapidly expanding and important record of Late Cretaceous terrestrial vertebrate evolution in the Western Interior. Understanding the inter-play between alluvial processes and fossil preservation is important for regional correlation of faunas and reconstruction of paleoenvironments and paleoclimate. Deposition within the formation was complexly controlled by sea-level fluctuations, the initiation of Laramide tectonism, and the prevailing climate. These processes imprinted multi-stratigraphic patterns on the Kaiparowits, including secular shifts in paleocurrents, river planform, channel-stack-ing, flood-events, and modes of taphonomic preservation. For example, there is a decrease in channel-stacking and a shift to more anastomosing-like rivers within the middle part of the formation, which coincides with an increase in the number of river-hosted vertebrate sites. We obtained δ18O and δ13C values from unionid bivalve shells and paleosol carbonate nodules distributed throughout the ~860 m thick formation in order to constrain the forcing mechanism behind the stratigraphic patterns. River water δ18O (VSMOW) estimates (~18‰) are indicative of high altitude runoff from existing Sevier uplifts and incipient Laramide structures. δ18O estimates from soil carbonates (~8‰) represent low-elevation (i.e. within basin) precipitation. Pond water falls on a mixing line between these two end-members in terms of both δ18O and δ13C. These values and patterns are consistent with an overall humid/sub-humid climate state with monsoonal precipitation patterns, and match taphonomy of highly pedogenic soils, microfossil assemblages, and stable isotopes. Fossils provide two sorts of temporal records that can be compared with physical oceanic factors and with molecular phylogenies: 1, taxic data, such as from the Paleobiology Database; 2, stratigraphically calibrated phylogenetic data, which provide some compensa-tion for the general patchiness of the record. The odontocete clades Platanistoidea and Del-phinoidea have fossil records that show long term, apparent mirror-image, rise and fall pat-terns at the family level. Platanistoidea were diverse in the Late Oligocene-Early Miocene, as represented by marine clades including Squaleodontoidei, Squaleodelphinidae, Waipatiidae, Alloodelphinidae, and stem-Platanistoidea. Platanistoids declined rapidly in diversity in the later Neogene, leaving only 1-2 extant riverine species. Delphinoids, in contrast, reportedly include only Krentiodontidae in the Oligocene to about middle Miocene. The earliest mem-bers of the diverse extant clades Delphinidae and Phocoenidae are uncertain Late Miocene; these and other delphinoids were clearly highly speciose in the Pliocene as in modern seas. Platanistoids differ from delphinoids and other odontocetes in functional complexes of the skull and forelimb, implying quite different ecologies. Physical drivers – long-term cooling and regression – therefore probably best explain the decline of the platanistoids.
ANAGENESIS AND LONG-TERM MORPHOLOGIC TRENDS IN CHASMOSAURINAEE (DINOSAURIA: CERATOPSIDAEE) REVEALED BY A NEW HIGH-RESOLUTION CHRONOSTRATIGRAPHIC FRAMEWORK, ONTOGENETIC ANALYSIS AND DESCRIPTION OF TWO NEW TAXA

FOWLER, Denver, Museum of the Rockies, Montana State University, Bozeman, MT, USA

A robust taxonomy is an essential foundation for all studies of paleobiology and evolution. Morphological variation forms the basis upon which fossil taxa are defined but the causes, or axes, of this variation are often overlooked. It can be possible to separate methodological artifacts from the natural ontogenetic and stratigraphic position. By using recent high-resolution chronostratigraphic frameworks and morphological analysis, we can now demonstrate certain patterns of morphological change in Late Cretaceous chasmosaurines. Our work on the Pentaceratops, a Cretaceous species from Alberta, Canada, provides support for the recently revived phylogenetic hypothesis that certain younger southern species exhibit gradual enclosure of the parietal embayment that characterized Anchiceratops, providing support for the recently revived phylogenetic hypothesis - in this case, that of Anchiceratops and Pentaceratops being recovered as sister taxa. This stepwise change of morphologic characters observed in chasmosaurine taxa that do not overlap stratigraphically is supportive of evolution by anagenesis. With recent anagenetic lineages, inflection points in morphologic trends represent important shifts in selection pressures for cranial display that might be correlated to external factors. This demonstrates how high-resolution chronostratigraphic frameworks can help tease apart methodological artifacts from anagenetic change and true clade speciation.

Romer Prize Session, Monday 8:45

ANAGENESIS AND LONG-TERM MORPHOLOGIC TRENDS IN CHASMOSAURINAEE (DINOSAURIA: CERATOPSIDAEE) REVEALED BY A NEW HIGH-RESOLUTION CHRONOSTRATIGRAPHIC FRAMEWORK, ONTOGENETIC ANALYSIS AND DESCRIPTION OF TWO NEW TAXA

FOWLER, Denver, Museum of the Rockies, Montana State University, Bozeman, MT, USA

A robust taxonomy is an essential foundation for all studies of paleobiology and evolution. Morphological variation forms the basis upon which fossil taxa are defined but the causes, or axes, of this variation are often overlooked. It can be possible to separate methodological artifacts from the natural ontogenetic and stratigraphic position. By using recent high-resolution chronostratigraphic frameworks and morphological analysis, we can now demonstrate certain patterns of morphological change in Late Cretaceous chasmosaurines. Our work on the Pentaceratops, a Cretaceous species from Alberta, Canada, provides support for the recently revived phylogenetic hypothesis that certain younger southern species exhibit gradual enclosure of the parietal embayment that characterized Anchiceratops, providing support for the recently revived phylogenetic hypothesis - in this case, that of Anchiceratops and Pentaceratops being recovered as sister taxa. This stepwise change of morphologic characters observed in chasmosaurine taxa that do not overlap stratigraphically is supportive of evolution by anagenesis. With recent anagenetic lineages, inflection points in morphologic trends represent important shifts in selection pressures for cranial display that might be correlated to external factors. This demonstrates how high-resolution chronostratigraphic frameworks can help tease apart methodological artifacts from anagenetic change and true clade speciation.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 9:15

RECONSTRUCTION OF SMALL MAMMAL DIETS DURING THE NEOGENE EXPANSION OF C4 GRASSES IN THE GREAT PLAINS USING LA-IRMS

FOX, David, University of Minnesota, Minneapolis, MN, USA

The stable carbon isotope composition of fossil mammal teeth has provided important perspective on the Neogene history of grassland ecosystems in the Great Plains. Mammal teeth inherit the carbon isotope composition of their diet, thus they record the dietary proportions of isotopically distinct C3 (trees, shrubs, cool season grasses) and C4 (warm season grasses, crops) plants through time. Stable isotopic analyses of new and previously overlooked early Neogene specimens from the Fossil Forest, Utah, Texas, and New Mexico, previously considered to represent late Maastrichtian (Late Cretaceous) latitudinal biogeographic variation, can now be demonstrated as lower to middle Eocene in age. Five new chasmosaurine taxa from the Hunter Wash Member (74.56 Ma–74.11 Ma) of the Kirtland Formation, New Mexico, form morphological and stratigraphic intermediates between Pentaceratops (~74.7-75 Ma) and Anchiceratops (~72-71 Ma). Units 1 & 2, Horseshoe Canyon Member, Alberta. The new taxa exhibit gradual enclosure of the parietal emayment that characterizes Anchiceratops, providing support for the recently revived phylogenetic hypothesis - in this case, that of Anchiceratops and Pentaceratops being recovered as sister taxa. This stepwise change of morphologic characters observed in chasmosaurine taxa that do not overlap stratigraphically is supportive of evolution by anagenesis. With recent anagenetic lineages, inflection points in morphologic trends represent important shifts in selection pressures for cranial display that might be correlated to external factors. This demonstrates how high-resolution chronostratigraphic frameworks can help tease apart methodological artifacts from anagenetic change and true clade speciation.

October 2010—PROGRAM AND ABSTRACTS 91A

USING DIFFERENT MOLECULAR WEIGHTS OF CARBOWAX

FOX, Marilyn, Yale Peabody Museum of Natural History, New Haven, CT, USA

Polyethylene glycol (PEG), a long chain polymer known by its trade name Carbowax, is used commonly in preparation. Water-soluble, it is best used as a removable support for small and fragile fossils and as a temporary filler for molding. Long-term use is not recommended as it remains tacky and attracts dust. It can migrate into porous bone when applied as a melted liquid, causing staining. The molecular weight of Carbowax defines its consistency and melting point. Molecular weights range from PEG 200 (a clear viscous liquid at room temperature) to 20,000 (a hard opaque white solid) each having differing properties. PEG 3300 and 4600 are fairly hard, stiff and brittle. These grades offer good support and may be removed manually from a fragile fossil that can be damaged by immersion in water. Although most labs stock only one molecular weight of Carbowax (usually PEG 3300 or 4600), other grades are useful, and we can explore new ways of using this material. For example, a softer grade of Carbowax, needing less force to remove than PEG 3350 or 4600, can be applied directly to the bone and supported with a harder grade. At the Yale Peabody Museum, we have a variety of molecular weights of Carbowax, including PEG 1000, 3350, 4600, 8000, and 20,000. By combining PEG 1000 and 3350 in a 1:1 ratio, we have a soft, pliable paste for filling that eases some of the difficulties we have experienced with the removal of hard Carbowax after molding. By using these differing properties, by combining two different molecular weights, or by overheating PEG, which makes the product softer, the preparator can adapt the material to better serve needs for support or filling.

Technical Session III, Sunday 2:45

A NEW, EARLY PUERCAN (EARLIEST PALEOCENE) SPECIES OF PURGATORIUS (PLESIADAPIFORMES, PRIMATES) FROM SASKATCHEWAN, CANADA

FOX, Richard, University of Alberta, Edmonton, AB, Canada; SCOTT, Craig, Royal Tyrrell Museum of Paleontology, Drumheller, AB, Canada

The early Puerican Purgatorius is the most primitive plesiadapiform primate yet discovered, mostly found from middle to late Puerca strata in Montana, deposited during the interval C29N of the geomagnetic polarity time scale. Here we describe a new species of Purgatorius from the Ravenscrag Formation, at the Rav W-1 horizon, Medicine Hat Brick and Tile Quarry, southwestern Saskatchewan. This horizon occurs within C29R, making this species the earliest discovered primate now known, while strengthening the evidence that plesiadapiforms, and hence primates, originated and underwent their initial diversification in North America. Most North American mammalian local faunas correlating with C29R have been assigned to the Pu1 (earliest Puerca) interval zone, but the taxonomic composition of the mammals accompanying Purgatorius n. sp. at Rav W-1 most resembles local faunas of Pu2 age. The occurrence at Rav W-1 of Pu2 aspect mammals within C29R agrees with similar occurrences at the Hiatt and PITA Flats localities in Montana and North Dakota, also correlated with C29R. The evidence from these three sites, all in the Williston Basin, suggests that in some areas of the Western Interior Pu2 aspect mammalian local faunas were coeval with those of latest Pu1 age, having evolved earlier than commonly assumed. A Pu1 occurrence of Purgatorius also strengthens the likelihood that primates originated during the Late Cretaceous.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 9:45

PALEONENVIRONMENTAL AND PALEOCOLOGICAL INTERPRETATIONS OF ISOTOPIC RECORDS DERIVED FROM EASTERN BERINGIAN CARIBOU ANTLERS

FOX-DOBBS, Kena, University of Puget Sound, Tacoma, WA, USA; THOMAS, Daniel, University of Otago, Dunedin, New Zealand; KOCH, Paul, University of California, Santa Cruz, Santa Cruz, CA, USA

We explored isotopic patterns derived from late Quaternary caribou antlers in eastern Beringia (Alaska and Yukon). Antlers are relatively abundant and generally well-preserved in the Beringian fossil record. They record paleoecological and paleoenvironmental information from the disused time interval of antler formation, thus yielding a novel short-term window of isotopic information. We collected radiocarbon, and carbon and nitrogen stable isotope records from antler collagen, and phosphate oxygen isotope values from bioapatite. The antlers ranged in age from greater than 50,000 to 6,000 14C yrs BP, and the isotopic chronologies reflect, (1) a relatively constant diet, and 2) temporal variation related to glacial-interglacial climatic changes. We then compared these isotopic chronologies to records generated from megafauna at other high-latitude late Quaternary sites. We assessed isotopic variation within single antlers by collecting samples from antler core to rim of both modern and fossil caribou. We determined that the biological complexities of antler formation may influence isotopic interpretations; an important factor to consider in future work on fossil antlers. We also analyzed skeletal bone collagen and tooth enamel from additional dated eastern Beringian caribou and horse individuals from the same sites, and found that the antler data were comparable.

Poster Session I, Monday 2:45

TROPHIC RELATIONSHIPS BETWEEN LATE PLEISTOCENE MAMMALS FROM AUCILLA RIVER, FLORIDA: EVIDENCE FROM NITROGEN AND CARBON STABLE ISOTOPES

FRANCE, Christine, Smithsonian Institution, Washington, DC, USA; KAUFMAN, Alan, University of Maryland, College Park, MD, USA

The Aucilla River site in Florida, USA (ca. 12,000 – 15,000 °C years before present) has yielded fossil specimens representing all the major groups of mammals present during the late Pleistocene in this region. A carbon and nitrogen stable isotopic study of bone collagen from this site has provided unique opportunity to examine the trophic relationships between the herbivores, omnivores, and carnivores, as well as the vegetation preferences of the extinct megaherbivores and omnivores. Preliminary results include the following: 1) giant ground sloths show the highest statistical similarity to omnivores; 2) individual herbivore genera exhibit generalized and opportunistic feeding habit with no one genus apparently dependent strictly on C4 plants and open grasslands; 3) two genera (Castor and Ondatra) exhibit isotopic values that could be indicative of specific plant choice; 4) isotopic signatures...
from limited carnivore species (canids and small felids) suggest predation in forested habitats or areas dominated by C3 plants as opposed to predation on open C4 grasslands. Insofar as the dated interval at Auscilla River was one of geologically rapid climate change (including the Bölling/Allerod interstadial and Younger Dryas cooling event), the generalized feeding habits of these herbivores as well as widespread omnivory and biodiversity, suggest that this ecosystem was relatively stable and able to withstand rapid climate change at the end of the Pleistocene Epoch in North America.

Technical Session V, Sunday 2:30

UNGULATE DIETS REVEAL PATTERNS OF NORTH AMERICAN GRASSLAND EXPANSION DURING THE LATE MIocene

FRASER, Danielle, The University of Calgary, Calgary, AB, Canada; THEODOR, Jessica, The University of Calgary, Calgary, AB, Canada

Environmental proxies (oceanic oxygen isotopes) indicate that the late Miocene was a time of considerable climate change which favoured the expansion of C4 plants. Studies of the carbon isotope signatures of equid tooth enamel have led to the hypothesis that there was a northward expansion of C4 grasslands during the Hemphillian (~ 7 Ma). We tested this hypothesis by comparing the diets of late Miocene ungulates from two primary localities showing lateral displacement (Coffee Ranch of Texas and Cambridge of Nebraska) using hypodonto, mesowear, and microwear. We also compared the numbers of contemporaneous browsers, grazers, and mixed feeders. Comparison of the diets of the two most abundant equids from Coffee Ranch (Dinohippus interpalus) and Cambridge (Calippus sp.) showed that the latter had a more leaf dominated diet, pointing to Cambridge as a more closed ecosystem. A speciose grazing fauna at the Coffee Ranch, comprised largely of equids, is indicative of a grass dominated ecosystem while a speciose browsing fauna at Cambridge suggests a more tree dominated ecosystem. They also reveal that climate change had variable effects along the environmental gradient in C4 plant distribution. They also point to the hypothesis of seven growth changes and (2) each adult skull type develops unique characteristics. One morph has seven defining characters: a rostral comb, a tall nasal boss, wide nasal walls, a tall vaulted parietal bar, a tall horn on the median parietal bar, a relatively constricted base on the median parietal horn, and twisted caudal parietal horns (P3). The other morph has six defining characters: a long nasal boss, deep palisades on the nasal boss, middle parietal horns (P2) with a constricted base, middle parietal horns (P2) that cross the midline, a deep sulci system on the middle parietal horns (P2), and straight caudal parietal horns (P3). The two morphs reveal that many of the diagnostic traits of P. lakustai, such as the anterointernal twist in the lateral parietal horns and the rostral comb, are only expressed in one of the adult skull types (presumably male), but not in the other (presumably female). These results enable a hypothesis of sexually selected characters for this species.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

UNCOVERING THE EVOLUTIONARY HISTORY OF A LINEAGE WITH NO FOSSIL RECORD: AN ODD PATTERN OF ENCEPHALIZATION IN AN ODD-NOSED MONKEY

FRAZIER, Brenda, Penn State University, University Park, PA, USA

Several million years separate the surviving members of the Nasalis lineage in Southeast Asia from a likely fossil ancestor, Mesopithecus, in Miocene Eurasia. Indirect evidence is therefore essential to illuminate the Plio-Pleistocene evolutionary history of the prosimian and simakobu monkeys (Nasalis larvatus and Simias concolor, respectively). One approach centers on other SE Asian species for which Plio-Pleistocene evidence exists (e.g., Pongo and Trachypithecus). The other focuses on the neontology of extant Asian colobines, particularly the prosimians and simakobu monkeys themselves. In this study, 3D cranial landmark data and endocranial volumes were collected from museum specimens of Nasalis and Simias. Brain and body mass data for other extant and fossil species were taken from published sources. Morphometric variables were subjected to a variety of allometric analyses. The pattern of encephalization in the Nasalis lineage appears to be unique among documented cases in anthropoids. The smaller-bodied simakobu is less encephalized relative to its larger-bodied sister the prosimians, defying allometric expectation. Compared to other fossil and extant Asian colobines, including the other odd-nosed monkeys (Rhinopithecus and Pygathrix), the simakobu’s brain also appears anomalously small. Many modern mammals (e.g., kangaroos, bison, and orangutans) are known to be smaller than their Pleistocene forebears. In this context, the probable reduction in size of the simakobu since its divergence from other living species is not surprising. Although its relatively large orbits are consistent with ontogenetic scaling, its small endocranial volume rules out “simple” ontogenetic scaling as the primary mechanism of cranial size reduction. These observations demand alternative hypotheses to explain the evolutionary and developmental bases of the brain-body size relationships of the Miocene primates. The continual construction and revision of such a theoretical framework enhances the explanatory power of new fossil discoveries not only in this lineage, but also in other instances where gaps in the fossil record frustrate direct investigation of extinct forms.

Craniofacial Ontogeny in Pachyrhinodinosauria Lakustai: Evidence for Sexual Dimorphism in an Ornithischian Dinosaur

FRIDERICKSON, Joseph, University of Wisconsin-Milwaukee, Milwaukee, WI, USA

Pachyrhinodinosauria lakustai is a ceratopsid dinosaur known from a monodominant bone bed in Alberta, Canada. These fossils were classified into three growth stages based on size of juveniles, subadults, and adults. These growth stages are problematic because they do not specify the relative maturity of the individual specimens to one another. A goal was to test the average ontogeny hypothesis of recovery through a clade-level growth series. Using the primary literature, I found 67 hypothetical growth characters among 42 specimens. The data were analyzed in PAUP with all characters equally weighted. The analysis calculated 71,600 trees with the shortest length of 94 steps and a CI of 0.65. The strict consensus tree collapsed into a single polytomy, so a 50% majority rule consensus was obtained to summarize the hierarchical structure in the data. Instead of recovering three growth stages, a continuous growth series was obtained, where the most mature specimen split into two sister branches. This divergence may represent sexual dimorphism because (1) both skull types share an identical sequence of seven growth changes and (2) each adult skull type develops unique characteristics. One morph has seven defining characters: a rostral comb, a tall nasal boss, wide nasal walls, a tall vaulted parietal bar, a tall horn on the median parietal bar, a relatively constricted base on the median parietal horn, and twisted caudal parietal horns (P3). The other morph has six defining characters: a long nasal boss, deep palisades on the nasal boss, middle parietal horns (P2) with a constricted base, middle parietal horns (P2) that cross the midline, a deep sulci system on the middle parietal horns (P2), and straight caudal parietal horns (P3). The two morphs reveal that many of the diagnostic traits of P. lakustai, such as the anterointernal twist in the lateral parietal horns and the rostral comb, are only expressed in one of the adult skull types (presumably male), but not in the other (presumably female). These results enable a hypothesis of sexually selected characters for this species.

Stratigraphic Correlation of Judith River Formation (CAMPANIAN, UPPER CRETACEOUS) Exposures in Kennedy Coulee (NORTHCENTRAL MONTANA) to the Foremost Formation (Alberta): Implications for Anagenesis in Hadrosaur Dinosauria

FREEDMAN, Elizabeth, Museum of the Rockies, Bozeman, MT; FOWLER, Denver, Museum of the Rockies, Bozeman, MT, USA

Kennedy Coulee (northcentral Montana, USA) exposes a highly fossiliferous section of the Judith River Formation (Fm) (middle-upper Campanian, Upper Cretaceous), and is continuous with the Foremost and Oldman Fm outcrop of Alberta. Historically, a thick coal at the base of the coulee was correlated with the Tabor Coal Zone (uppermost Foremost Fm); thus, overlying sediments were considered to be mostly Oldman Fm equivalent. However, recent advancements in terrestrial sequence stratigraphic methods and their application in Alberta have prompted revision of this diagnosis, with important implications for the vertebrate fauna. The presence of thick coals throughout Kennedy Coulee suggests that the Tabor Coal Zone is not restricted to the base of the section; most if not the entire section may be Foremost Fm equivalent. This reassessment is independently supported by microvertebrates and trace fossils. An abundance of Squirtithina (Chondrichthyes) teeth in the upper portions of Kennedy Coulee suggests that the entirecoulee is Foremost Fm equivalent since Squirtithina are previously reported from the Foremost Fm but not the Oldman Fm. Two hadrosaur sites preserving new species of Gryposaurus and Brachylophosaurus are located stratigraphically high in Kennedy Coulee, ~12m below a concreted channel sandstone. Presence of fossilized wood with Teredolites borings within the channel sand is indicative of tidal influence, and hence close proximity to the Western Interior Seaway (~50km). In which case, localities ~200km east of Kennedy Coulee, such as Malta, Montana, would have still been inundated by the Western Interior Seaway at the time of deposition of the Kennedy Coulee units. Thus, Judith River Fm outcrops of Malta, Montana, and their abundant Brachylophosaurus canadensis, were deposited after the regression identified at the base of the Oldman Fm, and are therefore younger than the Judith River Fm of Kennedy Coulee and its fauna. This stratigraphic reinterpretation is further supported by the more basal morphology of the new Gryposaurus and Brachylophosaurus species, consistent with their earlier occurrence within anagenetic lineages.

The Earliest Carnivores from Africa

FRAZIER, Brenda, University of California -Los Angeles, Los Angeles, CA, USA; KYONGO, Benson, Division of Paleontology, National Museums of Kenya, Nairobi, Kenya; MACHWARAS, Matthew, Division of Paleontology, National Museums of Kenya, Nairobi, Kenya; RASMUSSEN, D. Tab, Washington University in St. Louis, St. Louis, MO, USA

Latest Oligocene deposits in the Rift Valley of northern Kenya near the village of Losodok, have yielded a number of new taxa. Most of these have been endemic African taxa such as hyaenids, proboscidians, anthropoid primates, and diamantomyid rodents. One of the few exceptions to this has been the discovery of the earliest carnivorans in Africa. The feliforms Machinarctodon bohodeus and Leptictis sp. represent the first mammalian migrants from Eurasia, and represent the first in a wave, including artiodactyls, perissodactyls, and large carnivores, that will reshape African ecosystems. These earliest carnivorans were small,
under 5kg, which may have been the key to their success and their pioneer status. Prior to this, Africa contained a number of creodont taxa, both pterodontines and proviverrines, but they were all relatively large. This meant the small prey, such as rodents and primates, were probably underutilized. As has been demonstrated before (e.g., in North America) creodonts in Africa were subject to an "evolutionary ratchet" driven to large size and specialized carnivory, leaving ecological room for these new carnivore invaders. In addition, these new taxa shed light on early small feliform taxonomy and origins, including the endemic radiation of Malagasy taxa which dates to near this time.

Technical Session II, Sunday 8:30

KOMBUSSIA (SYNAPSIDA, DICYNODONTIA) FROM THE TRIASSIC OF ANTARCTICA, A REFUGE FROM THE TERRESTRIAL PERMIAN-TRIASSIC MASS EXTINCTION

FROBISCH, Jörg, Field Museum, Chicago, IL, USA; ANGIELCZYK, Kenneth, Field Museum, Chicago, IL, USA; Sidor, Christian, University of Washington, Seattle, WA, USA

We refer fossils from the central Transantarctic Mountains in Antarctica to Kombussia antarctica, one of four Triassic dicynodont lineages known to survive the end-Permian mass extinction. The specimens show similarities in size and proportions to the South African type species K. frerensis, and also possesses autopomorphies of Kombussia, including (1) a reduced pinal foramen, (2) a narrow, fusiform prearticular bone, and (3) a bifurcation of the right tympanic bulla, justifying its recognition as a distinct species. The Antarctic specimens extend the geographic range of the genus from the South African Karoo Basin to a wider portion of southern Pangaea. Moreover, they extend the known stratigraphic range of Kombussia from the Middle Triassic subzone B of the Cynognathus Assemblage Zone into rocks that are equivalent to the Lower Triassic Lystrosaurus Assemblage Zone, thereby significantly shortening the ghost lineage of this taxon.

The composition of the lower Fremouw Formation fauna implies a trophic network structure similar to that of the ecologically anomalous Lystrosaurus Assemblage Zone of South Africa, indicating that this type of community structure may have been widespread in the aftermath of the extinction perhaps because of continuing environmental perturbations. However, the occurrence of Kombussia and Lystrosaurus mcgregori in the Lower Triassic of Antarctica, and additional discordant tetrapod first and last appearances between Antarctica and fossiliferous sites around the southwestern United States, a significant proportion of the skeleton from around the southwestern United States, a significant proportion of the skeleton remains undescribed. The lack of diagnostic material such as dorsal vertebrae has hindered attempts to characterize the skeletal morphology of Alamosaurus and to resolve its phylogenetic position. The only dorsal vertebrae described date from the Jurassic of North America, and one posterior dorsal vertebrae from the Upper Cretaceous of Argentina. The new specimens collected from the latest Maastrichtian strata of Big Bend National Park in West Texas includes the first complete adult dorsal vertebrae to be described, consisting of three anterior dorsal vertebrae and one posterior dorsal vertebrae. These specimens allow for the detailed characterization of anterior and posterior dorsal vertebrae in the species as well as general patterns of variation along the dorsal series. Pneumatization of the vertebrae is extensive, invading all but the most delicate laminae. "Normal" spongiosa persists only at articulation surfaces. The more delicate laminae. "Normal" spongiosa persists only at articulation surfaces. The more delicate

Preparators' Session, Monday 8:15

MAPPING AND RECORDING THE EXCAVATION OF A MID-CRETACEOUS CROCODILE (ARCHOSAURIA: GONIOPHOLIDAE) AT AN URBAN DIG UTILIZING A CARTESIAN MAPPING SYSTEM

FRY, Roger, University of Texas - Austin, Austin, TX, USA; MAIN, Derek, University of Texas - Dallas, Richardson, TX, USA

The Arlington Archosaur Site (AAS) located in Arlington, Tarrant County, TX is a productive fossil site on a private tract of property covering 1700 acres that has produced abundant remains of a variety of Cretaceous vertebrates. The vertebrate fossils represented range from dinosauromorphs, crocodylomorphs, and cheloniates to elasmobranchs and dipnoans, with crocodylomorphs and chelonians being most common. The site, stratigraphically located within the Mid-Cretaceous Woodbine Formation (Cenomanian; 95 Mya), represents the paleo-environment of a coastal delta plain consisting of fine grained sediments (mudstone), rich with organic material, which overlies a peat bed. During the midst of the 2009 field season, a large (~7m) Cretaceous crocodile (Goniopholidae) was discovered and excavated from the basal peat bed in a one week period. Due to the urban location of the site, the predicted potential for bad weather, and the nature of the matrix surrounding the bone bed, an emergency excavation, now known as "Crocotrama", was organized utilizing the online social networking site, Facebook. In order to facilitate the rapid removal from the field of the fossils, the site was mapped using Cartesian coordinates in a 5m x 2.5m grid system divided into 50 cm squares. Each fossil was photographed in situ, located and drawn in on its unique grid square prior to removal, wrapped using the soft and dry method in its own package with coordinates recorded on the package as well as on the site map content page and then stored for transport. As the site has expanded, additional grids have been developed by extending the original coordinate system. The original grid coordinates were marked with a GPS as well as the expansion grids and a digital map is being developed which will tie together the various dig locations throughout the 1700 acres. Besides allowing for the accurate recording of the fossils in the field, the Cartesian mapping system will allow for a map based storage system for the fossils once they are prepared plus it will provide valuable information to the researchers who will be expanding the research at the AAS into a variety of different areas.

Technical Session II, Sunday 10:45

NEW SPECIMENS AND PHYLOGENETIC RELATIONSHIPS OF THE SOUTH AMERICAN JURASSIC TRICHOdont ARGENTOCOndon FARIssORUm GAELAntO, Leandro, Universidad de Buenos Aires, Buenos Aires, Argentina; ROUGIER, Guillermo, University of Louisville, Louisville, KY, USA

Osteological remains of Jurassic mammaliamorphs in South America are only known from the Quebrada Rallada locality of the central Chubut Province, Argentina. The Jurassic deposits of this basin include the Looco Trapaletal and Cialdian Asflato formations that likely span the middle Jurassic. Three different mammaliamorph forms are found in this locality: australoplophodont, an undescribed allotherian, and a triconodont. The last, Argentocodon fariasorum, was originally described on the basis of an isolated upper molariform; several additional A. fariasorum specimens are now available, including one with which preserves upper and lower jaws, as well as a few postcranial elements. We reconstruct the dental formula as C1(3P3)/P3(1-4M3), the dentition is very similar to that of Volaticotherium antiquus, likely from the Jurassic of China, and of both of them resemble Ichthyosodon javowrvokonor from the Cretaceous of Morroco. The anatomical similarity between Argentocodon and Volaticoth- erium extends to some postcranial elements. A phylogenetic analysis including most recently described triconodonts recovers a clade formed by Argentocodon, Volaticotherium and Ichthyosodon, with a minimal mid-Jurassic age and a wide, likely Pangaeic, distribution. This clade is nested within the traditional subfamily Alloconodontinae among triconodonts, supporting Volaticotherium as a triconodontid and not as a representative of a major new clade distantly related to other triconodonts as originally reported. Postcranial similarities between Argentocodon and Volaticotherium suggest they may have had similar locomotor habits; thus, if Volaticotherium was a glider, Argentocodon likely was too.
the corresponding ecoregion had an area of approximately 595,660 km² and a perimeter of substantially isolated localities in Argentina, Madagascar and India, only evenness in the prey corresponding to the modern communities. After removing three outliers, related to sub-
classifications of the data from the Miocene of Somosaguas allowed us to determine that both indices were also interpreted as a savanna assemblage, we studied the diversity patterns of body size structure of prey was studied. For this purpose, we calculated the Shannon’s diversity and Pielou’s evenness indices. Both indices were also computed for the extinct fauna of Somosaguas. Four different quadratic regression models were calculated to define the relationships between diversity indices (Shannon’s diversity and Pielou’s evenness) and geographic characteristics (area and perimeter) of the ecoregions corresponding to the modern communities. After removing three outliers, related to substantially isolated localities in Argentina, Madagascar and India, only evenness in the prey body size structure index presented significant relationships with both the area ($\tau = 0.935; p = 0.004$) and the perimeter ($\tau = 0.945; p = 0.003$) for the modern localities. The application of these models to the data from the Miocene of Somosaguas allowed us to determine that the corresponding ecoregion had an area of approximately 595,660 km² and a perimeter of around 3,719 km. These dimensions are congruent with the size of the Iberocretianian Region during the middle Miocene. This study opens the possibility for the development of new methodologies of paleoecological inference based on the study of the ecological structure of mammal faunas.

**Poster Session I, (Sunday)**

**BRAINCASE ANATOMY OF THE BASAL DIAPSID **Youngina**CAPENSIS FROM THE LATE CRETACEOUS "SUE" QUARRY: IMPLICATIONS FOR THE ORIGINATION AND FINE-SCALE HELL CREEK FORMATION BIODIVERSITY**

GARDNER, Nicholas, Marshall University, Huntington, WV, USA; HOLLIDAY, David, University of Missouri, Columbia, MO, USA; ZHU, Helen, Marshall University, Huntington, WV, USA; O’KEEFE, F. Robin, Marshall University, Huntington, WV, USA

Detailed descriptions of the braincase anatomy of early diapsid reptiles are rare due to the difficulty of accessing this deep portion of their often small, densely mineralized skulls. Previous descriptions of the braincase of the basal diapsid Youngina capensis, an important sauropod from the Late Permian (250 Ma) of South Africa, have relied on partially preserved fossils or data that could be gathered from superficial views of the skull. We used high-resolution X-ray CT scanning (HRXCT) and Amira v. 4.0 to visualize and describe a detailed model of the neurocranial anatomy of Youngina. The braincase of Youngina shows many pleiomorphies compared to more derived reptiles. It is similar to those of captorhinids and Petrolacosaurus by the presence of a large and open fenestra ovalis. The stapes is an interesting mosaic between these primitive taxa and more derived sauropods. It is slender and lacks a dorsal process, but still possesses a large stapelid foramen. Youngina shows some derived braincase characters, such as a contact between the distal paroccipital process and the quadrate, an abducens nerve which occupies a groove on the dorsum sella rather than passing through a foramen, and large basipterygoid processes. Youngina has a vestibulocochlear morphology similar to Sphenodon, which suggests similar auditory adaptations. These new data were included in a phylogenetic analysis of basal amniotes. Our analysis finds a terrestrial younginiform clade, while the aquatic tangasaurids are basal to Neodiapsida (Youngina plus crown diapsids). The interrelationships between non-crown neodiapsids were poorly supported and collapsed in the bootstrap analysis. Missing data are abundant in this area of the tree, suggesting that future work should focus on exploring the anatomy of other basal neodiapsids.

**Poster Session I, (Sunday)**

**ISOTOPE PALEOCENOLOGY OF THE PLEISTOCENE WASIRIYA BEDS OF RUSINGA ISLAND, KENYA**

GARRETT, Nicole, Department of Anthropology, University of Minnesota, Minneapolis, MN, USA; FOX, David, Department of Geology and Geophysics, University of Minnesota, Minneapolis, MN, USA; MCNULTY, Kieran, Evolutionary Anthropology Lab, University of Minnesota, Minneapolis, MN, USA; TRYON, Christian , Department of Anthropology, New York University, New York, NY, USA; PEPE, Daniel, Department of Geology, Baylor University, Waco, TX, USA

Africa is widely recognized as the birthplace of modern humans, but their subsequent dispersal throughout Africa and into Eurasia is not well documented in the paleontological record. Thus, the discovery of in situ Middle Stone Age tools associated with well-preserved fossil animal remains marks the Wasirinya Beds of Rusinga Island in Lake Victoria, western Kenya, as an important resource for understanding the interactions among early modern humans, co-occurring fauna and the environment. The Late Pleistocene Wasirinya Beds crop out discontinuously around the perimeter of Rusinga and contain several localities with artifacts and well-preserved ungulates, micromammals and gastropods. The mammalian fauna includes both extinct species and extant taxa that do not occur in the Lake Victoria region today. Hippopotamuses and other taxa are consistent with the fluvial sediments in which fossils are found, suggesting locally wet conditions. Species such as *Oryx* (*Oryx gazella*) and Grevy’s zebra (*Equus grevyi*), in contrast, suggest the presence of an arid, open, grassland environment. Here we present a paleoecological analysis of stable carbon and oxygen isotope ratios from fossil mammal teeth (n=10), pedogenic carbonates (n=13), and sedimentary organic matter (n=22) extracted from stratigraphically equivalent measured sections at the Wakondo and Nyamita localities in the Wa-

**Poster Session I, (Sunday)**

**MICROVERTEBRATE FAUNA FROM THE MAASTRICHTIAN (LATE CRETAUCEOUS) "SUE" QUARRY: IMPLICATIONS FOR THE ORIGINATION AND FINE-SCALE HELL CREEK FORMATION BIODIVERSITY**

GATES, Terry, Field Museum, Chicago, IL, USA; MAKOVICKY, Peter, Field Museum, Chicago, IL, USA; RIEPPEL, Olivier, Field Museum, Chicago, IL, USA

The remarkably complete *Tyrannosaurus rex* fossil “Sue” FMNH PR 2081 from the Hell Creek Fm is the subject of multiple studies on the anatomy and behavior of tyrannosaurids. Although other vertebrate taxa have long been known from the site, this is the first substantive investigation documenting the microvertebrate fauna associated with Sue’s remains. The microfauna to date—obtained from screenwashing over six cubic meters of sediment collected from the preparation of the skull—is dominated by several chondrichthyan fishes such as *Lorchidion*, *Myledaphus*, and a possible new species of *Chiloscyllium* (bamboo shark); osteichthyes including *Corioph*, amidis, and gar; the amphibians *Habrosaurus*, *Scapherpeton*, and two alburnepetids. Terrestrial taxa from the site include: *Chamosp* and a varanid among other lizards, four theropod dinosaur tooth morphs, rare chasmosaur and crocodilian remains, the turtle *Cedrocoba*, and one multituberculate mammal. Amphibians are the most common faunal constituent, whereas car fish remains are relatively rare. A pattern that is in stark contrast to many other Hell Creek Fm sites. The fossils are preserved in muddy sandstone interbedded with muddy siltstone layers preserving abundant leaf fossils, which provides an indication of burial time for the assemblage if the sediment alternation is seasonal. Here we propose a new method using macrovertebrate specimens as a time proxy for microvertebrate assemblages buried in the same layer by examining the taphonomic profile of the macrofossils and comparing with accepted degeneration times. The bones of FMNH PR 2081 do not show evidence of degeneration, or other physical damage associated with long exposure. Using these taphonomic features, we estimate that the microfauna obtained from this study likely accumulated in about five years or less. Increase in the precision of accumulation times is an advance from previous methods that could produce wide ranging estimates on the order of tens to hundreds of years. The narrower time span observed here may explain some of the faunal discrepancies compared to other Hell Creek microvertebrate assemblages that are more time-averaged.


**BEYOND HINGES: 3-D JOINT FUNCTION IN ERECT BIPEDS**

GATESY, Stephen, Brown University, Providence, RI, USA; KAMBC, Robert, Brown University, Providence, RI, USA; ROBERTS, Thomas, Brown University, Providence, RI, USA

The hind limbs of ground-dwelling birds bear many of the classic hallmarks of running ability: offset femoral head, elongate distal elements, reduced fibula, fused tarsals and metatarsals, digitigrade foot posture, symmetrical pes, and toe loss. Many of these skeletal features appeared earlier in dinosaur and theropod evolution. In accordance with a 2-D paradigm, hind limb motion in birds and other dinosaurs is often characterized as parasagittal, with hingelike hip, knee, and intertarsal joints restricted to flexion/extension. Methods of skeletal motion analysis have progressed to a point where we can now ask: what is being missed when joints analysis of guineafowl are beginning to reveal the functional potential of mammal faunas.

**Poster Session III, (Tuesday)**

**APPROXIMATION OF THE DIMENSIONS OF THE MIDDLE MIocene IBERIAN SAVANNAS**

GARCIA YELO, Blanca, Museo Nacional Ciencias Naturales - CSIC, Madrid, Spain; GÓMEZ CANO, Ana Rosa, Universidad Complutense De Madrid, Madrid, Spain; SANISIDRO, Oscar, Museo Nacional Ciencias Naturales - CSIC, Madrid, Spain; DOMINGO, Laura, Universidad Complutense De Madrid, Madrid, Spain; HERNÁNDEZ FERNÁNDEZ, Manuel, Universidad Complutense De Madrid, Madrid, Spain

The aim of this research was to determine the geographical dimensions of the ecoregion as-

**Poster Session III, (Tuesday)**

**NEW HIND LIMB MOTION IN BIRDS: EVOLVING EVENTS TO FAVOR COMPLEX JOINT FUNCTION AND BIPEDALISM**

GARDNER, Nicholas, Marshall University, Huntington, WV, USA; HOLLIDAY, David, University of Missouri, Columbia, MO, USA; ZHU, Helen, Marshall University, Huntington, WV, USA; O’KEEFE, F. Robin, Marshall University, Huntington, WV, USA

Previous descriptions of the braincase of the basal diapsid *Youngina capensis*, an important sauropod from the Late Permian (250 Ma) of South Africa, have relied on partially preserved fossils—consists of several chondrichthyan fishes such as *Lorchidion*, *Myledaphus*, and a varanid among other lizards, four theropod dinosaur tooth morphs, rare chasmosaur and crocodilian remains, the turtle *Cedrocoba*, and one multituberculate mammal. Amphibians are the most common faunal constituent, whereas gar fish remains are relatively rare, a pattern that is in stark contrast to many other Hell Creek Fm sites. The fossils are preserved in muddy sandstone interbedded with muddy siltstone layers preserving abundant leaf fossils, which provides an indication of burial time for the assemblage if the sediment alternation is seasonal. Here we propose a new method using macrovertebrate specimens as a time proxy for microvertebrate assemblages buried in the same layer by examining the taphonomic profile of the macrofossils and comparing with accepted degeneration times. The bones of FMNH PR 2081 do not show evidence of degeneration, or other physical damage associated with long exposure. Using these taphonomic features, we estimate that the microfauna obtained from this study likely accumulated in about five years or less. Increase in the precision of accumulation times is an advance from previous methods that could produce wide ranging estimates on the order of tens to hundreds of years. The narrower time span observed here may explain some of the faunal discrepancies compared to other Hell Creek microvertebrate assemblages that are more time-averaged.
NEW RECORDS OF FOSSIL TURTLES FROM GREECE

GELNIAW, William, East Tennessee State University, Johnson city, TN, USA; MEAD, Jim, East Tennessee State University, Johnson City, TN, USA

Scolecophidians are known in the fossil record beginning in the lower Eocene and have been found in North America, Europe, Africa and Australia. Only vertebral remains are known, and though identification to the subordinal level have been possible using existing character sets, more refined identifications have largely been based on present distributions of the families. We present 1) a review of the known fossil record of the suborder Scolecophidia (Serpentes); 2) an assessment of previously-used vertebral characters for the identification of the group, and 3) the introduction of five new characters that can be utilized to identify vertebrae to differentiate the family Typhlopidae from Leptotyphlopidae. This is the first time that diagnostic characters have been used to identify scolecophidian vertebrae at the familial level. The characters differentiate the taxa on the basis of the shape and place of the synapophyses, shape of the cotyle, size of the zygosphene, and shape of the prezygapophyseal facets. These characters have been used to identify three newly collected fossils from two caves in Western Australia. The fossils are confidently placed in the family Typhlopidae, which is consistent with what would be expected from the modern distribution of the two families.

Technical Session I, Sunday 8:30

TURNING SEMICIRCULAR CANAL FUNCTION ON ITS HEAD: DINOSAUR DIVERSITY SUGGESTS A NOVEL VESTIBULAR ANALYSIS

GEORGI, Justin, Midwestern University, Glendale, AZ, USA; SIPLA, Justin, University of Iowa, Iowa City, IA, USA; FORSTER, Catherine, The George Washington University, Washington, DC, USA

Historically, investigations into the comparative function of the semicircular canals have focused on the size of the canals with respect to body mass. This is based on pioneering work wherein body mass was compared to canal size under two different assumptions: geometrical similarity (heads are proportionately the same size) and dynamic similarity (heads produce the same stress on the neck in proportion to body size). Previously, we reported a pattern of canal morphology in non-avian dinosaurs that correlated the relative height of the vertical canals with posture (bipedal versus quadrupedal). Interpretation of this correlation was difficult due to the absence of a size factor. Furthermore, in our analysis, macrorian sauropods were not categorized properly, showing morphologies similar to the sampled bipeds. Alternatively, analysis of dinosaur canal size using the prevailing method of scaling to body mass does not discriminate between the posture categories. Non-avian dinosaurs, however, exhibit a broad array of head sizes relative to body size with extremes ranging from the very large (neoceratopsians) to the very small (neosauropods). Therefore, we hypothesize that the use of body mass as a proxy for head size under either of the previously suggested assumptions does not capture an accurate correlate for semicircular canal function in dinosaurs. To test this hypothesis, we estimated head mass by scaling published body masses to ratios of head and body measurements. Regression of the canal dimensions against estimates of head mass produces complete separation of the functional groups with bipeds (less stable locomotion) showing larger canal dimensions (more sensitive canals) than quadrupeds of similar head size. The macrorian sauropods lie on the quadrupedal regression suggesting that this analysis has greater power than previous analyses to discriminate locomotion using semicircular canal morphology. We suggest that this new method of analysis has important implications for reinterpreting most of the previous work done on the connection between locomotion and semicircular canal function across vertebrates.

EVOLUTION OF THE MODERN AFRICAN FAUNA, Wednesday 8:00

NEW DATA ON THE PRIMITIVE UNGULATE (CONDYLARTH-LIKE) MAMMALS FROM THE PALEOCENE OF THE OULED ABDOUN BASIN, MOROCCO

GHEEBRANT, Emmanuel, CNRS-MNHN, UMR 7207, Paris, France; AMAGHZAZ, Mbarek, OCP, Khouribga, Morocco; BOUYA, Baud, OCP, Khouribga, Morocco

In Africa scarce dental remains of poorly known condylarth-like mammals have been described from few Paleocene-Eocene sites in Morocco and Senegal, in contrast to their impressive Laurasian early Tertiary fossil record. The most important discoveries are genera Abdounodus and Ocephra from Ouled Abdoun Phosphate Basin, Morocco. Since 2001, significant new material has been discovered in Sidi Chemane quarries, testifying to their early Thanetian age, ca. 60 My. Abdounodus hamidi is still known only by lower premolar-molar series. This is a specialized bunodont crushing form convergent with the kollpaniine hypsodontina. A paenungulate affinity is suggested by presence of a hypolophid, postentosulcus, labial hypsulcosulcus, crescentic trigonid crests, and cubicular-like posteristid. This is
especially reminiscent of primitive hyracoids. Primitive (e.g., bunodont, paraconid, uncom- pressed trigonid) and specialized (P1-1.2 lost, diastema) traits suggest a basal lineage lateral to crown paenungulates. Intriguing resemblances with ptilolemaids are also noted, especially with Fayum Ptilolemaia fayumensis (e.g., molar pattern, P1-1.2 lost, diastema). Ocepeia daounasiss is the best known condylarth-like mammal from Ouled Abdoun. New material includes partial skulls and lower jaws. It is distinct from Abdounasias in the advanced selenedonty suggesting a folivorous diet. It also is specialized in striking simiform-like features such as a shortened rostrum (no P1-1.2, weak diastema), C1 shape, short mandibular symphysis, deep and inflated dentary. It is more primitive than paenungulates (paraconid, no hypocone, orbit distal, basiaroundum elongate). Despite some lopholophine resemblances, Ocepeia is closer to paenungulates than to Laurasian “condylarths” (e.g., entoplophid, dilambdodontid, jugal ventral process, wide zygoma and nasal cavity). The paenungulate features of Ocepeia and Abdounasias, and their mosaic of plesiomorphies and autapomorphies suggest an early African ungulate radiation predating that of modern Paenungulata. Their possible stem paen- ungulate relationship needs to be further tested with cladistic analysis.

**Posterior Nine Teeth Homologies in Mammalia**

GIALLOMBARDO, Andrea, American Museum of Natural History, New York, NY, NY, USA; ATOL MAMMAL MORPHOLOGY TEAM, USA

The ancestral number of postcanine teeth in Marsupialia and Placentalia is seven. While marsupials primitively have three premolars and four molars, placentals primitively have four premolars and three molars. To further complicate the comparison, some Mesozoic non- placental eutherians have five premolars instead of four. The positional homology of marsupial and placental premolars and molars has been subject to much debate. The uncertainty about dental homologies is seldom addressed in recent phylogenetic analyses of therians, and where postcanine characters were scored, the implicit tooth homology was not sufficiently justified. Such a justification, however, is inevitable to accomplish a mammalian phylogeny as the one our team is attempting.

Here we present a hypothesis of dental homologies for postcanine teeth in mammals. We use the tallest and most prehensile premolar as a landmark for identifying tooth positions. The morphology of eutherians that have five premolars, and the sequence of tooth germ origina- tion in ontogeny are used to deduce the order in which premolar and molar loci were lost in Theria. We also take into account that, in the two last premolar loci in Eutheria and the last premolar locus in Metatheria, the deciduous teeth are more molarized than their respective replacement teeth. Specifically, we propose that (a) the primitive condition in Theria is the presence of five premolars and three molars (P1, P2, P3, P4, P5, M1, M2, and M3); (b) P3 is absent in Metatheria and Placentalia; and (c) the most anterior molar locus of Metatheria is homologous to the last premolar locus of eutherians; the first metatherian molar would repre- sent the retained dp5 of generalized therians. Accordingly, the generalized postcanine dental formula would be P1, P2, P3, P4, P5, M1, M2, M3 for Eutheria; P1, P2, P4, P5, M1, M2, M3 for Placentalia; and P1, P2, P4, dp5, M1, M2, M3 for Metatheria. Lack of developmen- tal evidence makes expansion of this nomenclature to non-therian mammals challenging; among these taxa, when replacement is not available, the more traditional criteria of tooth morphology and differential wear are employed to determine focus homology.

**Population Structure of Tapirus Polkensis Based on Dental Eruption and Wear**

GIBSON, Matthew, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA

Individuals of Tapirus polkensis from the Gray Fossil Site exhibit an excellent level of preservation. Intact skulls collected from the site were arranged in a rough age class system separated into 7 categories based on the teeth present and amount of dental wear. Such an eruption series is useful for general comparisons among the tapirs; however the classes do not represent an age in years due to a lack of data on living tapirs. Consequently, it is possible that some age classes may contain several years of a tapir’s life, or comparatively only a few months. In this study we place ages on individuals of *T. polkensis* from the Gray Fossil Site based on age data taken from The Baird’s Tapir Project of Costa Rica (Baird’s Tapirs, T. bairdii) ranging from 4 months to less than 1 year. Based on this system class 1 represents up to the first year of life, eruption classes 2 through the early part of 5 years 5 to over 7. Data collected from the tapirs at Gray could improve our understanding of the population found at the site. The Gray Fossil Site sample gives us insight into under- standing the structure of tapir populations both past and present, potentially aiding conserva- tion efforts of the four extant tapir species.

**Tooth Pressures, Niche Occupation and the Evolution of the Cranial Ecomorphology of Crocodylians**

GIGNAC, Paul, Florida State University, Tallahassee, FL, USA

Crocodylians exploit prey resources through the integrated functions of their skull, neuromuscular systems, and dentition, which allow them to traverse feeding niches during development. This integrated suite of anatomy also appears to have tracked available niche space within a narrow range of ecomorphology during their evolutionary history and has likely been the driving engine of their diversification. Under this paradigm the anatomical components of the cranial ecomorph are expected to covary as they tightly track resource utilization. Cranial ecomorphology of crocodylians is functional role of the dentition, through which bite forces are administered to prey items. Tooth pressure, the maximum bite force applied over the cross-sectional area of a tooth, varies among extant taxa and correlates to dietary resources. Tooth pressures of needle-toothed, slender-snouted taxa are relatively high; those of blunt-toothed, broad-snouted forms tend to be relatively low; and the pressures of medium-snouted species are in between. Although recent research has focused heavily on rostral anatomy and performance, tooth pressures are also requisite for a comprehensive un- derstanding of crocodylian feeding evolution. Teeth are readily available among extant taxa for measurements of dental form necessary to quantify tooth pressure. However, bite forces are difficult to assess owing to a myriad of inaccessible anatomical variables such as muscle size, orientation, physiology, pennation, and neural control. Recent work has shown that bite forces in crocodylians can be accurately modeled using two methods: body-size scaling and jaw adductor muscle reconstruction. Tooth pressures for extinct crocodylian taxa were derived based on these methods and compared to those reported for 23 extant species. This study showed that by pairing rostral shape, dental form, and jaw adductor muscle function with feeding-niche occupancy in extant taxa, it was possible to explicitly identify potential prey resources exploited by fossil crocodylians, categorize their feeding niches, and elucidate the evolutionary nature of phenotypic covariation in their feeding functional morphology.

**Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 8:30**

**A Functional Investigation into the Jaw Joints of Two of the Earliest Stem Mammals: Morganucodon Watsoni and Kuehneotherium Praecursoris**

GILL, Pamela, University of Bristol, Bristol, United Kingdom; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom; ROBSON-BROWN, Kate, University of Bristol, Bristol, United Kingdom; GOSTLING, Neil, State University of New York at Oswego, Oswego, NY, USA

The evolution of the jaw joint is of pivotal importance in early mammal evolution, and here we investigate feeding-induced loads at the jaw joint in two important stem mammals. The dentary condyle is notably more developed and robust in *Morganucodon*, and that *Kuehneotherium* experiences over twice as much load at the jaw joint than *Morganucodon*. However, the *Kuehneotherium* jaw gains some advantage during piercing, as *Morganucodon* experiences an increase in almost double the loading on the condyle, whereas this is less than 50% in *Kuehneotherium*. We also manipulated the ratio of muscle loads, to simulate the increasing de- velopment of the masseter musculature in mammalian evolution. There is greater reduction of force at the condyle for *Kuehneotherium* when increasing the loading of the superficial masseter by 50%. The jaw of *Morganucodon* is stiffer, whilst *Kuehneotherium* experiences...
tortion during biting. This, coupled with the poorly developed dentary condyle and relatively greater loading during biting, suggests that a surangular-squamosal contact may have been present in Kuehneotherium. In current phylogenetic analyses, Kuehneotherium is placed further up the stem than Morganucodon and this more plesiomorphic jaw articulation in Kuehneotherium illustrates the mosaic nature of early mammalian evolution.

Poster Session I, (Sunday)

FOSSIL VERTEBRATES OF THE UPPER CRETACEOUS TROPIC SHALE, SOUTHERN UTAH

GILLETTE, David, Museum of Northern Arizona, Flagstaff, AZ, USA; ALBRIGHT III, L. Barry, University of North Florida, Jacksonville, FL, USA; TITUS, Alan, Grand Staircase-Escalante National Monument, Kanab, UT, USA

Cenomanian-Turonian strata in the Kaiparowits Basin of southern Utah include the Dakota Sandstone, Tropic Shale, and lower portion of the Straight Cliffs Formation (Tibbet Canyon and Smoky Hollow members). This stratigraphic interval was deposited during a transgressive-regressive cycle of the Greenhorn Cyclothem in the Cretaceous Western Interior Seaway. Marine macrovertebrates collected from the fully marine Tropic Shale in the past decade in and around Grand Staircase-Escalante National Monument and Glen Canyon National Recreation Area span the Cenomanian-Turonian stage boundary, and include at least six genera of chondrichthyan (Scapanorhynchus, Squalicorax, Cretoxyrhina, Creotolamna, at least five species of Psychodus, and c. Ichthyodus), at least four genera of bony fish (Xiphactinus, Gillicus, and Ichthyodesmus and at least one pycnodont), three taxa of turtles (Desmatophyllum, Naomichelys, and one or more protostegids), and five taxa of short-neck plesiosaurs (Brachacochesmus, Palmulasaurus, Trinacromerum, Eopolypterus, and c. Dolichorychotops). One dinosaur in the fauna, the therizinosaurus Notrhonychus graffami, is a non-marine reptile. Using detailed molluscan biostatigraphy, the Tropic Shale can be precisely correlated with deposits of similar age (Mancos Shale) in Arizona, Colorado, and Utah, and with beds on the eastern side of the seaway (Greenhorn Limestone) in Kansas and South Dakota. The fish and reptile component of the Tropic fauna recovered to date resembles faunas of the same age in the Mancos Shale and the Greenhorn Limestone, but the reptilian fauna differs in the high diversity of short-neck plesiosaurs, the lack of elasmosaurs and mosasaurs, and the presence of the therizinosaur. The lack of long-neck plesiosaurs and mosasaurs may be a consequence of ecological differences. The therizinosaur occurrence is probably a case of glat-and-float transport from land at least 100 km to the west. In contrast with the marine invertebrate fauna, the vertebrates do not appear to have suffered an extinction event at the Cenomanian-Turonian stage boundary between 94.2 and 93.5 million years ago from the globally recognized Oceanic Anoxic Event II.

Technical Session III, Sunday 3:30

SYSTEMATIC POSITION OF THE EOCENE PRIMATE DARWINIUS MASILLAE

GINGERICH, Philip, University of Michigan, Ann Arbor, MI, USA; FRANZEN, Jens, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany; HABERSETZER, Jörg, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany; HURUM, Jørgen, Naturhistorisk Museum, Oslo, Norway; SMITH, B. Holly, University of Michigan, Ann Arbor, MI, USA

Darwinius masillae is a middle Eocene (47 Ma) adapoid primate known from a virtually-complete articulated skeleton. The skeleton was recovered from maar lake deposits of the classical Messel locality in Germany. Fossils at Messel are found by separating laminated oil shales from the deposits, enabling reconstruction and study of bones and teeth buried within the Messel specimen. To investigate the systematic position of Darwinius masillae, we carried out a cladistic analysis using 30 morphological characters published by leading authorities as distinguishing primate Strepsirhini from Haplorhini. The characters used are textbook characteristics commonly taught in courses on primate evolution, and ‘total evidence’ in the original aspiration of ’broadly representative and independent’. Strepsirhini includes Lemuridae plus Lorini. Haplorhini includes Tarsiidae plus Anthropoidea (comprising Cebidae, Cercopithecidae, and Hominoidea). Our objective was to compare the relative merits of two hypotheses: Darwinius is a strepsirhine versus Darwinius is a haplorhine. Addition of Tupaioidae as an outgroup, appropriate coding, and exhaustive search of all phylogenetic trees using PAUP yielded two most-parsimonious primate cladograms of 37 steps. These have a high consistency index (0.84) and high retention index (0.90), and differ only in the monophyly or paraphyly of Strepsirhini. Darwinius is grouped unambiguously with Anthropoidea within Haplorhini both cladograms. The shared-derived characteristics of Darwinius supporting this grouping include: (1) short rostrum (with reduced pre- molar); (2) deep mandibular ramus; (3) partially fused symphysis; (4) spatulate incisors; (5) quadrate lower molars; (6) broad mesocenumiform; and (7) loss of groinning claws. Quadrats lower molars evolved independently in strepsirhines. With the exception of this homoplasy, there are no derived characters shared with strepsirhines. Consequently, we interpret Darwinius masillae as both a crown haplornine (within the Tarsioidae-Anthropoidea crown clade) and a stem anthropoid (sharing derived characteristics with anthropoids that are not shared with tarsiods).

Poster Session I, (Sunday)

BIOSTRATIGRAPHIC CORRELATION OF A NEW TRIASSIC FOSSIL LOCALITY WITHIN THE GETTYSBURG BASIN, MARYLAND

GOLD, Maria, University of Iowa, Iowa City, IA, USA

The Fulton fossil site lies within the Gettysburg Basin in the Newark Supergroup of Maryland. It comprises red siltstones and black shales and its location within a paleorift basin makes it an important addition to our knowledge of the Triassic history of the Atlantic Coastal Plain. Though this site has produced several vertebrate and invertebrate trace and body fossils, it has yet to be stratigraphically correlated regionally. There are two hypotheticals regarding the stratigraphic position of the Fulton Site; that the site represents the New Oxford Formation (a fluvial unit), or that it belongs in the Gettysburg Formation (a lacustrine unit). It’s age is also an issue. Correlation of the Fulton Site was assessed using biostratigraphic methods. The siltstones contain trace fossils (Gyromedichnium) that suggest periodic flooding surfaces and mudcracks that show dessication. The shales contain several species of brachiopods (Aviculopecten). The fish, which are indicative of a lacus- trine environment. Plant (Pagiophyllum diffusum) and trace fossils were dated to constrain the age of the site. The site can best be placed as between the Carnian and the Norian (Late Triassic). The lithostratigraphic boundary between the formations lies east (downslope) of the Fulton Site, placing it within the Gettysburg Formation. Having a constrained age and stratigraphic unit for this new locality will allow any future vertebrate fossil discoveries to be interpreted more accurately, giving us a better idea of the environment and fauna of the Triassic in Maryland.

Poster Session III, (Tuesday)

SAMPLING BIAS AND REDUNDANCY IN MAMMALIAN COMMUNITIES: DO THEY AFFECT TO PALAEOENVIRONMENTAL APPROACHES?

GOMEZ CANO, Ana Rosa, University Complutense of Madrid, Madrid, Spain; HERNÁNDEZ FERNÁNDEZ, Manuel, University Complutense of Madrid, Madrid, Spain; GARCIA YELO, Blanca, Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain

In this work we analyzed the problems associated with the potential loss of species records in mammal palaeocommunities, that could be particularly influential on palaeoecological studies based on community structure. We determined the importance of this influence on two palaeoecological techniques that use the composition of mammalian communities to infer environmental conditions: bioclimatic analysis and cenogram structure. Theoretically, the robustness of both methodologies in palaeoenvironmental studies might be undermined by the assumed loss of recorded species in a fossil site when compared with the original palaeocommunity, due to associated and significant changes in the perceived ecological structure; this might potentially render these methods as non-functional. The analysis was carried out on both methodologies with modern mammalian communities, covering a diverse range of terrestrial biomes. In each community we did a rarefaction analysis by deleting species within random sequences. Our results indicate that it is necessary to remove a high percent-age of species (always more than 50% of the species) to attain the occurrence of statistically significant differences in the studied ecological structures of the community, independent of the biome implied. These results, therefore, allow us to conclude that both bioclimatic analysis and study of cenograms are robust methodologies in the assessment of ecological structure in mammalian assemblages from fossil sites, as long as the species loss relative to the original palaeocommunity is not excessively elevated.

Poster Session I, (Sunday)

DIAGENETIC OVERVIEW ON VERTEBRATE FOSSILS FROM THE SANDY CHANNEL OF “LO HUECO” SITE (UPPER CRETACEOUS, SPAIN)

GONZALEZ-ACEBRÓN, Laura, Universidad Complutense de Madrid - Instituto de Geología Económica (CSIC), Madrid, Spain; BARROSO-BARCENILLA, Fernando, Universidad de Alcalá de Henares & Universidad Complutense de Madrid, Madrid, Spain; CAMBRA-MOO, Oscar, Universidad Nacional de Educación a Distancia, Madrid, Spain; CORENAS, Beatriz, Universidad de Alcalá de Henares, Madrid, Spain

The “Lo Hueco” vertebrate site was discovered in Cuenca, Spain, in a stratigraphical interval in “Garumn” facies (upper Campanian-lower Maastrichtian) formed by versicolor sandy conglomerates and breccias, sandstones (sublitoarenites and polymictic sandy conglomerates), and conglomerate intervals in “Garumn” facies (upper Campanian-lower Maastrichtian) formed by versicolor sandy conglomerates and breccias, sandstones (sublitoarenites and polymictic sandy conglomerates). Here, the diagenetic history of the “Lo Hueco” sandy channel deposit seems to correspond to a muddy coastal plain with edaphic intervals. This exceptional site has provided more than 8500 macrofossil remains, mainly from titanosaur dinosaurs, but also from marine reptiles (necromorphs, plesiosaurs, mosasaurs, and ichthyosaurs). The “Lo Hueco” sandy channel deposit (sandy channel structure) is studied. This structure reaches up to 10 m width and 3 m height and is made up by polymictic sandy conglomerates and breccias, sandstones (sublitoarenites and subarkoses) and sandy mudstones with soft clasts and vegetal and vertebrate remains. These vertebrate remains are constituted by partly calcitized apatite, and the preservation of their internal structures ranges from well preserved (secondary osteons with birrefringence varia- tion between their successive sheets) to totally dissolved tissues (secondary osteons replaced by non-ferric calcite first and gyspum second). Well-preserved secondary osteons present most of the haversian channels partially covered or totally occluded by ferric oxide cement (probably hematite). This ferric oxide cement frequently stains the neighbouring secondary haversian tissue (including surrounding lacunae). The internal parts of haversian channels’ lumen is usually filled by a first precipitation of gyspum. An early fractionation process of several vertebrate remains can also be inferred, as numerous in situ broken remains are
postdated by ferroan oxide cement and apatite cement. Specifically, the ferroan oxide cement precipitated below and above the apatite cement in palisade (crystals of ~150 μm) and, after these two cement phases, infiltration of sand occurred, suggesting the fracturation and cementation processes are syn-sedimentary and early diagenetic. A second phase of apatite cement in the palisade has also been observed, postdating the sandy infill of the fractures.

Technical Session II, Sunday 11:45

THE PHYLOGENETIC AFFINITIES OF THE ENIGMATIC MAMMAL DECCANOLESTES FROM THE LATE CRETACEOUS OF INDIA AND IMPLICATIONS FOR EUERATHERIAN MAMMAL EVOLUTION

GOSWAMI, Anjali, University College London, London, United Kingdom; PRASAD, Gunupalli, University of Delhi, Delhi, India; UPCHURCH, Paul, University College London, London, United Kingdom; BOYER, Doug, Stony Brook University, Stony Brook, NY, USA; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA

India’s Cretaceous mammals have received much attention because they include the only undisputed Cretaceous eutherians, such as Deccanolcestes, from the Gondwana Realm, and because they hail from a period when the Indian subcontinent was isolated from all other continents. Deccanolcestes has been previously found to have Laurasian affinities, but these analyses were based on the first described, poorly preserved teeth and tarsal elements. Descriptive studies have allied Deccanolcestes with the adapiforms of Africa, known from the Paleocene of Africa and Europe and recently suggested to be a stem eutherian, a stem primate, or an afrosoricid. A close relationship between Deccanolcestes and any placentals is of particular interest because it would represent the first pre-Tertiary fossil record of placental mammals. Extensive fieldwork in India’s intertrappean beds has now recovered dozens of better preserved specimens of Deccanolcestes and other mammals. We report the results of the first phylogenetic analysis to incorporate this new material and test the hypothesis that Deccanolcestes is a Cretaceous placental mammal. 415 dental, cranial, and postcranial characters, coded for 83 Jurassic to Recent mammalian taxa, including 8 Cretaceous taxa from India, Paleogene euarchontans, Paleogene afrosoricids, and two species of Afrodon, were analyzed in TNT. The strict reduced consensus tree from 544 most parsimonious trees shows a strong affinity between Deccanolcestes and Afrodon, supporting hypotheses of dispersal between India and Africa during the early Paleocene, before a subaerial connection between India and Asia existed. However, our results do not support a close affinity between either of these taxa and any crown placental clade, leaving open the sizeable gap in molecular and fossil divergence time estimates for crown placental mammals. In fact, this new data pushes the Deccanolcestes + Afrodon clade into a much more basal position than earlier analyses, suggesting previously unrecognized biogeographic divisions in early eutherian evolution and strengthening reconstructions of arboREALITY as the ancestral condition for eutherians.

Poster Session II, (Monday)

A NEW AFRICAN RECORD FOR POLYPHERID FISHES, FROM THE LATE Oligocene of Tanzania

GOTTFRIED, Michael, Michigan State University, East Lansing, MI, USA; OSTROWSKI, Sumner, Michigan State University, East Lansing, MI, USA; ROBERTS, Eric, Southern Utah University, Cedar City, UT, USA; STEVENS, Nancy, Ohio University, Athens, OH, USA; O’CONNOR, Patrick, Ohio University, Athens, OH, USA

Polypherid fishes (Cladistia, Actinopterygii) occupy a critical phylogenetic position in many analyses as the basal-most extant actinopterygians, but are otherwise similar in overall morphology. Certain features of the tarsus, such as the large plantar tubercle on the navicular and the well-developed groove below the sustentacular tali, are shared between A. mumak and Anacodon to the exclusion of other Arctocyon species and are suggestive of plantigrady. A statistical analysis of seven ecomorphological ratios successfully distinguishes a taxonomically diverse group of 47 extant taxa with differing locomotor specializations. When ratios are calculated for 6 taxa within Procordei, most values fall within the range of specialized terrestrial taxa. However, consistent with previous work, the smaller taxa Chiromys and Thyachtodon show arboreal features, while A. mumak may have been semi-fossil or generalist terrestrial, somewhat like the modern black bear Ursus americanus. This analysis also suggests that certain ecomorphological measures (radial head index) are more successful when dealing with taxonomically broad samples.

Poster Session I, (Sunday)

USING TUSK MICROWEAR TO RECONSTRUCT FEEDING BEHAVIOR IN EXTINCT PROBOSCIDEANS (MAMMALIA)

GREEN, Jeremy, North Carolina Museum of Natural Sciences, Raleigh, NC, USA

Mammal dental microwear patterns are linked with diet in living mammals and can be used as a proxy for feeding ecology in extinct taxa. Among proboscideans, microwear patterns on molars have been used to reconstruct paleodiet, yet the ecological significance of microwear on enlarged, ever-growing incisors ( tusks ) in proboscideans is unclear. Living elephants routinely use tusks as feeding aids (e.g., bark stripping in Elephas, Loxodonta) and a similar foraging behavior has been hypothesized for some extinct proboscideans (e.g., Gomphotherium). Here, I ask the question: is tusk microwear a reliable indicator of feeding behavior in extinct proboscideans? To address this question, orthodontic microwear variables were analyzed on distal wear facets of tusks in 2 living mammals [Loxodonta (n=5), Odobenus (n=6)] and 3 extinct proboscideans [Mammuthus (n=3), Gomphotherium (n=6), Cuvieronius (n=1)]. These data were used to test 2 hypotheses: 1) among living mammals, tusk microwear is significantly different between taxa that use tusks for feeding (Loxodonta) versus those that do not (Odobenus); 2) tusk microwear in extinct proboscideans is most similar to patterns in extant Loxodonta, supporting the use of tusks for procuring food. In support of hypothesis 1, discriminant function analysis revealed that, by having a significantly higher frequency of consistently oriented coarse and hypercorpose scratches, microwear in Loxodonta is significantly different from that of Odobenus. Among fossil taxa, microwear patterns on all Mammuth tusks and 3 of 6 Gomphotherium specimens were taxonomically altered and thus excluded. Taphonomically unaltered tusks of Gomphotherium and Cuvieronius reveal a predominately fine and coarse scratches oriented in a consistent direction, supporting hypothesis 2. In addition, differences in the frequency of gouges and number of scratches between these taxa and Loxodonta suggest that different tusk-feeding strategies were used in extinct proboscideans. This study supports the utility of tusk microwear as a proxy for feeding behavior in the Proboscidea and broadens the range of paleontological questions that can be addressed using dental microwear analysis.

Technical Session XV, Wednesday 9:00

COMMUNITY Structure of the Mississippian BEAR Gulch Bay FISHES

GREENFEST-ALLEN, Emily, University of Pennsylvania, Philadelphia, PA, USA; LUND, Richard, Carnegie Museum of Natural History, Mount Holly, NJ, USA; GROGAN, Eileen, Saint Joseph’s University, Philadelphia, PA, USA

The paleobiogeographic context of the small, tropical marine bay preserved in the Late Mississippian Bear Gulch Limestone prevents strongly resembles that of the modern African Rift Valley lake system. This diverse and highly productive ecosystem was quickly isolated by tectonic processes after formation; thus, some of its diversity likely arose from localized speciation. Analysis of Bear Gulch fish biodiversity reveals significant associations between local fish assemblages and resource exploitation, an observation on par with modern diversity studies, which highlight habitat partitioning as a major factor influencing speciation in island and rift radiations. Here we investigate the likely role this process may have played in the evolution of the Bear Gulch fish fauna by identifying ecological communities that reflect resource utilization and related factors that affect ecosystem stability. To detect communities, a correlation-network was generated from profiles of taxon abundance across the bay. This ecological structure was analyzed using community detection methods, identifying five well-supported communities. Each community is an association of chondrichthyan and osteichthyan taxa that share a unique pattern of occurrence across the bay. Some of these communities have overlapping and others opposing abundance profiles, possibly indicative of competitive control on taxon distributions. To assess potential ecological controls on these
associations, genera were coded for a set of functional characters, falling into 5 broad categories encompassing body form, fin and jaw morphology, and lifestyle. Coded genera were clustered and assigned to 14 nominal ecological guilds. The relative abundance of each guild was determined for each community. No one community was dominated by any single guild; instead each is an unique association of guilds. This likely reflects the availability of particular habitats in the bay, as not all guilds are present in all communities.

Poster Session II, (Monday)

THE OLDEST APTERODONTINAE (HYAENODONTIDAE, "CREODONTA") FROM THE MIDDLE EOCENE OF DOR EL TALHA (LIBYA)

GROHE, Camille, iPHd, Poitiers University, Poitiers, France; MORLO, Michael, Forschungsinstitut Senckenberg, Abt. Palaeoanthropologie und Messelforschung, Frankfurt, Germany; SALEM, Mustapha, Geology Department, El Fateh University, Tripoli, Libya; Lichtenstein; SALEM, Mustapha, Geology Department, El Fateh University, Tripoli, Libya; JAEGER, Jean-Jacques, iPHd, Poitiers University, Poitiers, France

After the Fayum record of Egypt, the late middle Eocene Dor El Talha escarpment (Central Libya) has provided one of the richest Paleogene faunas of North Africa. Currently, six orders of placental mammals, including primates, have been found in this outcrop. Here, we present the results of the first study of hyaenodontid (“Creodonta”) remains: dental and postcranial specimens discovered in 2007 and 2009 (Franco-Libyan cooperative program between University of Poitiers and University of El Fateh in Tripoli) and the historical material collected by Savage in 1965 and stored at the NHM (London). The oldest members of the Apterodontinae are identified. Apterodontines were hitherto recorded in the late Eocene and Oligocene of Europe (France, Germany) and Africa (Egypt, Kenya). The best preserved Libyan material is a subcomplet mandible and maxilla with several associated postcranial elements. It is morphologically close to the late Eocene Apterodon macrogнатus, recovered in the lower part of the Jebel Qatrani Formation (Fayum). Its teeth resemble those of the Egyptian species notably in its tubercular morphology and the bearing of a M2 metacone and a prominent parastyle of M3 on its maxilla. Postcranial elements, in particular the distal humerus, the proximal ulna and the tarsal bones indicate an ability to supinate, which excludes a cursorial locomotor type. In a first approach, the bulbous morphology of the teeth perhaps reflects an omnivorous or phytodagous diet. Phylogenetic relationships of the Apterodontinae within the Hyaenodontidae have been poorly discussed. However, we note that dental features as the lack of the metacodin and the presence of a talonid on lower molars can make it close to some African and Eurasian hyaenodontines.

Evolution of the Modern African Fauna, Wednesday 9-45

CENOZOIC AFRICAN BAT COMMUNITIES

GUNNELL, Gregg, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA

The African bat fossil record is very poor. Except for one enigmatic record from the middle Eocene of Tanzania, all pre-Miocene African bats come from North Africa and the Arabian Peninsula. All of these North Africa forms represent extinct genera except for one record of Hipposideros from Oman, however, some genera do represent extant families including Emballonuridae, Rhinopomatidae, Megadermatidae, Nycteridae, and Vespertilionidae. Other than isolated records from Morocco and Libya, all African Miocene bats come from East Africa and all are known from post-Aquitanian sediments (younger than 20 million years ago). All (except Scotophilus from Gebel Zeitien) represent modern bat families and of the 11 genera identified 73% (8) represent living forms. By the Pliocene, faunal samples begin to become available throughout Africa resulting in documentation of a wider geographic range of fossil bats. Recent study of Plio-Pleistocene large mammal bioecography indicates that North African assemblages are more similar to those of East Africa than they are to either Europe or South Africa. Initial comparison of Late Pliocene samples from Europe and Africa suggest that similar faunal associations do not hold for bats. Late Pliocene African and North and South African bat assemblages are all very similar being dominated by vespertilionids (Myotis and Miniopterus) and Rhinolophus. East African Pliocene samples lack vespertilionids and are mostly dominated by Hipposideros and emballonurids. However, sample sizes from East and South Africa are not especially good limiting the interpretation of these results. Additionally, all of the taxa shared in common between Europe, North Africa and South Africa are cave roosting forms and many of the fossil samples are derived from karst deposits and cave breccias. The East African taxa tend to prefer roosting in trees and hollow logs and most of the fossil material is derived from lake and over-bank floodplain deposits. The differences between East African and other African Pliocene bat samples may represent real differential distribution patterns but may also be the result of different habitat sampling as well.

Poster Session III, (Tuesday)

DIVERSITY BIASES OF THE PUBLISHED RECORD OF FOSSILS AT NINE MIocene Mammalian Faunas of Nevada and Oregon

GUSEY, Ali, Department of Geological Sciences, University of Oregon, Eugene, OR, USA; DAVIS, Edward, Department of Geological Sciences and Museum of Natural and Cultural History, University of Oregon, Eugene, OR, USA

Most paleoecology studies examine the species richness of a geographic area through time. Often this research is based only on the published literature, not accounting for additional, unpublished museum specimens. Unfortunately, publication of specimens is usually not intended to produce a record reflecting the ecological structure of the fauna. This bias is based on publishing only exceptional fossils, publication constraints, and by not reporting duplicate specimens. This reliance on published specimens introduces a potential problem because the published accounts are often more taxonomically even than the museum collections from the same area. To quantify this bias, we compared ecological parameters calculated using published and museum data from nine Miocene Great Basin mammalian faunas: the Stewart Springs fauna (early Barstovian), the Tonopah fauna (early Barstovian), the Tedford Pocket fauna (early Barstovian), the Quartz Basin fauna (late Barstovian), the Chalk Springs fauna (Clarendonian), the Fish Lake Valley fauna (middle Clarendonian), the Brady Pocket fauna (late Clarendonian), the Otis Basin fauna (late early Hemphillian), and the Little Valley fauna (early late Hemphillian). We rarified specimen data using the minimum number of individuals to compare published and museum data within these nine faunas. The museum data from eight of the nine faunas show a barely significant difference from the published data, but the Stewart Springs fauna shows a strong significance, with published data higher than museum. This anomalous result arises because of the unique publication history of the site: some of the taxa listed for the site were published without voucher specimens and none can be located today in the collections. Our results allow the construction of rules of thumb for including published data in faudiversity studies, the first of which is that voucher specimens from the collections are necessary for substantiating the data.

Physical Drivers and Marine Tetratop Evolution, Monday 11:15

10,000 MILES: MAXIMUM RANGE AND SOARING EFFICIENCY OF AZHDARCID PTEROSAURS

HABIB, Michael, Chatham University, Pittsburgh, PA, USA

Azhdarchid pterosaurs include the largest known flying animals, with the largest species reaching a potential mass of over 250 kg. Prior work suggests that several features of azhdarchid anatomy could be associated with a soaring-dominated lifestyle, including large size, burst-flapping adapted pectoral girdle and proximal forelimb, moderate to high wing aspect ratio, and exceptional pnuematicity. However, long-range flight ability of azhdarchid pterosaurs has not been quantified in the literature. I present the results from a quantitative analysis of long-distance travel efficiency in azhdarchid pterosaurs. Power analysis indicates that the largest pterosaurs needed to reach external sources of lift, following launch, before they exhausted anaerobic muscle endurance. The efficiency of the initial climb out from published accounts are often more taxonomically even than the museum collections from the same area. To quantify this bias, we compared ecological parameters calculated using published and museum data from nine Miocene Great Basin mammalian faunas: the Stewart Springs fauna (early Barstovian), the Tonopah fauna (early Barstovian), the Tedford Pocket fauna (early Barstovian), the Quartz Basin fauna (late Barstovian), the Chalk Springs fauna (Clarendonian), the Fish Lake Valley fauna (middle Clarendonian), the Brady Pocket fauna (late Clarendonian), the Otis Basin fauna (late early Hemphillian), and the Little Valley fauna (early late Hemphillian). We rarified specimen data using the minimum number of individuals to compare published and museum data within these nine faunas. The museum data from eight of the nine faunas show a barely significant difference from the published data, but the Stewart Springs fauna shows a strong significance, with published data higher than museum. This anomalous result arises because of the unique publication history of the site: some of the taxa listed for the site were published without voucher specimens and none can be located today in the collections. Our results allow the construction of rules of thumb for including published data in faudiversity studies, the first of which is that voucher specimens from the collections are necessary for substantiating the data.

Poster Session I, (Sunday)

MODERN ODONTOCETE EVOLUTION: MORPHOMETRIC DISCRIMINATION OF THE ACOUSTIC SYSTEM REVEALS ECOLOGICAL PARTITIONING BETWEEN RIVERINE AND MARINE TAXA SINCE THE MIocene

GUSTSTEIN, Carolina Simon, Facultad de Ciencias, Universidad de Chile, Santiago, Chile; COZZUOL, Mario Alberto, Departamento de Zoologia, Inst. Ciencias Biologicas, Universidad Federal de Minas Gerais, Belo Horizonte, Brazil; RUSINS, David, Area Paleontologia, Museo Nacional de Historia Natural, Santiago, Chile; PYENSON, Nicholas, Smithsonian Institution, Washington DC, WA, USA; CANALS, Mauricio, Facultad de Ciencias, Universidad de Chile, Santiago, Chile

The biogeography of living odontocetes is strongly shaped by divisions between marine and fluvial environments. For example, multiple odontocete lineages have independently colonized different freshwater river systems around the world, likely during episodic high eustatic sea-levels that flooded freshwater basins (e.g., Amazonia). Intriguingly, the freshwater descendant of ancestral marine odontocetes display convergent morphological specializations. Cranial modifications, especially for the auditory systems, have functional correlates with peak echolocation frequencies, spanning from high (most delphinids) to very high (‘river dolphins’ and phocoenids). Different acoustic properties in riverine (shallow, dark) and marine (clear) environment could plausibly drive such differences. To test this hypothesis, we developed a set of bony facial and auditory measurements from extant taxa that correlate with known overlying soft facial anatomy. We evaluated a dataset of 14 periotic and 17 skull measurements (divided by a size estimator to avoid size effect) with a taxonomic sample of extinct and extant Inioidea (specimens, n=26), Lipotoidae (n=1), Platynotoidea (n=5) and Delphinoidae (n=41). To test for environmental correlates, data were pre-classified by groups (river/marine) that showed a significantly high percentage of correct classifications for discriminant analysis (~95%) in both data sets. We also tested the classification of geological ages groupings (Miocene-Pliocene to Recent), which showed 91% correct classifications on skull and 80% on periotic (but functionally related to sound emission), the length of insertion of the nasal plug muscle and premaxillary saxes explain the largest amount of variation in the dataset; for sound reception, the best measurements were the external length and height of the pars cochleare, and the size of malleus fossa and aqueductus. The robust results on river versus marine classifications in fossil and extant odontocetes suggests that connection between the auditory and facial morphology can discriminate between marine or freshwater ecomorphologies, which have evolved independently in modern odontocetes.
even large azhdarchids should have been capable of staying aloft by using external sources of lift. A quantitative framework already exists for estimating maximum migration range in soaring birds using thermal lift. I have extended this framework to pterosaurs by altering existing models to accommodate the membrane wings of pterosaurs and uncertainty in potential muscle physiologicals. Maximum fuel capacity (stored as fat and additional muscle) was estimated by taking the difference between body masses scaled from skeletal strength (maximum) versus mass for maximum wing efficiency. This new migration model indicates that the largest azhdarchid pterosaurs had the capacity for non-stop flights exceeding 10,000 miles.

Poster Session I, (Sunday)

LATERAL AND TEMPORAL DISTRIBUTION OF MAMMALIAN FAUNA FROM EARLY PLEISTOCENE KOOBI FORA FORMATION, EAST TURKANA

HAKALA, Sarah, University of Georgia, Athens, GA, USA; BOBE, Rene, University of Georgia, Athens, GA, USA

The Koobi Fora Formation in East Turkana, Kenya, yields a diverse faunal record with over 90 species of larger mammals. Representative nearly 4 Myr of East African deposits, mammalian taxa from this location provide evidence for paleoenvironmental reconstructions during times when hominin species were evolving and diversifying throughout the Turkana Basin.

The Upper Burgi, KBS, and Okote are members within the latter half of the Koobi Fora deposit, spanning a timeframe from 2.0 Ma to 1.39 Ma, with a total thickness of 278 m. This study provides data for the distribution of select mammalian taxa within these members. The Turkana Paleontology Database, which contains a record of over 11,000 specimens from the Koobi Fora Formation, is used to analyze temporal differences in faunal proportions as well as lateral distributions across the Ileret, Karari Ridge, and Koobi Fora Ridge subregions. Comparisons include ordinal level (Carnivora and Primates), family level (Ceropithecidae, Bovidae, Suidae, Equidae, Rhinocerotidae, Deinotheriidae, and Giraffidae), and tribal level (8 boid tribes) analyses. Tests of significance and ordination are presented. Results show that Carnivora and Primates maintained relatively stable proportions temporally and laterally. Within the family level analysis, Bovidae remained the highest percentage throughout all 3 members and regions with Suidae having a high predominance as well. Ceropithecidae had a high percentage in the Ileret, Karari Ridge, and Koobi Fora Ridge subregions.

Our evidence is derived from comparisons among 42 ancient genetic samples (100 to 2000 years before present in Alaska, Washington, Oregon, and California) and 365 modern genetic samples (representing all major eastern Pacific rookeries). The detailed palaeontological record available for the northern fur seal provided a unique opportunity in facilitating an unprecedented look at genetic diversity of a species (Callorhinus ursinus). These traits allowed the species to maintain high levels of genetic diversity even through intensive harvesting by humans.

Recently the species has experienced part of its former range, despite facing threats similar to other similar marine mammals that have population genetic signatures of recent bottlenecks (e.g., the northern elephant seal). Our results also suggest that behavioral differences previously discovered in ancient populations of C. ursinus (longer weaning periods) result from phenotypic plasticity rather than local adaptation, providing further survival strategies for the species, and yielding insights about potentially important attributes of other threatened species.

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that extended ~15 m laterally from the quarry. Vertebrar (n=8), including an atlas, and ribs (n=7) dominated the assemblage. Pubis and rib fragments (n=7) were aligned parallel to their dispersal direction, which trended approximately east to southeast. Weathering and abrasion were minimal, and scavenging was not evident, which suggests limited subaerial exposure or fluvial transport following deposition. Associated microfossils include a single shed theropod tooth, fig seeds, and unidentified plant fragments. Description of bone modification, associated micro- or macrofossils, lithology, and stratigraphic position of isolated sites places them into a broader paleoenvironmental setting, which aids in paleobiological interpretations. Without these observations, fossils lack a significant amount of their scientific value, and scientists lose the opportunity to test important evolutionary and ecological hypotheses.

Poster Session I, (Sunday)

A NEW GENUS OF PTYCHODONTID SHARK FROM THE ALBIAN OF TEXAS AND ITS PHYLOGENETIC PLACEMENT WITHIN PTYCHODONTIDAE

HAMM, Shawn, none, Forney, TX, USA

AND ITS PHYLOGENETIC PLACEMENT WITHIN PTYCHODONTIDAE

A NEW GENUS OF PTYCHODONTID SHARK FROM THE ALBIAN OF TEXAS, and New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; SPIELMANN, Justin, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; RIEPEL, Olivier, Department of Geology, The Field Museum, Chicago, IL, USA; MOTANI, Ryosuke, Department of Geology, University of California, Davis, CA, USA; TINTORI, Andrea, Dipartimento di Scienze della Terra, Università degli Studi di Milano, Milano, Italy

The European terrestrial procelodont reptile Macrocnemus bassani is known from the Besano Formation (Grenzbüttmenzone, Anisian-Ladinian boundary, Middle Triassic) of Monte San Giorgio of Switzerland and Italy. Macrocnemus fuyuansensis, which is about 7 million years younger than the European taxon, was described from the latest Ladinian Xingyi-Fuyuan Keichousaurus Fauna in southwestern China, where abundant marine reptile fossils have been found in four layers in a 15 km wide region. A new well preserved specimen of Macrocnemus was collected from the lowest fossiliferous strata of a 40 cm thick grayish-black, platy marly limestone with abundant Keichousaurus specimens. It is from the same locality as M. fuyuansensis and almost of the same body size. The skull is complete with a large orbit and narrow postorbital region: the external naris is narrow and long. Its lower jaw is 90 mm long with a narrow mandibular fossa of 16 mm length. There are eight cervical vertebrae: the first two are much shorter, with lengths of 9 mm and 12 mm respectively, while the fourth and fifth are the longest, with lengths of 28 mm. The dorsal vertebral count is 17 and there are two sacrals. These measurements almost match those of M. fuyuansensis and M. bassani. The exception is that its ibia is 85 mm long but the femur 83 mm, differing from the original description of M. fuyuansensis whose diagnostic character is a relatively shorter tibia. At this point, the new species is closer to M. bassani. The only difference observed currently in the postcranial skeleton is the number of dorsal vertebrae, with the new species and M. fuyuansensis possessing 17, but M. bassani with only 16. Other possible differences include the longer anterior extension of the scapula of M. bassani, and possibly nine cervical vertebrae. A closer study of this new specimen will test if Macrocnemus fuyuansensis can be distinguished from M. bassani. The presence of Macrocnemus together with Tianyatrochus and several genera of small fishes in the latest Ladinian Xingyi-Fuyuan Fauna further strengthen its migration-evolution from Monte San Giorgio of the Western Tethys.

Poster Session I, (Sunday)

NEW SPECIMEN OF THE TERRESTRIAL REPTILE MACROCNEMUS FROM THE LATEST LADINIAN XINGYI-FUYUAN MARINE REPTILE LEVEL, SOUTHWESTERN CHINA

HAO, Wei-cheng, Department of Geology and Geological Museum, Peking University, Beijing, China; HAO, Wei-cheng, Department of Geology and Geological Museum, Peking University, Beijing, China; RIEPEL, Olivier, Department of Geology, The Field Museum, Chicago, IL, USA; MOTANI, Ryosuke, Department of Geology, University of California, Davis, CA, USA; TINTORI, Andrea, Dipartimento di Scienze della Terra, Università degli Studi di Milano, Milano, Italy

The European terrestrial procelodont reptile Macrocnemus bassani is known from the Besano Formation (Grenzbüttmenzone, Anisian-Ladinian boundary, Middle Triassic) of Monte San Giorgio of Switzerland and Italy. Macrocnemus fuyuansensis, which is about 7 million years younger than the European taxon, was described from the latest Ladinian Xingyi-Fuyuan Keichousaurus Fauna in southwestern China, where abundant marine reptile fossils have been found in four layers in a 15 km wide region. A new well preserved specimen of Macrocnemus was collected from the lowest fossiliferous strata of a 40 cm thick grayish-black, platy marly limestone with abundant Keichousaurus specimens. It is from the same locality as M. fuyuansensis and almost of the same body size. The skull is complete with a large orbit and narrow postorbital region: the external naris is narrow and long. Its lower jaw is 90 mm long with a narrow mandibular fossa of 16 mm length. There are eight cervical vertebrae: the first two are much shorter, with lengths of 9 mm and 12 mm respectively, while the fourth and fifth are the longest, with lengths of 28 mm. The dorsal vertebral count is 17 and there are two sacrals. These measurements almost match those of M. fuyuansensis and M. bassani. The exception is that its ibia is 85 mm long but the femur 83 mm, differing from the original description of M. fuyuansensis whose diagnostic character is a relatively shorter tibia. At this point, the new species is closer to M. bassani. The only difference observed currently in the postcranial skeleton is the number of dorsal vertebrae, with the new species and M. fuyuansensis possessing 17, but M. bassani with only 16. Other possible differences include the longer anterior extension of the scapula of M. bassani, and possibly nine cervical vertebrae. A closer study of this new specimen will test if Macrocnemus fuyuansensis can be distinguished from M. bassani. The presence of Macrocnemus together with Tianyatrochus and several genera of small fishes in the latest Ladinian Xingyi-Fuyuan Fauna further strengthen its migration-evolution from Monte San Giorgio of the Western Tethys.
of the following primitive characters: ventral ridge of the postaxial presacral centra are flat as they stimulate scientific inquiry for professionals, students, and the public. Increased access to analytical equipment. Such needs have facilitated numerous collaborations within various classrooms, store rooms, and laboratories. Small programs may also have limited interest in paleontology and related public education, UND has received little state support. The University of North Dakota (UND) are an example. UND has a relatively small paleontology program with strong regional collections. Similar to other small programs with a common interest in paleontology and related public education, UND has received little state support. UND collections have a limited computerized specimen and locality database. Even though the greatly improved fossil record from Africa in recent years confirms that the reduced diversity of hominoids during the late Miocene was not as dramatic as previously reported, and that the decline was not tied to an increase in cercopithecoid diversity. Hominoid and stem catarrhine diversity remained relatively high throughout most of the Miocene, and this continued into the Pliocene with the diversification of the early hominins. Cercopithecoids, by contrast, maintained a low taxonomic diversity throughout much of the Miocene, but the number of species began to increase during the late Miocene, and they reached their greatest diversity during the Plio-Pleistocene. Changes in relative diversity of catarrhines during the Miocene are unlikely to be explained as a consequence of direct competition between cercopithecoids and hominoids. Rather, it appears that several major climatic and ecological changes during the Neogene led to important restructuring (both taxonomically and adaptively) of the catarrhine communities, and that these environmental factors impacted differentially on cercopithecoid and hominoid diversity.

Poster Session II, (Monday)

BENEFITS, CHALLENGES AND SOLUTIONS OF COLLECTIONS AT SMALL PROGRAMS AND INSTITUTIONS USING EXPERIENCE FROM THE UNIVERSITY OF NORTH DAKOTA

HARTMAN, Joseph, University of North Dakota, Grand Forks, ND, USA; WEILER, Matthew, University of North Dakota, Grand Forks, ND, USA; SCHUMAKER, Karew, University of North Dakota, Grand Forks, ND, USA

Universities and institutions of smaller size face unique fossil collection management challenges due to their size. Despite scale issues, such facilities maintain significant regional collections of value to scientific research that may go overlooked. The collection facilities at the University of North Dakota (UND) are an example. UND has a relatively small paleontology program with strong regional collections. Similar to other small programs with a common interest in paleontology and related public education, UND has received little state support. UND collections have a limited computerized specimen and locality database. Even though the program at UND is small, there are a number of benefits that result from this. These benefits include an emphasis on regional fossils, with many population size samples, numerous collections for small-scale undergraduate research projects, fossils that serve as a local attraction for school groups, and ease of access for visiting scientists. The challenges related to the small size are primarily related to monetary support. A full time curator/collections manager position is not possible, so the responsibility falls upon the paleontology professor. UND has dealt with this challenge by involving students in the conservation and curation process which not only helps to maintain the collections, but provides students with collection management experience. Small groups of students have also been allowed to work on smaller projects, which may also be worthy of reclassification; Namely, the specimens from Swartkrans Member 3 and some of the Sterkfontein specimens which have distinctively large lower carnassials (though curiously, the Swartkrans specimens have upper carnassial measurements that are similar to those of modern C. mesomelas while those of these Sterkfontein have upper and lower carnassials that are correspondingly large) and some of the specimens from Swartkrans Member 5 which have statistically small upper carnassials. The specimens from Minnaars does not stand out in any of these measures. Our analyses also have implications for the taxonomy of the modern jackals, particularly that of C. aureus which may be worthy of splitting.

NEW LARGE BLUNT-SNOUTED DYROSOURID (MEOEUCROCODYLIA) FROM THE PALEOCENE OF COLOMBIA

HASTINGS, Alexander, University of Florida, Gainesville, FL, USA; BLOCH, Jonathan, University of Florida, Gainesville, FL, USA; IARAMILLO, Carlos, Smithsonian Tropical Research Institute, Panama City, Panama

Dyrosaurids are typically known as longirostrine, marine crocodyliforms best known from the Paleocene and Eocene of western Africa. Dyrosaurid fossils are exceptionally rare within South America, with only three taxa diagnosed. Recently described fossils of a new dyrosaurid (Cerrejonius improwus), pseudem crawling (Cerrejonius waywayunai), and giant boine snake (Tianoboa cereiobresis) from the Cerrejon coal mine in northeastern Colombia represent the first glimpse of tropical South American middle–late Paleocene (55–60 mya) terrestrial ecosystems. The deposits likely represent ancient estuarine to riverine environments. Here we describe a new large-bodied dyrosaurid (3–5 meters in total body length) that was recovered from the same deposits, and that represents a distinctly new and very different morphology for Dyrosauridae. The new dyrosaurid is known from four nearly complete skulls, preserving the snout, orbital region, skull table, parts of the braincase, and several teeth. The skull has expanded and elongate supratemporal fenestrae that are longer than they are wide, a widespread character of Dyrosauridae. The snout is notably short (39–50% of total skull length) as compared to the recently reported small-bodied dyrosaur, Cerrejonius improwus (55–59%). The teeth are round and blunt which, in combination with a short snout, was likely an adaptation for durophagy. The orbits are laterally placed, as seen in Paleogene sebecid crocodyliforms that are likely to have been mostly terrestrial. Postcrania include several vertebrae, ribs, thick osteoderms, distal ischia, and a partial ilium. Thick osteoderms are likely also an adaptation for a more terrestrial habitat as in marine crocodyliforms, including other known dyrosaurids, that instead possess reduced or absent osteoderms. The distal ischia are thin and spatulate, reflecting a reduction of the iochioidea-lum distal muscle utilized in pitch control within the water, also consistent with a more terrestrial or freshwater habitat. The large size, blunt-snout, and more terrestrial habitat of the new dyrosaurid represents a completely new ecomorphotype for the family Dyrosauridae.

FIRST OCCURRENCE OF THE MARINE CROCODILE TYPICAL PTEROSAURS TRAITORINES FROM THE UPPER CRETACEOUS (TURONIAN) OF MANITOBA

HATCHER, Joseph, Canadian Fossil Discovery Centre, Morden, MB, Canada; JANZIE, Anita-Maria, Canadian Fossil Discovery Centre, Morden, MB, Canada

The recent discovery and collection of the large marine crocodile Terminatoris from Mani- toba marks the first reported occurrence of this rare taxon within the province. During the Turonian, marine deposits from the Western Interior Seaway of North America preserved the disarticulated skeleton west of the town of Dauphin, Manitoba along the eastern bank of the Wilson River. The deposits are composed of calcareous shales from the Keld Member of the Favel Formation. Fort Dauphin Museum (FDM) specimen MD-1055-1 consists of elements from the appendicular skeleton including the incomplete right ilium, right proximal
humerus, incomplete left hind limb (femur, tibia, incomplete fibula) and incomplete left pes (astragalus, calcaneum, tarsals 3 and 4, incomplete metatarsals and incomplete phalanges) along with three dorsal vertebrae, three large caudal vertebrae, many ribs and osteoderms. In comparison to Royal Saskatchewan Museum specimen P2411.1 of Terminonaris robusta from Carrot River, Saskatchewan, the femur of MD-1055-1 is 38 mm shorter in length but exhibits a longer centrum in the largest caudal vertebra by 21 mm. These measurements as well as similar size related features of the axial skeleton are consistent with the genus. FDM specimen MD-1055-1 is hereby referred to as Terminonaris sp.; only the seventh document- ed occurrence of the genus in North America and the first documented occurrence of the taxon in Manitoba.

Poster Session IV, (Wednesday)
A NEW ASSESSMENT OF THE ENIGMATIC MANDIBLE OF THE LIVING FOSSIL L. aenigmamus
HAUTIER, Lionel, Museum of Zoology, Cambridge, United Kingdom; SAKSIRI, Soochan, Department of Biology, Faculty of Science, Mahasarakham University, Mahasarakham, Thailand

Rodents are considered to be one of the great success stories of mammalian evolutionary history. While exceptional for an intense diversification of lineages, the evolutionary history of the order Rodentia comprises only a small number of morphological morphotypes for the mandible that could partly explain the intense debates about the taxonomic position of the latest described member of this clade, the Laotian rock rat Laonastes aenigmamus (Diatomyidae). This discovery has reignited the debate on the definition of the Hystrixgenymus suborder identified using the angle of the jaw relative to the plane of the incisors. Our study aims to end this ambiguity. For clarity, it became necessary to revisit the entire morphologi- cal diversity of the mandible of extant and extinct rodents. However, current and past rodent diversity brings out the limitations of the qualitative descriptive approach and highlights the need for a quantitative approach. Here, we present the first descriptive comparison of the masticatory apparatus of L. aenigmamus combining classic comparative anatomy with morphometrical methods. First, we quantified the shape of skulls and mandibles of rodents using 3D landmarks. Then, the analysis of osteological features was completed by a detailed description of muscular insertions examined by standard dissections. We showed that the difficulties in classifying L. aenigmamus stem from the fact that it presents a mixture of sciurognathous and hystrixgnathous characters (i.e., the two rodent suborders). The contribu- tion from the fossil record was decisive in exploring the morphological variation. Most of the information available from the fossil material pertains to its morphology and the means to quantify morphological characters have become of great importance. This study illustrates how an holistic approach allows an objective study of the morphological variation while excluding any typological approach that implied a quasi-invariable distinction of different morphotypes. These results also bring new insights into the evolution of hystrixgnathy and have profound implications for the interpretation of the fossil record of early hystrixgnath rodents.

Poster Session IV, (Wednesday)
SIMPLE FEMORAL INDICATORS OF LOCOMOTION DERIVED FROM ANATOMICAL STUDIES
HAWKINS, Patrick, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA

Soft tissue anatomy can be ecologically or phylogenetically informative and is very useful as a supplement to skeletal data. Dissections can provide such anatomical details, but are not always informative for paleontologists. Using recently published muscle maps, our own dissection, and comparisons with close relatives, we investigated the femoral anatomy of Pristinailurus bristoli, a lesser panda from the Mio-Pliocene Gray Fossil Site in East Ten- nessee. Proximally, the presence of the gluteofemoralis in P. bristoli indicates them with arboreal procyonids, but the attachment site is direct and obscured by other posterior thigh muscles, making this character useless for the fossil. Fortunately, some visible osteological features on fossils can confirm the identity of a muscle, as well as its importance and action. For example, the relatively tall greater trochanter on P. bristoli indicates that it was more terrestrial than A. fulgens. The quadratus femoris, an extensor, is obvious in both species, although larger and more distal in P. bristoli. Distally, sesamoid articulations show where a muscle tendon changes direction before attaching to a long bone such as those embedded in the gastrocnemius. Although modern pandas have these sesamoids, their dimutive facets on the posterior femur suggest that the muscles are not as powerful. Also emphasizing the importance of limb flexion is the large lateral process for the attachment of the superficial digital flexor muscle on which aids the gastrocnemius. These distal features are similar to those of the more terrestrial Procynon lotor, which were readily available for comparative dissection. As A. fulgens is more specialized for tree climbing than P. lotor, the fossil taxon is suggested to be intermediate, with clear adaptations for both activities based on simple osteological fea- tures. These features are identifiable only because of modern anatomical studies that outline their function and location. Regardless of the difficulty in finding direct attachments within generalized groups of muscles, future anatomical research emphasizing osteological features is highly recommended.

October 2010—PROGRAM AND ABSTRACTS

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CRANIAL ANATOMY OF OPHIACODON UNIFORMIS: NEW INSIGHTS FROM AN EXCEPTIONALLY PRESERVED SPECIMEN USING COMPUTED TOMOGRAPHY
HAWTHORN, Jessica, University of Toronto, Toronto, ON, Canada; SCOTT, Diane, University of Toronto at Mississauga, Mississauga, ON, Canada; REISZ, Robert, University of Toronto at Mississauga, Mississauga, ON, Canada

Representatives of the family Ophiacodontidae (Synapsida, Eupelycosauria) comprise the earliest derived synapsid diversification, critical to understanding the initial stages of synapsid evolution. Exquisite, new three-dimensionally preserved cranial mate- rial of Ophiacodon uniformis (USNM PAL 87098) from the Lower Permian (Leonardian) Petrolia Formation of Baylor County, Texas, is studied for the first time. This specimen, the best-preserved and most complete known skull of Ophiacodon, was fully prepared, illustrat- ed, and scanned using x-ray computed tomography (CT) to allow for an improved, detailed description of the cranial morphology. Ophiacodon is the earliest described member of this clade and one of the smallest ophiacodontids, a group that exhibits the light construction of the skull with thin-walled bone typical of ophiacodontids. Like other derived ophiaco- dontids, it possesses a prominent supraorbital shelf composed of lateral expansions of the pre- and postfrontals, which are separated by a narrow incision forming the supraborbital notch. The frontal, though expanded at the level of the notch, do not contribute to the margin of the supraorbital shelf. This differs from the conditions observed in the independently evolved supraorbital shelves of derived members of Sphenacodontidae and Edaphosaurusidae, where the frontal contributes to the shelf margin. The postorbital and jugal are mediolaterally expanded where they form the postorbital bar, further reinforcing and protecting the orbital region. The distinctive supraoccipital buttress is clearly visualized on the medial surface of the maxilla through CT imaging. The vomer is tall, as is the anterior process of the pterygoid, separating the snout internally into distinct halves anterior to the cultriform process of the paraphrenoid. The sphenethmoid is preserved in the orbit, as expected, but a possible eth- noide is also observed, previously unknown in early synapsids. The dramatically improved understanding of ophiacodontid skeletal anatomy will form the basis of a thorough reevaluation of the evolutionary history of this early clade of synapsids.

Technical Session VII, Monday 3:00
CLIMATIC REGULATION OF MAXIMUM BODY SIZE IN POIKILOTHERMIC VERTEBRATES: AN EMPIRICAL TEST USING THE CRETACEOUS AND PALEOGENE RECORD OF NORTH AMERICAN TRIONYCHID TURTLES
HEAD, Jason, University of Toronto, Mississauga, ON, Canada

Body size of fossil reptiles is a potentially powerful thermometric proxy because a criti- cal minimum ambient temperature limits maximum body size for a specific mass-specific metabolic rate in poikilothermic vertebrates. As a result, Mean Annual Temperature (MAT) is the ultimate regulator of size for a given physiology and ecology. Multiple proximate factors can constrain body size, however, including habitat availability and food resources, and paleoecological reconstructions based on poikilothermic body size must account for other size-regulating mechanisms or risk underestimating temperature. To test whether body size is maximized for MAT in extinct poikilotherms over long time scales, size changes measured as a proportion of growth in the fossil records of trionychine and plastothermic turtles, from the Late Cretaceous through Paleogene in Western North America were compared with paleotemperature estimates from coeval floral and isotopic data. Body size change gener- ally corresponds with temperature in both clades: sizes increase from the Cretaceous to the Paleogene, with maxima occurring during the Paleocene and Early Eocene followed by subsequent decreases during the late Eocene. Absolute paleotemperature estimates for the largest fossil taxon Eusternys, derived from the relationship between size, metabolism, and minimum MAT for habitats in extant trionychids, approximates paleofloral estimates during the Bridgerian NALMA; however, temperature values derived from the majority of the turtle record substantially underestimate temperature relative to other proxy data. Additionally, size increases within the earliest Paleogene do not correspond to known temperature changes, but instead track the transition from fluvial to lacustrine depositional systems. These results indicate that although proportional changes in body size suggest a climatic signal, absolute size is not maximized relative to MAT for the examined samples, and other proximal factors, especially changes in depositional environment, had a controlling influence on body size in fossil trionychids.

Poster Session I, (Sunday)
BIOSTATIGRAPHIC SIGNIFICANCE AND REREDOCIPTION OF THE ENIGMATIC VERTEBRATE COLOGNATHUS OBSCURUS FROM THE UPPER TRIASSIC CHINLE GROUP, SOUTHWESTERN U.S.
HECKERT, Andrew, Dept. Geology, Appalachian State University, Boone, NC, USA

There are approximately 27 specimens of the bizarre Upper Triassic vertebrate Colognathus obscurus, known from Texas, New Mexico, and Arizona, repositioned in museums across North America. The holotype was recovered from the same jacket as the holotype skull of the phy- losaus Leposuchus croebiensis in Crosby County, Texas, and 23 of the other specimens have reasonable provenance data. The vast majority of Colognathus occurrences are from expo- sures of the Upper Triassic Tecovas Formation in Crosby County, Texas, including the type locality, the “upper” and “lower” Kalmyk microvertebrate sites, Walker’s Tank and vicinity, Brunson Ranch, Sand Creek, Davidson Creek, and the Blanco River. There are two other Texas specimens from exposures of equivalent strata in Palo Duro Canyon in Randall Coun-
ty. Texas. Isolated occurrences of shed (?) teeth are known from a microvertebrate locality near Lamy in the Los Esteros Member of the Santa Rosa Formation in central New Mexico and Crocodile Hill in Petrified Forest National Park, in the uppermost Blue Mesa Member of the Petrified Forest Formation in east-central Arizona. All occur with one or more Adama-
nian (Late Cretaceous) index taxa ("Leptosuchus", Slogtenolophus, Tecovasu-
chus, or Crassysaurus) A specimen putatively from the stratigraphically lower, Otis Chalk, Texas region is of questionable provenance. Almost all occurrences are singleton fragments of teeth or tooth-bearing (dentigerous) elements. None preserve definitive evidence of skel-
etal fenestrae or sutures with other elements. The best Colophonathus dentigerous specimens include a single, conical/pyramidal to recurved, anterior tooth and an elongate, molariform posterior tooth; less complete specimens consist of only one of these teeth. The posterior, molariform tooth is readily recognizable as a shed crown. Initially Colophonathus was consid-
ered an osteichthyan, but was later generally considered to be an aberrant placodophian. A sectioned jaw reveals that tooth implantation resembles that of placododonty overridden by acrodony, which instead hints at a lepadosaurian affiliation for Colophonathus.

Technical Session X, Tuesday 9:45

FROM BABY BIRDS TO FEATHERED DINOSAURS: INCIPENT WINGS AND THE EVOLUTION OF FLIGHT

HEERS, Ashley, University of Montana, Missoula, MT, USA; DEAL, Kenneth, University of Montana, Missoula, MT, USA

The function of proto-wings in theropod dinosaurs during the evolution of avian flight has long intrigued the scientific community. Recent studies demonstrate that immature ground birds with extremely underdeveloped and rudimentary wings are capable of generating useful aerodynamic forces during wing-assisted incline running and controlled flapping descent. Feather development in these birds resembles feather evolution in theropod dinosaurs, and reveals a predictable relationship between wing morphology and aerodynamic performance. This empirical, ontogenetic relationship can be used to infer aerodynamic performance of theropod proto-wings. Following the methods of Usherwood and Ellington, aerodynamic forces generated by dried wings of chukar partridges (Alectoris chukar) were measured as the wings were spun like a propeller at a range of Reynolds numbers, to mimic different-sized theropod proto-wings swinging at biologically relevant angular velocities. At slow angular velocities, wings produced aerodynamic forces similar in magnitude to those produced by immature chukars during wing-assisted incline running. At fast angular velocities, wings produced forces sufficient to support body weight. These findings suggest that proto-wings described by the fossil record may have provided useful aerodynamic function early in the history of theropods, with improvements in aerodynamic performance occurring as enhanced pectoral musculatures afforded higher wing beat frequencies.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

SEXUAL DIMORPHISM IN CRANIAL SHAPE OF THE SPOTTED HYENA
(CROCUTA CROCUTA)

HENSELY-MARSCHAND, Blair, Indiana University, Bloomington, IN, USA

The spotted hyena (Crocotta crocuta) is of interest to both paleontologists and archaeologists alike. Occurring now only in Sub-Saharan Africa, this species was widespread throughout Africa, and Eurasia during the Pleistocene. Specimens of this denning animal can be found in high densities in bone caves throughout this area. The biogeography of this species is complex, suggesting separate north- and south-African Pleistocene refugia and a genetic affinity with the cave hyena (Crocuta spelea). Most of the literature concerning sexual dimor-
phism in this species involves discussion of the unique genitals of the females of this species but this soft tissue identifier is not commonly available for archaeological or palaeontological specimens. The females of this species are, on average, larger than the males, and it was previously unknown whether this size difference translated to a shape difference in the skel-
etal remains of this species. Spotted hyena crania from the Field Museum of Natural History (Chicago, IL) and the William R Adams Zoological Laboratory (Indiana University, Bloomington, IN) were included in this study. Of the eighteen specimens, five were labeled as female, eight as male, and five were of unknown sex. A total of thirty-two 3-D landmarks were plotted for each specimen encompassing shape variation in maxillary tooth distribution and cranial length, width, and height. A multivariate analysis of variance between females and males finds a significant difference between the sexes. Additionally, specimens of unknown sex can be identified to sex based on discriminant function classification of skull shape variables. Archaelogical and paleontological communities can use these techniques to add to the data available for site analysis. New, previously unavailable determinations of sex can be used to support or oppose hypotheses regarding the agent of accumulation for sites in which spotted hyena remains are present. An abundance of female specimens will support a den-type origin while a paucity of females will oppose such a theory.

Poster Session I, (Wednesday)

MORPHOLOGICAL VARIATION IN THE HADROSUAR Dinosaur GREYPOSaurus FROM THE KAIPAROWITS FORMATION (LATE CAMPAIAN) OF SOUTHERN UTAH

HERRERO, Lucia, The Webb Schools, Claremont, CA, USA; FARKE, Andrew, Raymond M. Alf Museum of Paleontology, Claremont, CA, USA

Recent fieldwork in the Upper Cretaceous (Campanian) Kaiparowits Formation of southern Utah has yielded a number of new dinosaur specimens, with hadrosaurids particularly abun-
dant. Known taxa include Parasaurasaurus sp., Gryposaurus notabilis, and Gryposaurus monumentensis (unique to the formation). In 2007, a field crew from the Raymond M. Alf Museum of Paleontology (RAM) discovered a partial hadrosaur skull (RAM 12065) in a channel sandstone within the upper part of the middle unit of the Kaiparowits Formation. The skull includes the frontals, postorbitals, parietals, and squamosals, as well as a partial —Cranial sutures assigned to the genus Gryposaurus, based on the frontal’s contribution to the orbital rim and the nasal-invasive nasofrontal contact. Despite this, the skull differs in several key details from other Gryposaurus specimens found in the Kaipa-
rowits Formation, including the shape of the supratemporal fossa and the morphology of the postorbital. In all known specimens of G. monumentensis and G. notabilis, the caudal portion of the postorbital is sharply angled dorsally, providing a kinked profile to the skull roof in lateral view. In RAM 12065, the skull roof is planar. Gryposaurus incurringana shows intraspecific variability in this trait, suggesting that similar variation is possible for the other species but has not been recognized yet. Because the nasal arch, an important feature for differentiating Gryposaurus species, is missing, RAM 12065 cannot be diagnosed to the species level. Two possibilities exist: 1) the specimen belongs to G. monumentensis or G. notabilis, or 2) the specimen represents a previously unknown species. If RAM 12065 belongs to G. monumentensis or G. notabilis, then the diagnosis of those species should be revised in order to include the variations found in RAM 12065, most importantly the “un-
kinked” postorbital.

Technical Session XVI, Wednesday 3:15

INFERRING DIET FROM MORPHOLOGY IN EARLY WHALES: MORPHOMETRIC ANALYSIS OF FEEDING STRATEGY IN REMINGTONOCETUS

HERONYMUS, Tobin, Northeastern Ohio Universities College of Medicine, Rootstown, OH, USA; COOPER, Lisa, University of Illinois Urbana-Champaign, Urbana, IL, USA; VINYARD, Chris, Northeastern Ohio Universities College of Medicine, Rootstown, OH, USA; THEWISSEN, J.G.M., Northeastern Ohio Universities College of Medicine, Rootstown, OH, USA

Cetacean ancestors include archaeocetes (even-toed ungulates) that show a mosaic of mor-
phologies associated with both terrestrial and aquatic habits. Morphology of the feeding ap-
paratus in archaeocetes, such as Remingtonocetus, is distinct from that seen in closely related terrestrial archaeocetes, but also distinct from that seen in extinct odontocetes, providing an ambiguous picture of the feeding strategies that accompanied the initial cetacean invasion of marine habitats. To assess possible feeding strategies, we measured a suite of morphological variables related to the feeding apparatus in Remingtonocetus as well as a selection of extinct odontocetes, terrestrial archaeocetes, and terrestrial and aquatic carnivorans. Mammalian aquatic predation strategies fall into two general groups: snap feeding, in which the animal pushes its mouth through the water to engulf prey; and suction feeding, in which the water around the prey is forcibly drawn into the mouth. We thus coded feeding strategies in extinct taxa as snap, suction, or terrestrial. We applied phylogenetic principal components analysis (PCPA) to the morphometric data, clustered the taxa using the resulting PPC scores, and compared feeding strategy among well-supported clusters. Extant snap-feeding odontocetes separate from all other taxa, with PPC scores related to an elongate, narrow bony rostrum and a dorsosventrally shortened mandible. Extant suction feeding odontocetes fall out with the remaining taxa on the first axis, but show separation on the second axis, with PPC scores related to a broad, elongate basioccipital and a narrow, short mandible. Remingtonocetus clusters with terrestrial, snap-feeding odontocetes, and shows a similar feeding strategy. Pinnipeds do not show consistent differences from terrestrial carnivorans, suggesting a separate solution to aquatic feeding that is not adequately characterized by the measurements taken in this study. These results suggest that while the inferred modes of locomotion and prey detection for archaeocetes were markedly different from those of extant odontocetes, snap-feeding is likely to be the primitive feeding mode for early marine cetaceans.

Poster Session III, (Tuesday)

MODELING COMPLEX PAST ENVIRONMENTS WITH BULK ISOTOPIC DATA

HIGGINS, Pennilyn, University of Rochester, Rochester, NY, USA; MACFADDEN, Bruce, University of Rochester, Rochester, NY, USA; GARZIONE, Carmala, University of Rochester, Rochester, NY, USA

Isotopic data from the tooth enamel of fossil mammals have emerged as an excellent source of information toward understanding ancient climates. As isotopic methods have improved, smaller sample size requirements have allowed for serial sampling from a single tooth, mak-
ing explorations of intra-annual climate patterns possible. However, for smaller teeth, such annual-scale studies generally are not possible. We present a simple method for extracting annual-scale patterns of climate using bulk iso-
topic data from large water-dependent mammals. This model (the Carbon versus Oxygen or C\(O\) model) was built using isotopic data from mammals for which annual temperature, precipitation amount, and the timing of precipitation are known (extant mammals) or can be estimated using the Macropysical Climate Model (fossils less than 40 ka). Despite the potential for oversimplification, the C\(O\) model presents an opportunity to interpret ancient intra-annual climate patterns at localities where only bulk isotopic data are available from fossils. The C\(O\) model is most useful when making comparisons between widely separated fossil localities or between fossils of differing ages from localities in close proximity.
Fossil crocodyliforms and turtles from the Early Cretaceous of northeastern Mali
HILL, Robert, New York College of Osteopathic Medicine, Old Westbury, NY, USA; SERTICH, Joseph, Stony Brook University, Stony Brook, NY, USA; ROBERTS, Eric, James Cook University, Townsville, Australia; O’LEARY, Maureen, Stony Brook University, Stony Brook, NY, USA

Recent fieldwork in Cretaceous strata of northwestern Africa has significantly expanded the known diversity of non-avian sauroptid taxa, particularly crocodyliforms. Here, we describe new vertebrate fossils from the Early Cretaceous (possibly older) fluvial conglomerates in the Tlemcen Valley of northeastern Mali. These rocks previously yielded remains of titanosaurian dinosaurs and were briefly reported to contain crocodyliforms and turtles. The most complete fossils belong to a brevirostrine crocodyliform mandible including the symphyal portion of a right dentary with five alveoli; a partial basioccipital, ototocipital, and parabasiphenoid; a partial right quadrate, quadratodugal, and posterior jugal; and a partial left nasal and prefrONTAL. Size and preservation suggest that these elements may represent a single individual. Also preserved, but likely not associated, are a partial lower jaw preserving portions of both dentaries and splenials, a partial left maxilla, and a complete metatarsal. A separate longirostrine taxon is represented by a partial right maxilla with nine alveoli. Among the non-crocodyliform material also recovered is a partial scapula and shell fragments from a possible pleurodirine turtle. The new brevirostrine crocodyliform specimens compare closely with the Gondwanan peirosaurids. For example, the quadratodugal contributes approximately 20% of the mandibular condyle. The lateral margin of the dentary is concave for the reception of a large maxillary tooth as in Madagasaurus and Trematochampsa. Coincident with this concavity are two sets of alveolar couplets similar to those in Itacosaurus. Although the specimens are fragmentary, this combination of characters strongly suggests that they represent a member of Peirosauridae. Unusual or autapomorphic features of these specimens include the presence of confluent alveoli and a lower jaw whose lateral margin is concave opposite the rostral-most extent of the splenial symphysis. Inclusion of the new specimens as a composite OTU in a phylogenetic analysis shows that it groups with other African peirosaurids including Trematochampsa, Hamadusaurus, and Stoklosaurus.

Roman Prize Session, Monday 9-15
THE EVOLUTION OF RIBCAGE ANATOMY AND BREATHING FUNCTION IN THE MESOZOIC THERPODS
HIRASAWA, Tatsuya, RIKEN Center for Developmental Biology, Kobe, Japan

Ribcage anatomy of theropods is an essential key to rationalize the evolution of a unique breathing mechanism seen in extant birds. In extant birds, ribcage movement contributes to generating gas flow, and the inspired air first flows into the caudal aircasc system. In this study, I investigated comparative anatomy of ribcages in theropods, with an emphasis on the fossil record. Firstly, I collected data on the ribcage anatomy of 111 theropod species from the Mesozoic, through direct observations on museum specimens (37 species) as well as from the literature (74 species). On the basis of these data, character evolution was traced on a compiled phylogenetic framework based on recent published analyses. The results demonstrated that mechanical refinements of the ribcage were accumulated in a stepwise pattern in the following sequence. Initially, the ossification of sternum occurred. Then, the ossification of sternal rib occurred in the Middle/Late Jurassic. Subsequently, ossified uncinate were polyphyletically acquired during the Neocomian. These findings suggest gradual changes of costal aspiration mode in theropods. Secondly, I developed a model for representing the ribcage kinematics in three-dimensional coordinate space, on the basis of direct measurements on the fossil specimens. In this model, I used the orientations of the rotational axis for the rib and the rib curvatures of the theropods without the ossified sternal ribs. This model allows for a quantitative test of the mode of ventilation, whereas the previous studies discussed only the morphology of the costovertebral articulations. As a result, models of ribcage movements in Tyrannosaurus (Tyrannosauridae), Allosaurus (Allosauridae), and Majungasaurus (Ceratosaurus) suggested greater volumetric changes in the anterior or mid-thoracic regions than in the posterior thoracic regions. Consequently, without other accessory components (e.g., abdominal muscles), these theropods were not suited for the mode of ventilation seen in extant birds, where the inspired air flows into the posterior region. These lines of evidence lead to the interpretation that the highly specialized respiratory system seen in extant birds was not complemented at the time of origination of the airsacs by some theropods, but after the development of the movable joint between the vertebral and sternal rib in the Late Jurassic.
Posterior peripherals have serrated margin at the scute border. These characters suggests its affinities with living Geocemyda. Its extremely small size is shared by G. spengleri. Its much wider vertebrals and radiated pattern of longitudinal Sculptures on carapace seem unique features of this taxon.

Recent molecular research suggests both Malaysyms and Geocemyda should be rather isolat-ed from other geoemydids. These Japanese materials support the hypothesis that their origin should be traced back as early as the Paleogene.

Posterior Session II, (Monday)
MIRACINONYX TRUMANI (CARNIVORA: FELIDAE) FROM THE RANCHOLABREAN OF GRAND CANYON, ARIZONA AND ITS IMPLICATIONS FOR THE ECOLOGY OF THE “AMERICAN CHEETAH”
HODNETT, John-Paul, Northern Arizona University, Flagstaff, AZ, USA; MEAD, Jim, Eastern Tennessee State University, The Don Sundquist Center of Excellence in Paleontology, Johnson City, TN, USA; WHITE, Richard, International Wildlife Museum, Tucson, AZ, USA; CARPENTER, Mary, Northern Arizona University, Flagstaff, AZ, USA

A new and surprising record of Miracinonyx trumani has been recognized from the Grand Canyon of northern Arizona. Three sites along the length of the canyon contain fossils of M. trumani: Rampart Cave, Next Door Cave, and Stanton’s Cave. Rampart Cave contains partial skeletal of a juvenile and a sub-adult cat. Cranial fossils from Rampart Cave are distinct from Puma in the presence of a heavy dentition, a reduced protocone of the P4, short robust canine, and a reduced diastema between the c1 and p3. Next Door Cave has a single record of an adult calcaneum of M. trumani that is morphologically distinct from Puma in its large size and the presence of a well-developed navicular facet. Stanton’s Cave contains phalanges that are similar to Puma but are proportionately gracile in comparison with modern Puma. The presence of Miracinonyx within the Grand Canyon raises questions about the ecology of this large cat. Previously, Miracinonyx was proposed as a cheetah (Acinonyx jubatus) ancestor, or conversely cheetah-like feld that hunted prey in open savanna-like habitats. The rarity of ungulates adapted to a savanna-like habitat within the Rancholabrean within the Grand Canyon and the occurrence of the fossils of Miracinonyx within the canyon suggest that Miracinonyx was not confined to the cheetah-like model. The extinct mountain goat Oreamnos harringtoni was the most common ungulate within the Rancholabrean of the Grand Canyon and occurs at Rampart Cave and Stanton’s Cave and was perhaps the preferred prey for the Miracinonyx population at the Grand Canyon. We propose that the Grand Canyon Miracinonyx may have had a feeding ecology similar to that of the modern snow leopard (Uncia uncia), a large feld adapted for swift pursuit of mountain and canyon ungu-lates over nearly vertical rocky terrain.

Posterior Session III, (Tuesday)
UNDERSTANDING GRASSLAND EXPANSION, CLIMATIC FACTORS AND HYPSODONTY EVOLUTION THROUGHOUT THE MIocene IN THE JOHN DAY BASIN, OREGON
HOFFMAN, Jonathan, University of Wyoming, Laramie, WY, USA; CLEMENTZ, Mark, University of Wyoming, Laramie, WY, USA

Fossil mammals from the John Day Basin of central Oregon (1. Eocene to 1. Miocene) document the ubiquitous grazing adaptations that independently evolved in many North American fossil ungulates. The Miocene of the John Day Basin contains equids, rhinocerotids, and caprines, as well as other ungulate taxa, including ceratopsians and lagomorphids. Combined, these methods are used here to track ungulate communities across the Miocene of the John Day Basin and to assess the effects of climate change on grassland ecosystems.

Poster Session II, (Monday)
TOOTH PUNCTURE MARKS ON SKULLS OF DINICTIS (NIMRVAEIDAE) FROM THE Oligocene Brule Formation of North Dakota Attributed to Predation by Hyaeodon (HyaeodontaEIDAE)
HOGANSON, John, North Dakota Geological Survey, Bismarck, ND, USA; PERSON, Jeff, North Dakota Geological Survey, Bismarck, ND, USA

A complete skull of Dinictis felina (Mammalia: Carnivora: Nimravidae) (NDGS 59) was recovered from a clayey siltskull in the lower part of the Oligocene Brule Formation, from a North Dakota registered natural area in Stark County. The right P2-M1 and left M1 are present, all other teeth are broken or have been sheared off at the bone line, and the right zyg-o-matic arch was broken and distorted. The mandible was not recovered. This fossil occurred 5.55 meters above the contact with the South Heart Member of the Chadron Formation, and 3.15 meters below the Antelope Creek tuff of the Brule Formation. Associated vertebrate fossils include Mesocyon bairdi and Palaecologus burkei indicate a late Orellan (O4) interval zone (32.5-32.0 Ma). Other associated vertebrates include Stylonyx sp., ?Subhy-racodon sp., Ichthyosaurus sp., Hesperocyon gregarius, Eumys elegans, Leptictis dakotensis, Leptomeryx evansi, and a small eomammal (possibly Parahippusidae). Also associated were the gastropod Skinnerella leidyi, the trace fossil Pallicphus sp., and seeds from Cetilo sp. During preparation of the Dinictis skull, distinct and well defined tooth puncture marks were noted on the right temporal and parietal bones, with another possible bite mark present on the left parietal, although this latter mark is less distinct because of missing and fractured bone. Two possible gnaw marks are present on the left maxilla, near the orbit and suture with the frontal. No evidence of healing was observed around the puncture marks. Comparisons with other puncture marked specimens are made. Measurements of the geometry of the punctures, spacing between the punctures, and comparison to skulls and dentaries of potential predators indicate that Hyaeodon (Mammalia: Creodonta: Hyaeodontidae) was the likely attacker of this Dinictis. Although not recovered from this locality Hyaeodon is known from the Brule Formation and has been recovered from Stark County.

Poster Session IV, (Wednesday)
CRANIAL AND POSTCRANIAL ANATOMY OF OROHIPIUS (MAMMALIA, PERISSODACTYLA)
FIEDL, John-Paul, Northern Arizona University, Flagstaff, AZ, USA; MEAD, Jim, University of Wyoming, Laramie, WY, USA

Studies in the eighties and nineties cast doubt on the monophyly of Hyaenotherium and thus created uncertainty as to whether species previously assigned to Hyaenotherium rep-represented basal equids. As a result, later, equids, such as Orohippus from the Bridgerian of North America, have been included in phylogenetic analyses of basal perissodactyls in order to provide unequivocal representatives of the Equidae. Although denticles of Orohippus are fairly well known, little has been described or analyzed of its cranial and postcranial osteology. This study describes cranial and postcranial material of specimens of Orohippus held in the U.S. National Museum of Natural History, with the intent to uncover and score phylogenetically useful characters. Skulls of Orohippus exhibit posteriorly broad nasals with a transverse suture with the frontal, a character that is likely a perissodactyl synapomorphy. Orohippus also exhibits a confluence of the foramen ovale and the medial lacerate foramen, which is characteristic of equids, palaeotheriids, and Lambdotherium, among Eocene per issodactyls. Orohippus also exhibits other ancestral features for perissodactyls, such as contact between the premaxilla and nasal, presence of a postglenoid foramen, a prominent coronoid process of the scapula, a high greater trochanter of the femur, and a marginal fovea of the femoral head. Combining these osteological characters with dental characters in a phyloge-netic analysis of basal perissodactyls provides support for recognizing certain species previ-ously assigned to Hyaenotherium as basal equids.

Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 8:00
STRUCTURE AND FUNCTION OF THE REPTILIAN MANDIBULAR SYMPHYSIS: INSIGHTS FROM SQUAMATES
HOLLIDAY, Casey, University of Missouri, Columbia, MO, USA; GARDNER, Nicholas, Marshall University, Huntington, WV, USA

The mandibular symphysis links the two mandibular rami and offers numerous insights into the evolutionary biology of the head and feeding apparatus. The joint is diverse among saurian reptiles, including clades that interdigitate the joint (crocodileiforms), cap it with a novel ele-ment (ornithischian dinosaurs) or completely fuse it (birds). However, lepidosaurs, non-avian saurischian dinosaurs, and numerous other fossil taxa rely primarily on soft tissues to link the otherwise bone components. This presents a challenge to testing functional and phylogenetic hypotheses because these soft tissues are not well-documented in most extant taxa nor are they preserved in the fossil record. Using microCT, serial histology, and microscopy, we investi-gated the morphology of the mandibular symphysis in a variety of squamate taxa including iguanians, geckos, scincomorphs, lacertoids, and anguimorphs, in order to identify structurally and functionally informative characters in these tropically diverse species. The symphysis of all squamate taxa investigated exhibits dorsal and ventral fibrous portions of the joint that possess an array of parallel and woven collagen fibers, as well as anchoring Sharpey’s fibers. The middle and ventral portions of the joints are complemented by contributions of Meckel’s cartilages. Kinetic taxa have relatively loosely-built symphyses, with large domains of parallel-oriented fibers, whereas hard-biting and akinetic taxa have symphyses primarily composed of dense, woven fibers. Whereas most taxa maintain unfused Meckel’s cartilages, iguanians and geckos independently evolved fused Meckel’s cartilages. However the morphology of the
cartilages suggests a role for different developmental mechanisms. Given the small absolute sizes of these joints, osteological correlates of soft tissues are poorly defined without microscopic approaches; however correlates in larger taxa are recognizable. These data shed light not only on squamate evolutionary morphology, which itself is complicated and important, but also form an anatomical basis to analyze symphyseal morphology and function in many non-avian dinosaurs, pseudosuchians, and other fossil taxa.

Poster Session III, (Tuesday)

AN ANALYSIS OF THE MEGALONYX JEFFERSONI MATERIAL FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA AND AN EXAMINATION OF MEASURING TECHNIQUES FOR GROUND SLOTHS

HOLTE, Sharan, East Tennessee State University, Johnson City, TN, USA; SCHUBERT, Blaine, East Tennessee State University, Johnson City, TN, USA; WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA

Excavations by the Red Mountain Museum personnel of Birmingham, Alabama from 1984 to 1987 revealed the remains of multiple Megalonyx jeffersoni (Jefferson’s ground sloth) specimens from ACB-3 Cave, Colbert County, Alabama. The excavation team suggested as many as sixteen M. jeffersoni were recovered from the cave deposits, but a subsequent reported MNI (minimum number of individuals) suggests fewer sloths. The recovered sloths (currently residing at the McWane Center in Birmingham) range in individual age from fetal to adult and provide the best known evidence of denning, and even gliding and flight. Bipedality in theropods may have allowed the forelimb to evolve free from the constraints imposed by terrestrial locomotion, and it has been suggested that this freedom allowed a wider range of forelimb morphologies to emerge. While derived maniraptora clearly had longer arms than their predecessors, and clades like tyrannosauridae and parvornithes had reduced forelimbs, the distribution and evolution of various changes in forelimb length among theropods have not yet been documented in detail. In particular, the ancestral states for relative forelimb length, as well as seasonal patterns within the forelimb, have not been reconstructed in a phylogenetic context. To investigate this, we collected data on the lengths of the bones of the forelimb in 125 theropod taxa. These measurements were scaled against the length and circumference of the femur, which were used as proxies for overall body size. The relative lengths of the forelimb bones, and of the forelimb as a whole, were mapped as continuous characters onto a broadly-sampled theropod phylogeny. Reconstruction of ancestral states was carried out using both linear and squared change parsimony to examine hypotheses of clade-specific forelimb length change. This analysis showed that forelimb elongation does not characterize all maniraptora, and instead occurs only within Paraves. Elongation also takes place independently in ornithomimosaurids. Shortening of the forelimb occurs independently in ceratosaurs, carcharodontosaurs, tyranosaurids, and alvarensaurids. The relative lengths of the constituent bones of the forelimb often change in different ways in different clades.

Technical Session III, Sunday 1:45

EUROPEAN EARLY PALEOGENE LOUSINISINES: HIGH DIVERSITY AND ENIGMATIC RELATIONSHIPS

HOOKER, Jerry, Natural History Museum, London, United Kingdom; RUSSELL, Donald, Museum National d’Histoire Naturelle, Paris, France

The European early Paleogene has yielded a relatively high diversity of lousinids (22 species), peaking in the Paris Basin latest Paleocene with 13 species (10 new) in six genera (two new). The case has already been made on dental and postcranial evidence that lousinines together with North American apheliscids belong to the order Macroscelidea (elephant-shrews) and not hypsodontid condylarths (ungulates), where they had been placed. Alternative early views on the relationships of some apheliscids have included the “insectivoran” family Adapisoriae. Indeed the lousinine Psachtherium dolloi was originally placed in Adapisores. To tackle this issue, cladistic analysis has been undertaken of European lousinines, the better represented of North American apheliscids, African macroscelidean Chambius and some early “insectivorans” including adapisorceids. Probably because tarsal differences are more key to lousinid affinities, are known for only a few taxa, the “insecto-anses” Adapisores, Lithochoerus and Macrocanion sit nested within Apheliscidae. Excluding tarsal characters from the analysis has the effect of excluding the “insectivornans” from the Apheliscidae, but also of splitting the latter into two independent clades, consisting of Pas- chtherium and the rest. Excluding also the North American apheliscids from the analysis produces a Lousininae plus Chambius that is monophyletic. Support for homogeneity of the Apheliscidae thus currently appears weak, despite the tarsal evidence. A potential primitive lousinine from the late Paleocene of Walbeck, Germany, newly available to us from the collection in Bonn, shows teeth with sharp cusps and relatively strong cresting. It blurs some of the distinctions between the two taxa, and suggests that this freedom allowed a wider range of forelimb morphologies to emerge. While derived maniraptora clearly had longer arms than their predecessors, and clades like tyrannosauridae and parvornithes had reduced forelimbs, the distribution and evolution of various changes in forelimb length among theropods have not yet been documented in detail. In particular, the ancestral states for relative forelimb length, as well as seasonal patterns within the forelimb, have not been reconstructed in a phylogenetic context. To investigate this, we collected data on the lengths of the bones of the forelimb in 125 theropod taxa. These measurements were scaled against the length and circumference of the femur, which were used as proxies for overall body size. The relative lengths of the forelimb bones, and of the forelimb as a whole, were mapped as continuous characters onto a broadly-sampled theropod phylogeny. Reconstruction of ancestral states was carried out using both linear and squared change parsimony to examine hypotheses of clade-specific forelimb length change. This analysis showed that forelimb elongation does not characterize all maniraptora, and instead occurs only within Paraves. Elongation also takes place independently in ornithomimosaurids. Shortening of the forelimb occurs independently in ceratosaurs, carcharodontosaurs, tyrannosaurus and alvarensaurids. The relative lengths of the constituent bones of the forelimb often change in different ways in different clades.
Shotwell’s work has come under fire for problems with statistical artifacts in his methods of analysis; however, his fossil collections are ideal for paleoecological studies, having been made with rigorous attention to avoiding collecting bias. A comprehensive analysis of Shotwell’s collections as well as specimens curated or collected subsequently enables a test of these ideas and the history of habitats in Oregon through time.

We apply some more robust statistical methods to analyzing habitat representation in the fossil record of eastern Oregon, using collection records to describe relative abundances and community composition. Cluster analysis, principal components analysis, and other multivariate methods were used to distill the general trend in faunal composition and establish the habitat affinities of the faunas at individual sites. We find that there are significant differences in the communities represented by different localities collected by Shotwell, and that those differences often correspond reasonably well with Shotwell’s reconstructed habitats. Ongoing field work in this area focused on nonfaunal proxies for habitat type, such as paleopedology and geochemistry, is expected to vindicate Shotwell’s fifty-year-old paleoecological conclusions.

Poster Session II, (Monday)

GEOPHYSICAL VARIATION IN THE JAWS OF HOLOCENE SPHENOdont (LEPIDOSAURIA: RHYNCHOCEPHALIA) DEMONSTRATED BY LANDMARK ANALYSIS

HUMPHRIES, Emma, UCL, University College London, London, United Kingdom; JONES, Marc, UCL, University College London, London, United Kingdom

The tuatara, Sphenodon, is an extinct terrestrial reptile mainly restricted to islands off the coast of New Zealand. As the only extant rhynchocephalian it has played an important role in understanding the phylogenetic context of its fossil relatives (such as Diphodyontosaurus) that were successful and globally distributed during the Mesozoic. However, the extensive Holocene fossil record of Sphenodon has been largely overlooked. This record shows that the genus was previously distributed across both the North and South Islands and provides a valuable resource for examining variation related to size and geographic location. Almost 150 Holocene Sphenodon dentaries from seven different localities (North Island: 3, South Island: 4) were landmarked and after Procrustes superimposition were subjected to geometric morphometric analysis. Results show that variation in shape includes differences in the doroventral height of the element, relative length of the tooth row and posterior process, and shape of the ventral margin and coronoid process. The main ontogenetic changes involve an increase in jaw depth and reduction in relative tooth row length. Multivariate analysis of variance and sum of squares comparisons demonstrates that there are significant shape differences between adult jaws from localities on the same island as well as those from locations separated by the Cook Strait about 450,000 years ago. The amount of shape variation that can be accounted for by location is twice that of latitude and ten times that of longitude. The apparent geographic morphotypes do not necessarily represent different species but they do demonstrate relatively recent geographic variation in Sphenodon. A comparison of the Holocene sample to a number of Mesozoic Rhynchocephalia (e.g., Cleoraosaurus, Cynosphodon, Gephyrosaurus, and Priosphenodon) showed that shape variation was substantially greater than the Mesozoic taxa and no Mesozoic taxon was found to possess a dentary of equivalent shape to that of Sphenodon. This contradicts the still widely held notion that Sphenodon is no different from its fossil relatives and ‘unchanged for over 150 million years’.

Poster Session III, (Tuesday)

ESTIMATION OF CROCODILLIAN BODY FORM FROM SNUt-VENT LENGTH AND TAIL GIRTH

HURLBURT, Grant, Brock University, St. Catherines, ON, Canada

We present a multiple regression equation which estimates body mass (MBd) from Snout vent length and maximum tail girth (TG) data in 38 American alligators (Alligator mississippiensis), ranging in MBd from 5 to 280 kg. The equation has wide applicability because many fossil vertebrates had crocodile-shaped body forms. Dissection of alligators shows that the vent is approximated by the posterior limit of the ischium, providing a landmark for measuring SVL (snout vent length) in fossil vertebrates. Alligator tail girth is approximated by an ellipse whose two axes are respectively the maximum transverse between tips of transverse processes, and the dorsal ventral distance between the ventral chevron and the dorsal spinous process of the vertebrae, a method applicable to fossil vertebrates. This equation has two advantages over equations using Total Length (TL). Firstly, tail length varies more than snout-vent length (SVL) among species, and secondly, it is more likely to find fossil specimens with complete trunks and skulls than specimens which are complete from snout tip to tail tip.

The equation is Log MBd (g) = –4.7346 + (1.8421 x log SVL (mm)) + (1.3774 x log TG). With r = 0.9913. Logs are log10. Interaction between SVL and TG was not significant (Pr > F = 0.0672).

Alligator body masses were normally distributed.

Technical Session II, Sunday 9:30

BONE HISTOLOGY AND GROWTH IN THE PERMO-TRIASSIC THERAPSID INOSCHIRINUS KITCHINGI (SYNAPSIDA: THERAPSIDA) FROM THE KAROO BASIN OF SOUTH AFRICA

HUTTENLOCKER, Adam, University of Washington, Seattle, WA, USA; BOTHA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa; SIDOR, Christian, University of Washington, Seattle, WA, USA

Therapsidians were an ecologically diverse and speciﬁc clade of non-mammalian therapsids whose fossil record spans the Middle Permian through Middle Triassic. Their remains...
common in nonmarine Permo-Triassic rocks of Africa, exceeded only by those of dicynodonts in abundance, and are well represented by both cranial and postcranial material. Their excellent fossil record and survivorship of the end-Permian extinction make them an ideal group for studying life history evolution during large-scale ecological perturbations. Here, we offer a preliminary report of the long bone histology of the Permo-Triassic akidnognathid thecodontian *Meschorhinus kitchingi* and investigate its life history tactics in the context of the end-Permian transition. Serial sectioning of 16 elements from nine individuals spanning the Permo-Triassic boundary facilitates a comparison of histomorphologic traits across a broad temporal interval. In general, early subadult *Meschorhinus* display a humerus with an increasingly thickened bone wall and a medullary region that is nearly completely occluded by coarse trabeculae. The femoral cortex and outermost cortex of the humerus show more PFB and longitudinally oriented canals at this stage (~70-80% largest size). Most elements display at least one anulus. Beyond these general observations, variation in the degree of cortical vascularity and number of preserved LAGs and annuli cannot be attributed to body size alone, and may, thus, reflect differences in growth strategies adopted in Permian and Triassic environments. These preliminary observations merit further investigation into predicted changes in growth tactics within individuals genera and species during the Permo-Triassic transition. Future research phases will investigate the histology of other thecodontians with the goal of understanding large-scale patterns of life history evolution in Permian and Triassic eutheriodonts.

**Post Session I, (Sunday)**

**A FOSSIL ANURAN FROM THE LOWER CRETACEOUS SASAYAMA GROUP OF HYOGO PREFECTURE, SW JAPAN**

IBRAHIM, Nizar, University College Dublin, Dublin, Ireland

Despite uniformitarian arguments to the contrary, as knowledge of the deep past has grown it has become increasingly clear that some ancient vertebrate ecosystems have no modern analogues. Possible examples, such as the fossil assemblage from the Late Cretaceous Kem Kem beds of Morocco, present two challenges: (1) to demonstrate that such candidate ecosystems are truly unique and are not taphonomic artefacts; (2) to identify principal components (e.g., trophic structure) of such ecosystems. Although articulated skeletons are rarely found in the Kem Kem sequence, large numbers of isolated finds from several localities permit a detailed assessment of taxonomic diversity, as well as the temporal and geographical distribution of taxa. Fossils of fish, amphibians, turtles, crocodyliforms, pterosaurs and dinosaurs, reveal a diverse ecosystem with several highly unusual features. Arguably the most striking of these is that theropod remains, representing *Carcharodontosaurus*, *Deltaferus*, *Secernosaurus* and several undescribed taxa, seemingly dominate the dinosaur macrofaunal and ichno-assemblages. Significantly, at least three genera reached or surpassed the size of *T. rex*. By contrast, ornithopod fossils are extremely rare and sauropods, while taxonomically more diverse (*Rebbachisaurus* and possibly two other undetermined, large forms), are also only represented by sparse records. The co-occurrence of principal taxa in multiple localities and horizons in the sequence, an absence of obvious taphonomic biases affecting vertebrate remains, present in some other predator dominated assemblages, and a repetition of this unique taxonomic profile in geographically remote, but essentially contemporaneous units such as the Bahariya Formation in Egypt, suggest that the taxonomic composition of the Kem Kem cannot be explained away as a purely taphonomic artefact. The ecology of the Kem Kem vertebrate biota is uncertain, but profound differences in the jaw morphology and postcranial anatomy of the large theropods suggest a number of feeding specialisations (macrophyagh, piscivory and possibly omnivory) that go some way toward explaining this unusual assemblage.

**Post Session IV, (Wednesday)**

**A NEW ORNITHOPOD (DINOSAURIA: ORNITHISCHIA) SPECIMEN FROM THE UPPER CRETACEOUS BAJA BARREAL FORMATION OF PATAGONIA, ARGENTINA**

HARROUD, Lucien, Drexel University, Pennsylvania, PA, USA; LAMANNA, Matthew, Carnegie Museum of Natural History, Pittsburgh, PA, USA; MARTINEZ, Ruben, Universidad Nacional De La Patagonia San Juan Bosco, Comodoro Rivadavia, Argentina; CASAL, Gabriel, Universidad Nacional De La Patagonia San Juan Bosco, Comodoro Rivadavia, Argentina; LACOVARA, Kenneth, Drexel University, Pennsylvania, PA, USA

We describe an associated partial postcranium as the third definitive ornithopod dinosaur record from the Upper Cretaceous Baja Barreal Formation of central Patagonia, Argentina. Specifically, the specimen was recovered from the uppermost Cretaceous (Campanian ?Maastrichtian) Upper Member of the Baja Barreal Formation as exposed on an ephemeral island in the southeastern portion of Lago Colhu Huapi in southern Chubut Province. Identifiable skeletal elements include four partial dorsal vertebrae, three incomplete proximal caudal vertebrae, a middle caudal neural arch, a partial distal caudal vertebra, a dorsal rib fragment, the right calcaneum, and portions of the left metatarsal III and right metatarsal IV. Comparisons with corresponding elements of other ornithischians indicate that the material pertains to a medium-sized, non-hadrosaurid ornithopod. In particular, the morphology of the calcaneum is characteristic of those non-hadrosaurid ornithopods. The new discovery enhances our understanding of the latest Cretaceous continental vertebrate assemblages of central Patagonia and adds to the generally meager record of Late Cretaceous ornithischians from the Southern Hemisphere. Furthermore, it is important in constituting a representative of Ornithischia from the same general geographic region, and probably an equivalent stratigraphic unit, as two problematic members of this clade: the supposed ceratopsian *Notoceratops* and the fragmentary hadrosaurid *Secernosaurus*. The taxon represented by the new specimen may therefore have relevance for resolving the controversies surrounding the stratigraphic provenance of both of these Patagonian ornithischians and the systematic position of *Notoceratops*.
cropped out at the same quarry in Mifune Town. To evaluate the taxonomic reconstruction of the vertebrates from the Mifune Group, I present here the taphonomic and sedimentological data of the bonebed in the Mifune Group. The facies of bonebed 1004-A is a greenish gray siltstone alternated with thin fine sandstone beds representing reverse grading, and siltstone that contains a high amount of plant fragments. Therefore, these facies is interpreted as a levee and floodplain deposit. Although the collected specimen is still insufficient, taxonomic composition of bonebed 1004-A might be monodominate. The material consists of isolated theropod, a few crocodiliforms, and turtle elements. The facies of bonebed 1004-B, lying under 1004-A, is a pebbly sandstone accompanied by rip-up mud clasts. The sandstone units show lining-upward, are cross-stratified, and have an erosional basal contact. This facies may suggest channel-fill fluvial deposits. About 1100 specimens indicate that this bonebed has a multitudinous and high diversity taxa; the taxonomic composition consists of at least three lineages of theropods, hadrosauru, ankylosauru, crocodiliforms, 6 genera of turtles, actinopterygians, and eutherian mammals. Because there are several degrees of abrasion stages and breakage classes, it suggests variable accumulation processes on each of the bones. It is considered that the remains in bonebed 1004-A were preserved in the overbank deposit without out reworking, while reworking and concentration of fossils from the previous sediments formed bonebed 1004-B in the meandering river system. Although both modern and parlic depositional settings are abundant in the Upper Cretaceous of Japan, this results indicate the terrestrial and freshwater vertebrate paleocommunity was also diverse in the Late Cretaceous of the active margin of East Asia.

Technical Session XIV, Wednesday 9:30 ANATOMY OF THE BASAL THERIPOD TAWA HALLAE AND ITS IMPLICATIONS FOR EARLY DINOSAUR PHYLOGENY IRMS, Randall, University of Utah, Salt Lake City, UT, USA; NESBITT, Sterling, University of Texas, Austin, TX, USA; SMITH, Matthew, Field Museum of Natural History, Chicago, IL, USA; TURNER, Alan, Stony Brook University, Stony Brook, NY, USA; DOWNS, Alex, Ruth Hall Museum of Paleontology, Abiquiu, NM, USA Much of our understanding of early theropod dinosaur evolution relies on the Late Triassic taxa Herrerasaurus from South America and Coelophysis bauri from western North America, two disparate body plans that share few derived character-states. Tawa hallae, a basal theropod from the Petrified Forest Member of the Chinle Formation in northern New Mexico (Ghost Ranch), fills this morphological gap. Known from many well-preserved and nearly complete skeletons, Tawa provides new osteological data for understanding basal theropod evolution and early dinosaur relationships. Tawa hallae shares several characters with neotheropods, such as a subarcal gap between the premaxilla and maxilla, pneumatic openings in the cervical vertebrae, and a symmetrical, blade-like fourth trochanter on the femur, whereas it also retains some plesiomorphic features that are widespread among basal dino- saurs, including a restricted antorbital fossa on the maxilla, a short pre-acetabular process of the ilium, and an elongated metatarsal I. To test the phylogenetic relationships of Tawa and basal dinosaurs, we performed a parsimony analysis on a comprehensive dataset consisting of 41 taxa and 315 characters. Tawa is recovered as the sister-taxon to Neotheropoda with strong character support values. The transitional mosaic of character-states present in Tawa strengthens the placement of herrerasaurins, Chindesaurus, and Eoraptor as basal theropods rather than basal saurischians. Crucially, Tawa helps polarize character-states within Neotheropoda, demonstrating that many features previously thought to be coelophysoid synapomorphies may in fact represent basal neotheropod plesiomorphies. This further shifts the traditional Coelopsysideidae into a paraphyletic grade of basal neotheropods, which reduces several Late Triassic and Early Jurassic theropod ghost lineages. These data suggest that Tawa is vital to understanding character evolution and phylogenetic diversification among early dinosaurs and neotheropods alike.

Technical Session XIV, Wednesday 12:00 UNCOVERING THERIPOD EGGS: WATER VAPOR CONDUCTANCE AND NESTING STRATEGY OF TROODON JACKSON, Frankie, Montana State University, Bozeman, MT, USA; JACKSON, Robert, Montana State University, Bozeman, MT, USA; VARRICCHIO, David, Montana State University, Bozeman, MT, USA; ZELENITSKY, Darla, University of Calgary, Calgary, AB, Canada The water vapor conductance rate (Gwa,m) calculated for a fossil egg provides important infor- mation on nesting environment when compared to eggs of modern reptiles and birds. Most avian eggs are exposed to the atmosphere during incubation, and the eggs exhibit low porosity and gas conductance that aid in water conservation, while permitting adequate oxygen and carbon dioxide exchange. In contrast, reptiles typically incubate their eggs underground or in vegetation mounds characterized by high humidity and low oxygen conditions. Accordingly, their eggs are far more porous and typically have Gwa,m values four to eight times greater than those of birds. Troodon egg clutches consist of tightly packed, elongate eggs standing near vertical within the substrate. A lithologic change occurs at roughly two-thirds of the egg length. Potential incubation modes hypothesized for troodontid eggs include complete burial within a subterranean or partial burial with the upper portion covered by a vegetation mound or by an attending adult. To test these hypotheses, we analyzed eggshell thin sections from five locations on the asymmetrical Troodon egg. The pore density in the upper half of the egg is 2x greater than in the lower portion. This variation in porosity suggests the presence of distinct incubation media for the lower and upper portions of the egg. The mean Gwa,m of 46 mg water per day Torr calculated for the entire egg is comparable to the 45 mg of water per day Torr of an avian egg of comparable mass. This low water vapor conductance supports previous interpretations that the eggs were partially buried and incubated by an adult. Physical Drivers and Marine Tetrapod Evolution, Monday 9:15 PHYSICAL DRIVERS OF EVOLUTION AND THE HISTORY OF THE MARINE TETRAPHOD FAUNA OF ANGOLA JACOBS, Louis, Roy M. Huffington Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA; POLCYN, Michael, Roy M. Huffington Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA; ARAÚJO, Ricardo, Roy M. Huffington Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA; STRGANAC, Christopher, Roy M. Huffington Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA; MATEUS, Octávio, Departamento de Ciências da Terra (CICEGe-FCT), Universidade Nova de Lisboa, Lisbon, Portugal Modern marine species populations are often evaluated in terms of bottom-up, resource limited structure, or top-down, predator controlled structure. In a larger timeframe, investiga- tion of physical drivers in marine tetrapod evolution relies on the recognition of patterns and the correlation in timing of physical events with biotic change. However, it has been demon- strated through the study of fossil cetaceans that a broader deep-time perspective within a top-down or bottom-up framework is informative. Here we examine the fossil record of Cretaceous marine tetrapods in Angola to discern patterns that may reflect physical drivers of evolution, and that are also relevant to population structure. In modern marine ecosystems, distribution patterns reflecting primary productivity are indicative of bottom-up control. In the fossil record, productivity-controlled distribution patterns can also be perceived. Physi- cal parameters resulting in environmental stability, sea-level change, oceanic anoxic events, paleoclimate, and paleogeography are examined in comparison with taxonomic diversity and life history patterns. Mosasauris originated during a time of high global temperatures and shallow temperature gradients. As upper-trophic-level species of modest size and plesioside limb structure (capable of terrestrial locomotion), early mosasaurs were subject to both top- down and bottom up pressures. The attainment of larger size coupled with emigration and biogeographic distribution in areas of high primary productivity, and niche differentiation shown by δ13C values, indicate bottom-up pressures. Productivity along the African coast since the formation of the Atlantic Ocean facilitated the co-occurrence of diverse marine tetrapods through time, and has culminated today in the Benguela large marine ecosystem. Just as the current Benguela ecosystem has tetrapod species populations dominated by both bottom-up (cetaceans) and top-down strategies (sea birds and pinnipeds), so too did the Cre- tacuous community, with mosasaurs and plesiosauris having predominantly bottom-up population structure, while sea turtles and pterosaurs were more subject to top-down pressures.

Poster Session IV, (Wednesday) ON THEIR KNEES: DISTAL FEMUR ASYMMETRY IN UNGULATES AND ITS RELATIONSHIP TO BODY SIZE AND LOCOMOTION JANIS, Christine, Brown University, Providence, RI, USA; SHOSHITAISYI, Boris, Brown University, Providence, RI, USA; KAMBIC, Robert, Brown University, Providence, RI, USA Distal femur asymmetry (where the medial trochanteric ridge is larger than the lateral one) has been observed in domesticated and wild species and has been associated with a stay apparatus, and bovids, where associated with open habitat preference. We measured femora of 63 species of ungulates (including 21 extinct species, plus 3 proboscidens, and 3 carnivorns) and plotted the degree of asymmetry against a body size estimate (average femur cross-sectional diameter). Carnivores, camels, and proboscidens show little asymmetry. Within ungulates there is a clear correlation between the degree of asymmetry and body size. Within ruminant artio- dactyls asymmetry also correlates with habitat: open habitat species have more asymmetric femora than closed habitat ones, a pattern also seen among rhinos and tapirs. Among equids, extinct brachydont species (assumed to be closed habitat) have a lesser degree of asymmetry than hypsodont ones (open habitat). Both the lack of asymmetry in camels and proboscidens, and the greater degree of asymmetry among open habitat forms, imply a correlation with locomotor behavior. Most ungulates use the gallop gait at high speeds, during which they land on a single hind limb from a period of suspension. Neither camels (habitual pacers), nor proboscidens (whose fast gait is an amble), would be likely to experience this kind of hind limb stress. (Interestingly, the included chalicotheres and brontotheres show little asymmetry, indicating an elephant-like, versus rhino-like, gait.) Additionally, open habitat ungulates would be more likely to habitually gallop than closed habitat ones. We propose that distal femur asymmetry in ungulates is related to supporting the body mass, including a large gus mass, during the gallop. (The issue of gut mass may explain why large cursorial carnivores do not exhibit femoral asymmetry.) By analogy with humans, where a large lateral trochanter resists lateral dislocation of the patella, the larger medial trochanter in ungulates may resist medial patella dislocation. Scaling factors (e.g., gus mass versus muscle cross-sectional area) would make this issue more acute in larger galloping ungulates, hence their greater degree of femoral asymmetry.
Two partial pachycephalosaurid skulls, from the upper Fruitland and lower Kiirtland forma-
tions (Upper Cretaceous), are recognized as belonging to a new species of Stegoceras. This new pachycephalosaurid differs from the only other recognized species of Stegoceras (sensu
stricto) in possessing: a reduced and sub-rectangular postrostral extension of the parietal;
parallel squamosal suture surface contacts of the postrostral extension of the parietal;
enlarged and medially positioned supratemporal fenestra; and a small (adult) size. Fusion of
the frontal and parietal in one specimen, coupled with a smooth dorsal surface of the
frontoparietal dome, is consistent with an adult ontogenetic stage. Gross histology reveals four
histomorphs, the fourth (outer-most layer) indicates arrested growth, further attesting
to its mature state. The new pachycephalosaurid is known from, and restricted to, the upper
Fruitland Formation (Forest Fossil Member) and lower Kiirtland Formation (Hunter Wash
Member); the collective vertebrae from these contiguous strata make up the Hunter Wash
local fauna. Contrary to previous reports, the Prenocephale (= Sphaerotholus)-like pachy-
cephalosaurs are not known from the early Kiirtlandian, but are restricted to the Willow
Wash local fauna of the upper Kiirtland Formation (De-na-zin Member). This new pachy-
cephalosaurid is temporarily younger (Kiirtlandian) than the well-known Stegoceras validum
from the Judithian of Alberta, Canada.

Poster Session I, (Sunday)

RELATIVE ABUNDANCE OF LATE PLEISTOCENE MEGAFAUNA IN CENTRAL
ALBERTA, CANADA
JASS, Christopher, Royal Alberta Museum, Edmonton, AB, Canada; BURNS, James,
The Manitoba Museum, Winnipeg, MB, Canada; MILOT, Peter, Royal Alberta Museum,
Edmonton, AB, Canada

The late Pleistocene history of Alberta includes a record of the ultimate ecosystem distur-
bance (e.g., a total loss of pre-glacial environments and the coalescence of post-glacial fauna
across much of the province. Subsequent glacial retreat allowed for the return of plants
and animals to Alberta. Therefore, Alberta’s Quaternary faunal record has the potential for
providing perspective on how mammals respond as ecologically disturbed regions become
available for re-colonization. Significant work has gone into describing the Ice Age fauna
from Alberta, but as of yet, relatively little work has been dedicated to understanding the
actual structure of Quaternary faunal assemblages in the province. Development of such a
dataset will be necessary to fully understand the composition of pre- and post-glacial faunas
in the province, and may eventually provide an important historical perspective for modern
conservation questions.

Pleistocene fossils collected from gravel deposits near Edmonton were used to examine
patterns of relative abundance of megafauna from both pre- and post-glacial time periods.
Relative abundance for genera of Pleistocene megafauna was calculated using the number of
individual specimens (NISP) from twelve individual localities (i.e., gravel pits) comprising
two regional data sets. Pre-glacial localities with reasonable numbers of radiocarbon ages (n
> 5) are dominated by horse (Equus). Mammoths (Mammuthus) and bison (Bison) are com-
mon, but other megafauna (e.g., Jefferson’s ground sloth [Megalonyx], Yesterday’s camel,
[Camelops]) are comparatively rare. There is some indication that post-glacial faunas are domi-
nated by Bison rather than Equus, but further radiocarbon age data are needed to verify this.

Poster Session III, (Tuesday)

PREDATION ON EARLY MIOCENE PRIMATES, PROCONSUL,
DENDROPITHECUS AND LIMNOPITHECUS FROM RUSINGA ISLAND
JENKINS, Kirsten, University of Minnesota, Anthropology Department, Minneapolis, MN,
USA

Early Miocene deposits from Rusinga and Mfangano Islands, Kenya, have yielded one of
the largest collections of primate fossils in the world. In addition to these rich primate as-
semblages, there are 50,000 mammals, reptile, bird, invertebrate, and macrobotanical fossils
are known, presenting a unique opportunity to study the ecology and faunal communities
in which these early primates lived. Here, I present the first formal taphonomic analysis of
the primate assemblage in order to identify the accumulating agents of these Miocene catar-
rhines. Preliminary reports of damage and skeletal part frequencies of Proconsul fossils sug-
gested that some individuals were accumulated as prey by medium-sized creodonts. I further
tested this hypothesis by comparing surface modifications and skeletal part frequencies to
actualistic studies of modern carnivore assemblages as well as modern raptor assemblages.
Data on the location, frequency, and size of tooth pits, gnawing, probable raptor damage and
insect modification, and where possible, breakage patterns were collected on specimens of
Proconsul, Dendropithecus, and Limnopithecus. I accounted for post-depositional deletion
of skeletal parts by examining weathering stages and fragmentation. Multiple tooth pits on
fossil long bone shafts and gnawing on the epiphyseal ends of fossil long bones are consis-
tent with damage produced by modern carnivores. I also found irregular punctures marks
on fossils consistent with damage left by modern raptors when de-fleshing carcasses. These
results confirm that creodonts were responsible for accumulating a portion of the primate as-
semblage on Rusinga Island, but suggest that raptors also preyed upon the smaller species of
Proconsul, P. heseloni. These results represent the first evidence of raptor predation on fossil
primates from Rusinga, and further inform our understanding of the selection pressures faced
by our earliest hominoid ancestors.

Technical Session VIII, Monday 3:00

MODES OF GNATHOSTOME FIN SPINE DEVELOPMENT INFERRED FROM
THREE-DIMENSIONAL HISTOLOGY
JERVE, Anna, Uppsala University, Uppsala, Sweden

Dermal spines are found on some extinct shark and bony fish groups, but in the past they had
a much wider taxonomic distribution across early stem- and crown-group gnathostomes.
When spines are associated with median and/or paired fins they are referred to as fin spines.
Fin spines usually only appear in crown gnathostomes but morphologically similar spiny
structures have been identified on stem gnathostomes. There is a large degree of morpho-
logical diversity in spines which has rendered them useful taxonomic tools, but questions
about their growth and evolution remain unanswered. Here, I present a comparative analysis
of spine vascularization using detailed three-dimensional reconstructions of placoderm
(Romundina) and acanthodians as well as a putative osteichthyan spine base from the
Devonian of Scotland. The specimens were scanned at the European Synchrotron Radiation
Facility (ESRF) in Grenoble and permit virtual three-dimensional reconstruction of vascular
architecture of the spines. These reconstructions of the material show that the spines from
the placoderm and acanthodian each have their own unique vascularization, indicating differ-
ent growth modes. The vascular architecture of the acanthodian spine is organized into three
layers: two layers defining longitudinal veins, implying that the oldest part of the spine is the
tip. In contrast, the oldest part of the Romundina spine appears to be the middle part of the ante-
rior edge, and growth continued in all directions from that point to create the overall shape of
the spine. Dentine elements (the outer mantle of the acanthodian spine, a superficial layer
of tubercles in the Romundina spine) were also added and organized in fundamentally different
ways. The putative osteichthyan spine base contains endochondral bone, a tissue unknown
in acanthodians and placoderm. The evidence shows that morphologically similar spines in
early vertebrates grew quite differently despite their overall external similarities and creates
a potentially rich source of phylogenetic characters.

Technical Session IV, Sunday 2:00

PHYLOGENETIC ANALYSIS OF SHASTASUARIDAE ILLUMINATED BY
GUZHIOUCHITTHYSOURAS FROM CHINA INDICATES A POSSIBLE PATHWAY
OF THE MIGRATION OF THIS FAMILY
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; MOTANI, Ryouke, Department of Geology, University of
California, Davis, Davis, CA, USA; HAO, Wei-cheng, Department of Geology and
Geological Museum, Peking University, Beijing, China; SUN, Zuo-yu, Department of
Geology and Geological Museum, Peking University, Beijing, China

Shastasauridae has been widely reported from the Middle Triassic of Italy and the Late
Triassic of North America. During the last decade, a large number of Guizhioucithysouras
(Shastasauridae) were found from South China, filling the paleogeographic gap. The strati-
graphic sequence of this family is, from older to younger: Besanosaurus (Anisian-Ladinian
boundary), Guizhiouchithysouras (Late Ladinian and Early Carnian), Shastasaurus and
Shonisaurus (Late Carnian and Norian). The phylogeny of Shastasauridae was analyzed based on a published data matrix by adding
Guizhiouchithysouras. The matrix contained 105 characters and 34 species. A maximum
parsimony analysis resulted in 12 most parsimonious trees with CI=0.5940, RI=0.8372,
TL=234. The tree topology suggests that Shastasauridae is monophyletic: (Besanosaurus,
(Guizhiouchithysouras, (Shastasaurus, Shonisaurus))), with ten characters supporting the basal
node: long parietal supratemporal process, squamosal not participation in UTF, humer-
ous squarish, radius continuous shaft notched, upper and lower dental groove absent, pubis
obturator foramen mostly in but open on one side, more than 60 vertebral centra and riba
wider than long, etc. Guizhiouchithysouras is the sister group of (Shastasaurus, Shonisau-
rus), supported by maxilla dorsal lamina, scapula axis and glenoid facet orientations at about
60 degrees, radius more than 1.5 size of ulna. The phylogenetic sequence is in accordance
with the stratigraphy and paleogeographic distribution of the family, indicating that Shasta-
sauridae possibly migrated to South China from Western Tethys during the Middle Triassic
and then spread to Eastern Pacific during the Late Triassic. They later had multidirectional
migration pathways as there are Himalayasaurus specimens found in the Norian of Tibet
(Western China).

Guizhiouchithysouras shared some characters with Besanosaurus and some other charac-
ters with Shastasaurus. Some characters suggest progressive changes from Besanosaurus to
Shastasaurus through Guizhiouchithysouras. For example, the radius/ulna length ratio is 1.2
in Besanosaurus, 1.5 in Guizhiouchithysouras and 2.0 in Shastasaurus.
COMPARISON BETWEEN THE CHINESE MIDDLE TRIASSIC MARINE REPTILE FAUNAS AT THE EAST END AND THE MONTE SAN GIORGIO FAUNA AT THE WEST END OF TETHYS

JIAO, Da-yong, Department of Geology and Geological Museum, Peking University, Beijing, China; RIEPPEL, Olivier, Department of Geology, The Field Museum, Chicago, IL, USA; HAO, Wei-cheng, Department of Geology and Geological Museum, Peking University, Beijing, China; MOTANI, Ryosuke, Department of Geology, University of California, Davis, CA, USA; TINTORI, Andrea, Dipartimento di Scienze della Terra, Università degli Studi di Milano, Milano, Italy

Three Middle Triassic marine reptile faunas are known from the Tethys: the middle Anisian Panxian-Luoping Miosaurus paxianensis Fauna (about 240 mya) in the eastern part; the Anisian/Ladinian boundary Monte San Giorgio Miosaurus cornulatianus Fauna (about 237 mya) in the western part; and the latest Ladinian Xingyi-Fuyuan Ichthyosauria hui Fauna (about 230–228 mya) in the East. The Panxian-Luoping Fauna shows a strong similarity to the younger Monte San Giorgio Fauna by the co-occurrence of several genera of marine reptiles and fishes, e.g. Miosaurus, Placodus, Nothosaurus and Lariosaurus, occurring in the course of global sea level rises on the stage-scale and the period-scale. They represent a rapid biotic radiation and the quick westward establishment of a new vertebrate ecosystem with concurrent marine palaeoenvironmental stabilization along the northern coastline of the Paleotethys. Recent collection of new pterosaurian isopod fossils, similar to Australian fresh water Protanopthis wianamattensis, also reveals a potential southward (Australian) vertebrate palaeogeographic affinity.

The Xingyi-Fuyuan Fauna, comparing to the older Monte San Giorgio Fauna, has no confirmed record of Miosaurus, but still yields Nothosaurus, Lariosaurus, as well as the pachypleurosaur saxopterygien Ichthyosauria, the askeptosaurid thalattosaur Anshunsaurus, and the shastasaurid ichthyosaur and eumododontid placodonts. More interesting is that the strange Tanyosphingus and the terrestrial Mamenchiasaurus appear in both faunas, even though the Monte San Giorgio Fauna is about 7 million years older. The level of Xingyi-Fuyuan Fauna corresponds to the last stage of the Middle Triassic biotic radiation in a stable marine palaeoenvironment, and in the stage-scale regressive course, but on the period-scale in the process of the global regression. It might be a result of eastward migration from the western Tethys.

CROCODYLIFORMS FROM THE EARLY MIOCENE DOMO DE ZAZA LOCALITY OF CUBA

JIMÉNEZ VÁZQUEZ, Osvaldo, Oficina del Historiador de la Ciudad de La Habana, Ciudad de La Habana, Cuba; BROCHU, Christopher, University of Iowa, Iowa City, IA, USA

The Domo de Zaza locality is an Early Miocene deposit located in the province of sancti spiritus (south-central Cuba). Terrestrial, lagoonal, and marine environments are represented, and at least two enigmatic crocodyliforms can be identified. One is currently only known from distinctly compressed serrated teeth closely resembling those of Sebecus and related forms from the Cenozoic of South America. The other is known from fragmentary cranial and mandibular material and is more difficult to assess. The dental symphyseis is short and the lateral squamosal groove does not flare anteriorly, arguing against tomistomite or gavialoid affinities. It has a dorsoven trally expanded medial quadrate hemiconderyly resembling that of crocodyloids (though not with the same degree of expansion), but the lateral squamosal-lavine suture intersects the posteroventral corner of the external otic aperture, a feature unique to alligatoroids. The supertemporal fenestrae are unconstructed and the descending lamina of the exoccipital does not extend to the basicranial tubera, arguing against a relationship with caenolestiformes. A sebecid in the Miocene of Cuba would be consistent with evidence from other vertebrate assemblages suggesting extensive dispersal between the greater Antilles and South America during the Neogene, and it would be the first Neogene record of the group outside South America. Other crocodyliforms may indicate the presence of an endemic West Indian lineage not closely related to any living group during the Neogene.

BISON ANTIQUUS FROM NORTHWESTERN OAXACA, SOUTHERN MEXICO

JIMÉNEZ-HUIDOBRO, Paulina, Universidad de Chile, Santiago, Chile; OTERO, Rodrigo, Consejo de Monumentos Nacionales, Santiago, Chile; RUBILAR-ROGERS, David, Museo Nacional de Historia Natural, Santiago, Chile

We report here a left ischium of a large tylosaurine mosasaur (SGO.PV.6650, National Museum of Natural History of Santiago, Chile) from the late Campanian beds (based on fossil invertebrates with good chronostratigraphic value) of the Chanco Formation (Region del Maule, Central Chile). The bone displays a sigmoidal shape preserving its acutabular portion, without well-differentiated facets. The external surface is convex and smooth, while the internal surface is flat and wrinkled. The transverse section is elliptical and the distal and medial margins show a reduction of the bone thickness, suggesting the presence of a blade-like portion that is not preserved. The sigmoidal shape differs from the straight ischium seen in Mosasaurus and Platecarpus, while in Clidastes, this bone has a reduced acutabular portion and broader general shape. SGO.PV.6650 most closely corresponds to the ischium of the genus Tylosaurus. The most compressed portions of SGO.PV.6650 match the gracile portions of the ventral portion of the ischium of Tylosaurus. Since SGO.PV.6650 does not preserve the anterior or ventral processes, it is not possible to establish an accurate generic identification; nevertheless its morphologic affinities allow us to refer it to the subfamily Tylosaurinae. This is the first occurrence a Tylosaurinae in Chile and southern portion of South America. A comparison between the Chilean tylosaurine and Lakumasauros antarcticus from northeast Antarctic Peninsula will help to understand the biogeography of tylosaurines (in particular the Weddellian Biogeographic Province), in the southern hemisphere while highlighting the fossiliferous potential of this region.

FUNCTIONAL MORPHOLOGY OF THE EARLIEST VERTEBRATE FEEDING STRUCTURES

JONES, David, University of Bristol, Bristol, United Kingdom; EVANS, Alistair, Monash University, Melbourne, Australia

Teeth constitute the majority of the vertebrate fossil record and are typically the first site of direct interaction between an animal and its food; this makes them obvious targets for the application of engineering approaches to understanding their functional morphology. Such work is well advanced for mammals, together with many reptile and fish groups. However the potential of such methods for elucidating conodont functional morphology remains unexplored, despite conodonts representing a major portion of Paleozoic and early Mesozoic marine vertebrate diversity and possessing an excellent fossil record, which preserves a variety of tooth forms rivaling or surpassing that of other vertebrate groups. To address this shortcoming, we have conducted the first rigorous analysis of conodont tooth function based upon engineering principles. Following a similar methodology to that previously applied to mammals, our approach treats conodont teeth as tools. We have concentrated on the food processing (P) teeth and focussed initially on those with a flattened, blade-like morphology. We have tested the current hypothesis of P tooth function through analysis of the geometry of function – relating to the most efficient shape for food fracture – in a range of taxa. This has revealed that the diversity of conodont tooth morphology in fact reflects a diversity of function and occlusal mechanics. We demonstrate how changes in size and shape of the functional components (e.g. cusps and denticles) influence functional mode (cutting versus puncturing). For the first time, this has established constraints on the properties of the food types consumed by conodonts (e.g. viscoelastic versus brittle). This work will ultimately help place evolutionary changes in conodont tooth morphology within a functional and ecological context and allow investigation of the extent to which functional mechanics of blades can be generalised, thereby permitting an assessment of functional convergence in feeding structures in other vertebrates.
DISCORDANT CRANIAL MORPHOLOGICAL DISPARITY AND TAXONOMIC DIVERSITY IN PINNIPED versus FISSIPED CARNIVORANS

JONES, Katrina, Johns Hopkins University, Baltimore, MD, USA; GOSWAMI, Anjali, University College London, London, United Kingdom

Species number is a common measure of a clade’s diversity, but taxonomic diversity and morphological disparity are not always concordant. Here we demonstrate the discordance of taxonomic and morphological diversity in the order Carnivora. In evolutionary studies, Carnivora is a heterogeneous group of taxa that contain aquatic pinnipeds (e.g., seals) and paraphyletic fissipeds, which include terrestrial, arboREAL, fossorial, and semi-aquatic species. Fissipeds date from the early Paleocene and are more taxonomically diverse (129 extant and over 300 extinct genera), while pinnipeds date from the late oligocene and are less diverse (21 extant and 48 extinct genera). To test if this taxonomic diversity also translates to morphological disparity, we collected 3D landmark coordinate data (k=23) from the crania of 37 extant and extinct fissiped species (n=64), encompassing all extant families and the full breadth of ecological diversity, and 28 extant species of pinnipeds (n=67). After Procrustes superimposition and Principal Components Analysis, morphological disparity of the two groups was measured in three ways: A) mean pairwise Procrustes distance; B) mean Procrustes distance from the group centroid; and C) convex hull volume. Results for all three disparity measures show that pinniped cranial disparity is significantly greater than that of all fissiped carnivorans (Disparity B, p=0.02) and that of their sister clade, Musteloids (B, p=0.01). Analyses of cranial regions further show that pinniped facial disparity is significantly larger than that of fissipeds. Pinniped disparity is greater in the zygomatic/orbital region, while fissiped disparity is greater in the palatal region. Rostral disparity is equal in Disparity A and B, but much greater in pinnipeds in Disparity C, which measures morphospace occupation, indicating that there are a few species with very unusual rostral morphology. The specialization of the postcranium during the terrestrial-marine transition, and the related shift of prey capture and mating display functions to the cranium, have likely driven the remarkable cranial disparity in pinnipeds, despite their low taxonomic diversity.

Technical Session IV, Sunday 3:00
CRANIAL JOINTS IN SPHENODON (RHYNCHOCEPHALIA) AND ITS FOSSIL RELATES WITH IMPLICATIONS FOR LEPIDOSAR SKULL MECHANICS

JONES, Marc, UCL, University College London, London, United Kingdom; CURTIS, Neil, University of Hull, Hull, United Kingdom; O’HIGGINS, Paul, University of York, York, United Kingdom; FAGAN, Michael, University of Hull, Hull, United Kingdom; EVANS, Susan, UCL, University College London, London, United Kingdom

The tuatara, Sphenodon, is the sole survivor of the Rhynchocephalia, a diapsid group that was widespread during the Mesozoic. Increasing evidence shows that rhynchocephalians were anatomically diverse with respect to feeding apparatus and skull shape. Moreover, there is an apparent evolutionary trend towards increased bite force as indicated by shorter outer levers, stouter teeth, and larger adductor chambers in derived taxa. As elements of an infinite-dimensional, nonlinear manifold equipped with a well-defined Riemannian metric, shapes of curves are invariant to killing, and the shape space, which is an infinite-dimensional sphere where geodesics can be analytically defined in particular spots of the ventral and posterior margins, whereas changes in jugal shape between basal hadrosauroids and Hadrosauridae, and between basal (e.g., Aralosaurus) and derived lambeosaurines (e.g., Parasauroplophus) lied on the rostral process. This supports the importance of the rostral region in the development of the maxilla and nearby areas of the face during hadrosaurid and lambeosaurine early evolution. This study demonstrates the potential of EGA for approaching morphology-based questions in evolutionary biology.

Technical Session II, Sunday 8:45
A COMPREHENSIVE REVISION OF THE DICYNODONT ‘WASTE BASKET GENUS’ DICYDON (THERAPSIDA: ANOMODONTIA)

KAMMERER, Christian, American Museum of Natural History, New York, NY, USA; ANGIELCZYK, Kenneth, Field Museum, Chicago, IL, USA; FROBISCH, Jörg, Field Museum, Chicago, IL, USA

The herbivorous dicynodonts were the most abundant and speciose terrestrial vertebrates of the Late Permian. Although the alpha taxonomy and phylogeny of Permian dicynodonts have recently become increasingly well-resolved, one major obstacle remains: the genus Dicyodon. The first dicynodont to be described, Dicyodon contains 149 nominal species, most of them represented by a single specimen from the Karoo Basin of South Africa. This plethora of poorly-characterized species has seriously hindered accurate estimation of diversity in the terminal Permian and vertebrate extinction severity across the Permo-Triasic boundary. Here we present a comprehensive revision of the species of Dicyodon and interpret these results in a phylogenetic, stratigraphic, and biogeographic framework. The majority of nominal species of Dicyodon can be recognized as synonyms of other Permian dicynodont taxa (predominantly Diictodon, Oudenodon, and Tragmentosaurus). We recognize only 12 valid species worldwide that can be assigned to “Dicyodon sensu lato (i.e., dicynodontoids similar to the type species Dicyodon lacerticeps).” Phylogenetic analysis of Permo-Triasic dicynodonts indicates that “Dicyodon” is paraphyletic with respect to both Lystrosauridae and Kannemeyeriiformes. We recognize four valid species of South African “Dicyodon”: Dicyodon lacerticeps, Daptocephalus iconicus, Dinanomodon rubigae, and Sinteccephalus alticus. A second species of Dicyodon sensu stricto, D. huenei, is present in the Usil Formation of Tanzania, but other nominal species of Dicyodon from Europe, Asia, and the Americas are not referable to this genus and should not be used for biostratigraphic correlations with the African species. Daptocephalus lacerticeps and Dinanomodon rubigae are found in both the Cistecephalus and Dicyodon Assemblage Zones of South Africa, whereas Daptocephalus iconicus is restricted to the Dicyodon Assemblage Zone.

Poster Session III, Tuesday
GIANTS AND THEIR LITTLE SECRETS: TOOTH MICROSTRUCTURES IN MYLODONT SLOTHS (MAMMALIA, FOLIVORA)

KALTHOFF, Daniela, Swedish Museum of Natural History, Stockholm, Sweden

GIANT ground sloths are among the few mammals whose teeth lack the hard, protective outer enamel layer. Like other toothed xenarthrans, they have developed continuously growing teeth with a composition of different dentine types and of cementum. Sloths actively chew the food, and therefore need tooth relief. Resistant rims are generally formed by orthodentine. A broad scanning electron microscopic study of microstructures in xenarthran teeth showed that species of Scelidotherium, Lestodon, Glossotherium, Paramylodon, and Mylodon have an unusual, washboard-like structure in the outer portion of the orthodentine. Raised parts are radially oriented and perpendicular to the outer margin of the tooth. Microstructurally, the washboard-like structure consists of bundles of several, individual dentinal tubules (ca. 5-15 per bundle). This is remarkable because dentinal tubules usually are subparallel to each other. In scelidotherine and mylodonte sloths instead, tubules form bundles which converge towards the tooth’s centre and which are between 300 to 700 µm in length. The bundles therefore look like ice-cream cones and are somewhat offset against each other. This structure was found in specimens which are late Pliocene and younger in age. It is an interesting fact that Scelidotherium as well as Nematitherium as basal mylodontids lack the washboard-like structure which is considered to be a derived character. This leads to the hypothesis that this structure has been developed independently in scelidotherine sloth and in mylodonte sloths. The washboard-like structure most probably serves as a grinding reinforcement to enhance food processing in the oral cavity. Remarkable is that the washboard-like structure occurs both in wide- and narrow-nuzzled ground sloths which are thought to have had different feeding behaviours. The structure can be compared to functionally-similar structures known from rhinocerotid enamel, which are there caused by vertically-oriented Hunter-Schreger bands.
**PRELIMINARY NOTE ON LONG-TAILED PTEROSAURS FROM WESTERN LIAONING OF CHINA**

KELLMER, Alexander, Museu Nacional UFRJ, Rio de Janeiro, Brazil; WANG, Xiaolin, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; JIANG, Shunxing, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology; Graduate University of Chinese Academy of Sciences, Beijing, China

In the last two decades, no other part of the world has yielded so many long-tailed pterosaurs than China. Particularly in western Liaoning, the quantity and diversity of those small archosaurs have opened a new window for the study of the Pterosauria. Up to date, pterodactyloids by far outnumber non-pterodactyloid taxa, but recently several new specimens of the latter have been found in the Tiaojishan and the Daohugou formations. Here we present two long-tailed pterosaurs that shed new light on the rather enigmatic non-pterodactyloid clade Wukongopteridae. IVPP V16047 and 16049, both almost complete skeletons, share with Wukongopterus (Daohugou Formation) and Darwintonopterus (Tiaojishan Formation - here regarded as a wukongopterid) a conical nasoantorbital fenestra, elongated cervical vertebra and an inclined quadrate - features typical of the Pterodactyloidea but quite unusual for non-pterodactyloids. The new specimens differ from Wukongopterus and Darwintonopterus and from each other in a number of aspects. IVPP V16047 further shows a well preserved wrist clearly demonstrating that the pteroid bone is articulated to the proximal carpal, contradicting the long held view that this element was attached to the lateral (preaxial) carpal. The new specimens suggest that wukongopterids are a rather diverse Jurassic/Early Cretaceous non-pterodactyloid clade, so far restricted to China. Other briefly described taxa from China (e.g. Changchengopterus) might also be part of or at least closely related to the Wukongopteridae.

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**RANGE OF MOVEMENT IN A NOASAURID FORELIMB: IN SITU DATA AND JOINT RECONSTRUCTION**

KEILOR, Tyler, University of Chicago, Chicago, IL, USA; SERENO, Paul, University of Chicago, Chicago, IL, USA; MASEK, Robert, University of Chicago, Chicago, IL, USA

Discovery of a diminutive forelimb on an articulated skeleton of a noasaurid theropod presented an opportunity to study its range of motion. In situ orientation and joint spacing was preserved by preparing a one-piece silicone mold that incorporated a portion of the adjacent shoulder girdle and ribcage. The forelimb was removed from the skeleton for further preparation, and the glenoid and sternal plates were fully exposed. The humerus, radius, ulna, carpus, and manus were then more fully prepared. A second round of molds and casts were made from the prepared limb elements. After study of opposing joint surfaces, joint spacing and movement were restored by embedding mechanical joints composed of 0.4-mm stainless steel ball studs into sockets. The finished jointed and poseable forelimb model enhances visualization of the relation between joint surfaces and exploration of range of motion and the positioning of the strongly-clawed manus. Forelimb manipulation of live crocodilians and dissections of chicken and alligator shoulder and elbow joints provided comparative data on range of motion, joint spacing, and articular cartilage.

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**GLOBAL GEOCHRONOLOGICAL CONTEXT OF EARLY MESOZOIC MARINE REPTILE EVOLUTION**

KELLEY, Neil, University of California Davis, Davis, CA, USA; MOTANI, Ryosuke, University of California Davis, Davis, CA, USA; JIANG, Da-yong, Peking University, Beijing, China; RIEPPLE, Oliver, The Field Museum, Chicago, IL, USA

Early Mesozoic geochemical records display trends and excursions thought to reflect major physical changes in the oceans. These events affected marine invertebrate groups, but their influence on marine vertebrates has not been fully explored. We compared species diversity of early Mesozoic (Triassic-Early Jurassic) marine reptiles to published records of marine 87Sr/86Sr, δ13C and δ18O through the same interval. Isotopic data suggest that taxonomic and ecological diversity of marine reptiles was influenced by changes in climate, tectonics, productivity and sea level. The earliest occurrence of marine reptiles in the latest Early Triassic is synchronous with the end of rapid 13C fluctuations during the delayed recovery from the Permo-Triassic mass extinction. Taxonomic diversity of Triassic marine reptiles peaked during the Middle Triassic—an interval of relatively stable 13C and 18O and falling 87Sr/86Sr. Marine reptile diversity declined steadily during the Late Triassic with the extinction of several clades during an interval characterized by rising 87Sr/86Sr and several abrupt shifts in 13C and 18O. Marine reptiles diversified again during the Early Jurassic. This interval shows steadily declining 87Sr/86Sr values until an abrupt increase at the end of the Early Jurassic accompanied by 13C and 18O excursions and another extinction event. We grouped marine reptiles according to tooth shape, limb shape and tail shape to test for ecologically selective extinction based on habitat or dietary preferences. Changes in substage 87Sr/86Sr negatively correlate with the proportion of durophagous taxa. This supports the hypothesis that long-term sea level decline in the Late Triassic drove the extinction of near shore groups while pelagic groups survived into the Jurassic. As sea level rose in the Early Jurassic new terrestrial groups invaded near shore environments. These results suggest that the physical factors that influence seawater chemistry such as climate, sea level and productivity may play an important role in shaping broad patterns of evolution and extinction among Mesozoic marine reptiles.

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**CONTINUOUS IMPROVEMENTS IN THE USE OF ARCHIVAL MATERIALS FOR THE PADDLED PLASTER JACKET STORAGE METHOD: WHAT WE HAVE LEARNED IN TWENTY YEARS**

KEYSER, William, Contractor for Smithsonian, Arlington, VA, USA; KROEHLER, Peter, Smithsonian, Washington, DC, USA; JABO, Steven, Smithsonian, Washington, DC, USA

The use of plaster as a supporting cradle has been used by preparators for nearly as long as preparations have been collected and storing vertebrate fossils. In the past many cradles have been bulky and nearly as heavy as the bones they were supporting due to the use of the materials available at the time. Ambient vibration common in large buildings in urban settings as well as the improper handling by museum staff and visitors has damaged many large verte-
brate fossils not properly cradled. We have reported on the use of stronger plasters reinforced with fiberglass cloth and a method of lining the cradles with one quarter inch ethafoam padding; further updated by the use of polyfyl as an alternative padding. This presentation demonstrates new archival methods of adhesion of the ethafoam and polyfyl, in addition to the use of balsa wood as handle and support. As a Keyser contractor at the Smithsonian’s Vertebrate Preparation Lab. These nonmetal supports allow for CT scanning, X-raying, and magnetic resonance imaging of the fossil in it’s cradle. There will be a series of photographs and a video presentation of early examples and the latest versions from our collections at Natural History as well as their use in exhibition and from the many collections moved to the Smithsonian’s Museum Support Center in Silver Hill, MD.

Poster Session III, (Tuesday)

AUSTRALOPITHECUS SEDIBA: A TAPHONOMIC PERSPECTIVE
KIBII, John, University of the Witwatersrand, Johannesburg, South Africa; BERGER, Lee, University of the Witwatersrand, Johannesburg, South Africa; DE KLERK, Bonita, University of the Witwatersrand, Johannesburg, South Africa

The discovery of a new hominid species, Australopithecus sediba, is set to provide new insights to human evolutionary history. The well preserved, minimally damaged and partially articulated sediba skeletons are argued to have been accumulated through a death trap. The diverse mammalian faunal assemblage associated stratigraphically with Australopithecus sediba is characterized by a number of partial skeletons and/or antemortem sets of bones across all taxonomic groups. Analyses of bone surface modification reveal no biotic or bone-accumulating agent damage. In addition to other taphonomic data, these observations suggest that the remains of animals recovered in context with Australopithecus sediba are from individuals that died in the cave either having accidently fallen through vertical shafts that connected the cave to the ground surface or became trapped and were unable to escape after intentional entry.

Technical Session VI, Monday 3:15

THE SCALING OF LIMB ROTATIONAL INERTIA IN CURSORIAL MAMMALS: A PRECURSOR TO MODELING LIMB INERTIA IN EXTINCT TAXA
KILBOURNE, Brandon, University of Chicago, Chicago, IL, USA

Inferences into the locomotor biomechanics of extinct taxa first require studies of the locomotion and functional morphology in extant taxa. For studies of terrestrial locomotion, one trait that is poorly understood in both extinct and extant taxa is the rotational inertia of limbs and its relation to body size and locomotion. Therefore before modeling limb inertia in extinct taxa, the study of limb inertia in extant taxa is essential. To understand how limb rotational inertia is related to body size and locomotion, I examined the scaling of hindlimb rotational inertia with body mass across 20 mammalian species, including cursorial, scansion, and aquatic species. For a subset of 13 cursorial taxa, I also examined the scaling of hindlimb rotational inertia to discern whether locomotor types may influence the scaling of limb inertia. For the full dataset of 20 taxa, hindlimb inertial properties (e.g., limb mass, center of mass position, moment of inertia, and natural frequency) scale according to geometric similarity, with small and large taxa having relatively equal inertial properties with respect to their body size. For cursorial taxa, hindlimb mass scales with isometry, indicating that small and large cursorial cursors have hindlimbs of equal mass with respect to body size. However, cursorial taxa exhibit negative allometry of hindlimb center of mass position, signifying that large-bodied cursorial have hindlimbs with a relatively proximal concentration of mass. In cursors, hindlimb moment of inertia and natural frequency also scale with negative allometry, suggesting that the hindlimbs of cursors are relatively easier to swing and have a lower optimal frequency of oscillation for their body size. The low residuals and high coefficients of determination for these scaling relationships make them useful for modeling limb inertia in extinct taxa, particularly extinct mammals. Along these lines, differences in the scaling of limb inertia between cursorial mammals and mammals in general stress the need to pay close attention to anatomical function and specialization when choosing modern analogues as a basis for modeling the functional morphology of extinct taxa.

Poster Session II, (Monday)

A POSSIBLE ICHTHYODECTIFORM (PISCES, TELEOSTEI) FROM THE EARLY CRETACEOUS OF SOUTH KOREA
KIM, Haung-Mook, College of Sciences, Pusan National University, Busan, Korea, South; CHANG, Mi-eun, Institute of Vertebrate Paleontology and Palanthropology, Beijing, China; SEO, Seung-Jo, Chinnu National University of Education, Chinnu City, Korea, South; KIM, Yang-Hee, Pusan National University, Busan, Korea, South

Here we report the first possible ichthyodectiform in Chinnu Biota from the Early Cretaceous Chinnu Formation, Sindong Group, Gyeongsang Supergroup at Hoyojangyo, Micheon-myeon, Chinnu City, South Gyeongsang Province, southern Korea. It shows the following ichthyodectiform characters: 1) up to five long urohyals are observed in the caudal skeleton: the first with enlarged anterior end and reaching antevertebrally to the posterior end of the third preural centrum, and the first two urohyals covering the dorsolateral surface of the first and second preural centra; 2) coracoid expanded ventrally; 3) a long anal fin with more than 35 rays; 4) the dorsal fin situated posteriorly, with its origin opposite to that of the anal. Besides, the caudal skeleton also exhibits features often seen in ichthyodectiforms and some other primitive teleosts, e.g., six neural spines and five hemal spines are prolonged to support the procurent caudal rays (12 dorsal and 8 ventral); all upper hyurals have thick bases, projecting out laterally and shown under the urohyals; a urodermal is present. The fish is noticeably similar to the Chuxiongichthys species from the Early Cretaceous Kumagai Formation of the Kannon Group in Kyushu, Japan, and the Jiangdihe Formation of similar age from Chuxiong, Yunnan Province, China. Chuxiongichthys was, in turn, comparable with Megalaspis shangchingsis from the Shouchang Formation in Shouchang, Zhejiang Province, China. Although the materials of these genera are not well preserved and need to be restudied, they show certain ichthyodectiform characters mentioned above, such as 1, 3, and 4. Nevertheless, the fish from Korea and Chuxiongichthys from Japan and China can easily be distinguished from other ichthyodectiforms in the higher body depth and shorter length, longer dorsal fin, and oval-shaped opercle. The new materials from Korea are better preserved, allowing for a relatively complete description of the fish, providing more information for discussion of their phylogenetic position, enriching the diversity of the local fish fauna, and helping us better understand the paleobiogeographical distribution of the group.

Poster Session IV, (Wednesday)

USE OF FINITE STATE ANALYSIS TO DETERMINE THE OPTIMUM ANGLE OF THESCSELOSOURUS (DINOSAURIA) METATARSALS
KING, Leigha, East Tennessee State University, Johnson City, TN, USA; YACOBUCI, Margaret, Bowling Green State University, Bowling Green, OH, USA; FARVER, John, Bowling Green State University, Bowling Green, OH, USA

It has been proposed that bipedalthecosaurians walked in a similar manner to emus and cassowaries. Such motion would result in their metatarsals being placed vertically in the foot. Through the creation of programs such as Finite Element Analysis (FEA), it is now possible to test this hypothesis by comparing how stresses are distributed over bones in both living and extinct fauna. Therefore, the question at hand was to determine, based on stress values and concentrations, if in fact that interpretation of the metatarsals of thylescosaur was correct. The specimen studied here was collected by the Museum of the Rockies in 2007 from Montana’s Hell Creek Formation. Images of the first two metatarsals were taken, and the medial view of Digits 1, 2, and 4 were studied as well as the lateral view of Digit 3 (deformation obscured the medial side). Images were placed in the freeware 2D FEA program LISA, where a mesh was created of each bone, and walking stresses were applied. Material properties of bovine bone were assigned to the meshes as is standard with most FEA. Images of both the tensile and compressive stress distributions, as well as the highest stress values created in MPa, were analyzed. Since bones are designed to be under constant compressive stresses, it can be assumed that the bones would not be able to withstand high tensile stresses. Therefore, tensile stress values would be a better approximation of what stresses would cause the bones to break. Based on the data collected from the tensile stress values, it was apparent that all four digits would have been optimally placed in the foot between 0 and 10 degrees toward the posterior from vertical. However, each digit had a unique angle that produced the lowest tensile stresses and therefore, the metatarsals have a high likelihood of being found at their respective optimum angle. Specifically, Digit 1 would be best placed to accommodate tensile stresses between 1 and 4 degrees from vertical; Digit 2 at 4 degrees; Digit 3 between 0 and 3 degrees; and Digit 4 between 0 and 7 degrees.
the Amira v. 3.1.1. Based on this virtual endocast, we conclude that the endocranial volume of were thresholded using ImageJ software, and a virtual endocast was reconstructed using with an in-plane resolution of 39 microns and an inter-slice spacing of 87 microns. Data High-Resolution X-ray Computed Tomography Facility at The University of Texas at Austin, including significant portions of both cervical rings (nodosaurids have three cervical rings). who whose jugals, quadrates, and braincase were damaged on discovery. Of the major postcranial tinuber such as the antorbital fenestra of "Halticosaurus" orbitoangularis tapers quite like that of a theropod such as Coelophysis bauri and probably less than a "sphenosuchian" crocodylomorph like Sphenosuchus acutus. More importantly, the teeth of "Halticosaurus" orbitoangularis bear two serrated carinae following the classic theropod style and are not circular in section, but rather oval. The ratio of mesial to distal serration diameter is equivalent to that in some theropods, such as Dilophosaurus wetherelli. Some teeth present apicobasal fissures on the crown surface, but none bear pronounced striations as in some crocodylomorphs. Ad- ditional characters suggestive of affinities with theropods rather than with crocodylomorphs include a labial parapet on the dentary (as in Dilophosaurus wetherelli). Admittedly, further studies are warranted to resolve the systematic position of "Halticosaurus" orbitoangularis within archosaurs; however, its characters are consistent with it being a theropod dinosaur. The disarticulated state of the holotype specimen, as well as possibly the only slightly laterally compressed teeth, suggests that it is from an immature individual. Technical Session XIV, Wednesday 11:15 A NEARLY COMPLETE SKELETON OF A NEW ORNITHOMIMID FROM THE NEMEGT FORMATION OF MONGOLIA KOBYASHI, Yoshitsugu, Hokkaido University Museum, Hokkaido University, Sapporo, Hokkaido, Japan; LEE, Yuong-Nam, Korea Institute Geoscience and Mineral Resources, Daejeon, Korea, South; LÜ, Junchang, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada The remains of the Mongolian ornithomimids, Gallimimus bullatus and Anserimimus planiceps, are common occurrences in the Upper Cretaceous NemegtFormation. In 2006, the Korea-Mongolia International Dinosaur Expedition recovered a beautifully-preserved, uncrushed ornithomimid skeleton from Ulán Khushuu in the Gobi Desert, Mongolia. The almost complete skeleton has a disarticulated skull, but missing only the tail, and, is referable to a new taxon. The Ulán Khushuu specimen differs from all other ornithomimids in having an additional ridge along the deltopectoral crest, nearly straight main ungual phalan- ges, and an accessory ventral process on the lateral posterior condyle of the proximal tibia. It shows an affinity with the other two Nemegt ornithomimids in having a laterally displaced glenoid of the coracoid. Although it shares several derived characters present in the Qipan ornithomimid from China and in North American taxa, suchas the anterior extension of the pubic boot and large acute angle between the dorsal edge of the pubic boot and shaft, it is basal to all North American taxa due to its lack of the ventral expansion of the pubic boot. Cranial material, especially the braincase, is three-dimensionally preserved, and reveals important anatomical information. Similar to Shenzhouaurus orientalis and Sinornithomimus dongi from China, the skeleton preserves a mass of gastriliths within articulated ribs and gastralia, the first such occurrence in a Mongolian ornithomimid. The possession of gastro- liths has been suggested as evidence for herbivory in this group, but the presence of isolated fish vertebrae in the matrix of the gastrilith mass may represent in situ stomach contents. This would suggest that the new ornithomimid may have had a more omnivorous diet.
Environmental Changes and Evolutionary Diversification of Pinnipeds

KOHINO, Naoki, National Museum of Nature and Science, Tokyo, Japan

The pinnipeds (otariids, odobenids, phocids and their fossil allies) are flip-footed carnivores having been adapted to life in water since the Late Oligocene, ca 28 Ma or much earlier. Recent investigations on the phylogeny of the arctoid carnivores revealed that the Oligo-Miocene semi-aquatic mustelidsan Potamotherium and Pujirra, which still retained somewhat that otter-like form, were recognized to have special affinities with the pinnipeds. However, the oldest known record (ORK) of these taxa dates back only to the Late Oligocene, ca 26-25 Ma. Therefore, the speciation event of the pinnipeds is thought to lie near the time of the “pinnipeds’” ORK. However, the fossil record in general does not point to the real timing of divergence because the first stratigraphic appearance of a taxon in the fossil record is subjected to the sporadic sedimentary hiatus due to erosion, no sedimentation during regression, or the type of sedimentary basin. In this regard, a recent investigation of pinniped phylogeny based on molecular evidence reveals new information on the divergence times of pinnipeds independently of such problems. When calculating the divergence times of each clade of the Recent pinnipeds based on molecular phylogenetics, it is suggested that the otarioid-phocoid split occurred at around 27.6 Ma and that the otarioid-odobenid and monachine-phocine splits occurred at around 19.7 Ma. However, the ORK of morphologically distinctive otarioids dates back only to the late Early Miocene (ca. 16.6 Ma), and that of phocids is the early Middle Miocene (ca 16 Ma). Intriguingly, data from sequence stratigraphy suggest that these times suggested by molecules and morphologies correspond respectively to gradual marine transgression sequences and rapid marine transgression-regression fluctuations in the geological time periods.

Physical Drivers and Marine Tetrapod Evolution, Monday 10:45

DISCOVERY OF A LARGE REPTILIAN TRACKWAY FROM THE CRETACEOUS JINDONG FORMATION OF GOSEONG COUNTY, KOREA

KONG, Dal-Yong, National Research Institute of Cultural Heritage, Daejeon, Korea, South; LIM, Jong-Deock, National Research Institute of Cultural Heritage, Daejeon, Korea, South; KIM, Tae-Hyeong, National Research Institute of Cultural Heritage, Daejeon, Korea, South; KIM, Kyung-Soo, Chinn University of Education, Chinn, Korea, South; KOHNO, Naoki, National Museum of Nature and Science, Tokyo, Japan

For more than a century, fossil vertebrates have been collected from Pennsylvanian-Permian nonmarine red beds of the Cutler Group (El Cobre Canyon and Arroyo del Agua formations) in Cañon del Cobre (El Cobre Canyon), Rio Arribo County, New Mexico. Megafossil plants, saur (34.6 cm) from Goseong County.

Based on the reptilian characteristics of the trackway, including the wide step, angle of footprints to the middle line, number and size of digits, the new trackway belonged to a giant reptile that lived alongside dinosaurs.

Poster Session II, (Monday)

TO TILT OR NOT TO TILT? A NEW WAY OF ORIENTING QUADRATES IN PLIOPLATECARPINES (SQUAMATA: MOSASAURIDAE), AND ITS IMPLICATIONS FOR STREPTOSTYLY IN THESE MOSASAURS

KONISHI, Takuya, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada

Quadrates in mosasaurs have long served as the most diagnostic element of these giant, Late Cretaceous marine reptiles. For one thing, these elements preserve well as they are robust. When found in association with the skull however, mosasaur quadrates exhibit a variety of orientations due to the postmortem dislocation. Conventionally, skull restorations of mosasaurs have indicated that quadrates are upright in orientation, where the broadly convex cephalic condyle articulates with the suspensorium (i.e., the squamosal and supratemporal bones) at the postcroral corner of the upper temporal fenestra. Examination of various isolated quadrates and well-articulated skulls of pliopletecarpines mosasaurs, however, suggests otherwise. In these mosasaurs, there are two longitudinal aligned eminences along the distomedial border of the longitudinal superomedial process of the quadrates. Each eminence then respectively fits into the ventrally-facing concavity of the squamosal and anterolaterally-facing concavity of the supratemporal, each in a ball-and-socket fashion. This arrangement requires the quadrates to tilt forward, in order to maintain the horizontal orientation of the upper temporal bar. Furthermore, the joint articulation among these three bones renders streptostyly in pliopletecarpines unlikely. In fact, the streptostyly rotation of the quadrates would cause the cephalic condyle to crush the upper temporal bar of those mosasaurs.

Technical Session III, Sunday 2:00

MIMOTONID TARSAL BONES FROM THE EOCENE OF CHINA AND THE EVOLUTION OF LOCOMOTION IN DUPPLICIDENTATA

KRAATZ, Brian, Western University of Health Sciences, Pomona, CA, USA; MENG, Jin, American Museum of Natural History, New York, NY, USA; WANG, Yuan-Qing, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LI, Chuankui, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Leporids are one of the few small mammals that exhibit a highly cursorial mode of locomotion. Osteological correlates to cursoriality and salination, related to joint stabilization, have been identified previously within the tarsals of living and some fossil lagomorphs. The early evolution of the cursorial mechanism, however, remains poorly understood. Based on new mimotonid tarsal elements from the Eocene of China, and observation of various fossil and extant lagomorph specimens, we discuss the origin of these lagomorph tarsal features, their correlations to locomotion, and their significance for phylogenetic analyses in Duplicidentata (Mimotonidae + Lagomorpha). One mechanism of joint stabilization is the oblique nature of the transverse tarsal joint (TTJ), which minimizes transverse rotation via the additional contact of the calcaneus with the astragalus and navicular; some Middle Eocene mimotonids and all lagomorphs exhibit two related facets. The facets are confluent in mimotonids and separate in lagomorphs, yet did not evolve in the earliest mimotonids. In addition, the upper ankle joint (UAA) of lagomorphs has an additional tabular facet on the calcaneus, a condition described here for the first time in mimotonids.

Our findings suggest that modifications to the TTJ and UAJ did not take place simultaneously. While modification of the TTJ appear in Middle Eocene mimotonids and lagomorphs, and indicates that cursoriality initiated at this time, it was likely of a different grade then observed in living leporids. Overall, the mosaic evolution of duplicidentate tarsals caution their usage for high-level phylogeny such as the pairing of arctostylopids with gilroid Iliriformes. Lastly, we show that the living Ochotona and the fossil Desmatolagus share highly derived similarities in aspects of the peroneal process. This is strong support for their close relationship, and suggests that the locomotion of Desmatolagus was similar to that of modern pikas.

Poster Session I, (Sunday)

VECTEBRATE PALEONTOLOGY, BIOSTRATIGRAPHY AND BIOCHRONOLOGY OF THE PENNSYLVANIAN-PERMIAN CUTLER GROUP, CANYON DEL COBRE, NORTHERN NEW MEXICO

KRAINER, Karl, Innsbruck University, Innsbruck, Austria; LUCAS, Spencer, New Mexico Museum of Natural History, Albuquerque, NM, USA; HARRIS, Susan, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; SPIELMANN, Justin, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; RINEHART, Larry, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA

For more than a century, fossil vertebrates have been collected from Pennsylvanian-Permian nonmarine red beds of the Cutler Group (El Cobre Canyon and Arroyo del Agua formations) in Cañon del Cobre (El Cobre Canyon), Rio Arribo County, New Mexico. Megafossil plants,
palynomorphs and fossil vertebrates indicate that the Pennsylvanian-Permian (~Virgilian-Wolfcampian) boundary is stratigraphically high in the El Cobre Canyon Formation in Cañon del Cobre, though the exact position of the boundary is not certain. A detailed vertebrate biostratigraphy in Cañon del Cobre constructed from all localities that can be placed into precise litostratigraphic position identifies three, temporally successive and distinct vertebrate fossil assemblages that represent three land vertebrate faunachrons (LVFs). The middle and upper assemblages belong to the Coyotean and Seymourian LVFs, respectively, and the lower assemblage is the characteristic vertebrate fossil assemblage of the Cobrean LVF, an older, entirely Late Pennsylvanian (Virgilian) LVF. The Pennsylvanian-Permian boundary is in the Coyotean LVF. The Cañon del Cobre vertebrate fossil record thus provides three, stratigraphically-successive vertebrate assemblages that support recognition of three time-successive LVFs across the Pennsylvanian-Permian boundary.

**Posters Session IV, (Wednesday)**

**EVIDENCE FOR SPECIALIST FEEDING IN HYPSILOPHODON FOXII**

KRAUSS, David, BMCC, New York, NY, USA; SALAME, Issa, CCNY, New York, NY, USA

Hypsilophodon is typically portrayed in reconstructions as a generalist herbivore, feeding on low vegetation. Compared to other herbivorous dinosaurs Hypsilophodon is unusual in hav- ing a heterodont dentition. It has occurred to us that its unusual dentition may be the result of specialist feeding on cycad seeds. In order to test the validity of this hypothesis we used cranial material from specimens of Hypsilophodon foxii at the Museum of Natural History, London and Dinosaur Isle, Sandown, Isle of Wight to produce estimates of the occlusive force that could have been generated by their jaws. Based on insertion points for the adductor mandibulae externus we were able to develop estimates of total occlusive force from 24-41N. In order to test the hypothesis that Hypsilophodon could have fed on cycad seeds we used experimental experimentation. We produced an epoxy model of Hypsilophodon jaws held together with surgical tubing scaled to various strengths within the range cited above. We then used the model to try to pry seeds from cycad cones. If the strength was insufficient the tube would allow the model jaws to open and the seed would be left behind. If the force exerted by the jaws was sufficient the seed would be pried free. We found that at the maximum estimates of jaw strength seeds were easily pried from cycad pods while at the minimal estimates only smaller seeds could be removed from very ripe pods. At most levels an animal could have extracted seeds from cycad cones. Hypsilophodon could have fed on cycad seeds. It would have used its beak to pry the seeds loose from cones. The small ante- rior teeth could have been used to slice through the seed coat and then the pulp inside would have been masticated in the posterior dentary teeth. Furthermore, the flexibility of the small forelimbs would have allowed sufficient mobility to push thorny fronds out of the way al- though we were able to develop estimates of total occlusive force from... 

**Poster Session IV, (Wednesday)**

**A NEW BASAL ORNITHOPOD FROM THE MIDDLE-CRETACEOUS WAYAN FORMATION OF IDAHO**

KRÜMENACKER, I.J., Department of Geological Sciences, Brigham Young University, Provo, UT, USA; BRITT, Brooks, Department of Geological Sciences, Brigham Young University, Provo, UT, USA; SCHEETZ, Rodney, Museum of Paleontology, Brigham Young University, Provo, UT, USA; EVANS, Benjamin, Department of Geological Sciences, Brigham Young University, Provo, UT, USA

A small, possibly fossorial ornithopod represents Idaho’s most completely known dinosaur. This taxon numerically dominates vertebrate fossils recovered from the Wayan Formation, which has a moderately diverse but poorly represented vertebrate fauna. The ornithopod is represented by nearly all postcranial elements and a few cranial elements recovered from multiple well-preserved but incomplete individuals. Diagnostic characters include elongate cervical and dorsal centra 1.6 times as long as tall, more than 55 elongate caudal centra encompassed by a sheath of ossified tendons, a robust coracid, a scapula with an elongate scapular spine (as in Orodromeus), and a femoral head set on an elongate neck that pro- jects medially well above the greater trochanter and at a ~45° angle relative to the femoral shaft axis. Phylogenetic analyses indicate a close but unresolved relationship within the Orodromeus–Orodromeus–Zephyrosaurus clade. Taphonomic and geologic evidences of possible social and fossorial behavior include: 1) the occurrence of most specimens in cal- careous paleosols (modern fossorial vertebrates prefer well drained soils), 2) the articulated to semi-articulated condition of most specimens and the absence of tooth marks, trample breakage, weathering, and abrasion (suggesting quick burial), and 3) close association of multiple individuals of various ontogenetic stages in a monogenetic fossiliferous pod (sug- gesting group behavior similar to the fossorial ornithopod Orodromeus). Biomechanical evidences suggestive of fossoriality include: 1) a robust shoulder girdle, 2) a well-developed olecranon process, 3) a high femoral head offset from the shaft (increased muscle attach- ments and hindquarter stability, possibly useful for digging) and 4) a possible sacro-pubic articulation. This new ornithopod demonstrates the potential for more discoveries in the Wayan Formation and suggests preservational and/or ecological differences from the coeval Cedar Mountain Formation of Utah, and similarities to the roughly coeval Blacklead Forma- tion of Montana.

**Technical Session X, Tuesday 11:15**

**NEW SPECIES FROM THE LATE OLIGOCENE OF NEW ZEALAND REVEAL THE SKELETAL PLAN OF STEM PENGUINS (AVES: SPHINICIFORMES)**

KSEPKA, Daniel, North Carolina State University, Raleigh, NC, USA; FORDYCE, Robert Ewan, University of Otago, Dunedin, New Zealand; ANDO, Tatsuo, Ashoro Museum of Paleontology, Hokkaido, Japan; JONES, Craig, Institute of Geological and Nuclear Sciences, Lower Hutt, New Zealand

Three skeletons collected from the late Oligocene Kokomo Greensand of New Zealand are the most complete Paleogene penguins yet reported. These specimens represent two new species and reveal for the first time the unique proportions of a giant fossil penguin taxon. Morphological details of many key elements of the stem penguin skeleton associated with underwater flight are illuminated, including the first reasonably complete sternum and pelvis, one of only two complete forelimbs and the first described pygostyle. The new species differ from all living penguins in possessing a straight, narrow beak, remarkably slender sternum, elongate flipper and very robust hindlimb. These features contribute to a graceful profile previously unrecognized in fossil penguins. The pygostyle lacks the derived triangu- lar cross-section seen in extant penguins, suggesting the rectrices attached in a more typical avian pattern. Conservative reconstructions suggest the latter of the two new species had a standing height of 1.3m. New specimens detailed here help resolve several long-standing phylogenetic and biogeographic problems surrounding New Zealand penguin fossils. A phy- logenetic analysis sampling 56 penguin species and 15 outgroup taxa for 238 morphological characters and including sequence data from five genes yields 90 most parsimonious trees of 5171 steps. The two new species form a small clade of stem penguins crownward to the late Eocene-early Oligocene giant penguin Pachydyptes but basal to the late Oligocene taxa Archaeospheniscus and Platypodius. Polyphyly of the weskabetax toxon Palaeouhydrpes in these results indicates the genus must be split. Re-examination of casually referred material also erases any evidence for cosmopolitan fossil penguin species distributed across multiple continents.

**Technical Session II, Sunday 8:15**

**THE ROLLING MODE OF THE ACRODOPUS IN EXTINCT SYNAPSIDA**

KUERMELL, Susanna, University Witten/Herdecke, Witten, Germany; FREY, Eberhard, Staatliches Museum fuer Naturkunde, Karlsruhe, Germany

The rolling mode of the acropodria in most extant reptiles is characterized by dorsal exten- sion of the mid digital and basal digital joints. The usual phalanges are flexed and cause friction on the substrate with the claws. In most mammals, however, the mid digital joints of the digits II to V are kept flexed during the propulsion phase and thus form a digital vault. On the end of the propulsion phase the phalanges adjacent to the digital joints of the digits II-V are maximally extended to 180° against each other. Such a digital vault reduces the lever arm of the reaction force on the substrate but increases that of the profound flexor tendons. This saves muscular force and increases the pressure of the terminal sole pads or claws on the substrate. Friction is replaced by impulse and the claws dig into the substrate only in the terminal rolling phase or during acceleration. The presence of a digital joint allows the extrimals to be placed on the basal digital joints and a weak or missing guiding sulcus on the dorsal face of the trochan of as well as significant foot prints caused mainly by the separated sole pads. According to the osteology of the mid
digital joints and ichnoforms are the most Mesozoic Mammaliaformes also walked with a digital vault. The articular heads of the mid-digital joints of non-mammalian synapsids and pelycosaurs (**Dimetrodon, Ophiacodon**) bear a dorso-distally facing process or a protruding lip emerging from the dorsal margin of the articular face. Both structures block dorso-distal movement of the adjacent phalanges and indicate the presence of a digital vault in the acropodia in these groups as well. In early synapsids, e.g. Pelycosaurs, with a phalangeal formula of 2-3-4-5-3-4, the proximal medial phalanges can barely have a lever effect within the digital vault. With the reduction of the number of phalanges to three in the digits II to V the lever effect of the middle phalanges increases. The result is a Z configuration of acro- and metapodia, which acts as a spring that helps to economize the rolling movement.

Poster Session II, (Monday)  
**CARNIVORA ASSOCIATED WITH **Australopithecus** sediba, Malapa, Gauteng, South Africa**  
KUHN, Brian, Institute for Human Evolution, Johannesburg, South Africa; WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden; HARTSTONE-ROSE, Adam, Pennsylvania State University Altoona, Hawthorn, PA, USA; LACRUZ, Rodrigo, Center for Craniofacial Molecular Biology, Los Angeles, CA, USA; BERGER, Lee, Institute for Human Evolution/School of GeoSciences, Johannesburg, South Africa

Recent discoveries at the new site of Malapa (Gauteng, South Africa), have yielded a relatively rich faunal assemblage including the new hominin species *Australopithecus sediba*. Dating of this deposit using U-Pb and palaeomagnetic methods has provided an age of 1.95 my to 1.78 my, making it one of the best-dated deposits in the Cradle of Humankind. The faunal assemblage is relatively diverse and includes several carnivore species. To date 62 specimens have been identified as carnivore, of these at least five species have been positively identified. Most notably, the Malapa site has produced a number of extinct feld taxa including the genera *Megantereon* and *Dinofelis*, as well as representatives of modern hyaenids. Smaller carnivores are rare in the fossil record, but are also represented at Malapa, and include the genera *Atelail*, and *Morgen*. The geoarchaeontological age of Malapa, the associated hominin taxa and extinct felids and hyaenids provide a unique window of research into mammalian evolution during a relatively unknown period in South Africa and elsewhere. In particular, the fauna represented at Malapa has the potential to elucidate aspects of the evolution of *Dinofelis* and may help resolve competing hypotheses about faunal exchange between East and Southern Africa during the late Pliocene or early Pleistocene. We here present details of the carnivore assemblage, compare it with other carnivore assemblages from the Cradle of Humankind, and consider what the carnivores can tell us about the paleoecology of this site.

Poster Session II, (Monday)  
**PETROSAL ANATOMY AND INNER EAR STRUCTURES OF A NEW MULTITUBERCULATE MAMMAL FROM THE LATE CRETACEOUS OF CHINA: NEW DATA FROM MICRO-CT ANALYSIS AND PALEOBIOLOGIC INFERENCE**  
LADEVÉZE, Sandrine, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; DE MUIZON, Christian, Muséum national d’Histoire naturelle, USM203, UMR7207-CNRS, Paris, France; MATTHEW, Colbert, Jackson School of Geosciences, University of Texas, Austin, TX, USA; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

The derived middle and inner ears of mammals are the major features distinguishing them from non-mammalian vertebrates. Among them, the multituberculate mammals represent an important transitional stage and a ground plan for the thierian ear evolution. We present the reconstruction of petrosal features of a new multituberculate from the Late Cretaceous of Inner Mongolia (China) based on high resolution computed tomography and three-dimensional imaging analysis. This study reveals a combination of derived and primitive characters, such as a thierian-like vascular and nervous pattern and internal acoustic meatus, and a monotrete-like inner ear, but with a derived semicircular canal planarity. The probable presence of a primary bony lamina for the basilar membrane suggests that the first step in the elaboration of a coiled cochlea might have been already present in multituberculates. Auditory capabilities can be induced for this animal, which was certainly terrestrial and possibly fossorial.

Technical Session XVII, Wednesday 2:15  
**FIRST NON-AVIAN DINOSAUR FROM THE LOWER CRETACEOUS (APTIAN) XIAGOU FORMATION OF THE CHANGMA BASIN, NORTHWESTERN CHINA**  
LAMANNA, Matthew, Section of Vertebrate Paleontology, Carnegie Museum of Natural History, Pittsburgh, PA, USA; LI, Da-Qing, Fossil Research and Development Center, Third Geology and Mineral Resources Exploration Academy, Gansu Provincial Bureau of Geo-Exploration and Mineral Development, Lanzhou, China; HARRIS, Jerald, Physical Sciences Department, Dixie State College of Utah, St. George, UT, USA; ATTERHOLT, Jesse, Department of Integrative Biology, University of California at Berkeley, Berkeley, CA, USA; YOU, Hai-Lu, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China

Finely-beded lacustrine mudstones of the Lower Cretaceous (lower-middle? Aptian) Xiangou Formation exposed near the town of Changma in the Changma Basin of northwestern Gansu Province, China have yielded approximately 100 exceptionally preserved avian specimens, many including carbonized remnants of feathers, keratin, or skin. All but one of these specimens (the holotypic distal pelvic limb of the orthonothoromorph *Gansus yumenensis*) have been discovered since 2002. Despite this abundance of Early Cretaceous bird material, however, no other types of dinosaurs had been recovered from Changma until recently. Here we report the first non-avian dinosaur fossil from the Xiagou Formation of the Changma Basin. The specimen consists of an articulated, essentially complete and three-dimensionally preserved pectoral girdle and limb lacking the carpus and manus. Based on the presence of a very large, elliptical fenestra in the coracoid (termed the “supracoracoid fenestra” by previous authors), the fossil is referable to the dromaeosaurid theropod clade Microraptorinae. Uncontroversial representatives of Microraptorinae have been previously reported only from the Lower Cretaceous (Barremian-lower Aptian) Jehol Group of northeastern China (*Oura* *sinensis* (= *Juravenator*), *Microraptor* spp., and *Sinornithosaurus* spp.) and the Upper Cretaceous (middle-upper Campanian) Dinosaur Park and Oldman formations of Alberta, Canada (*Hesperornyx elizabethae*). Consequently, the new Changma specimen likely constitutes the geologically youngest record of the clade from Asia, and the second-youngest globally; moreover, its occurrence broadens the geographic distribution of Microraptorinae to include the central region of the Asian continent. The three-dimensional preservation of the specimen also promises to shed light on microraptornine pectoral girdle and limb morphology, mobility, and function.

Technical Session XI, Tuesday 2:00  
**TREE BALANCE AND MISSING DATA COMPILATIVE BAYESIAN PHYLOGENETIC ANALYSIS OF FOSSIL TAXA**  
LAMM, Kristin, North Carolina State University, Raleigh, NC, USA

When fossil-inclusive data sets are subject to Bayesian phylogenetic analysis, problematic results have been widely recognized but poorly characterized. In situations where there is a stem lineage leading to a crown clade, extinct taxa tend to group together, even when the available character data appear to unambiguously support a pectinate arrangement of stem taxa. This problem is encountered in both empirical and constructed data sets, and is not observed in maximum likelihood or parsimony analyses. Here, a novel method for simulating fossil-inclusive trees is presented. This is accomplished via birth-death process, followed by a fossil sampling step motivated by an understanding of taphonomy and ecology. Patterns of tree balance are compared to those of commonly implemented and widely used tree priors. Trees that include extinct taxa are found to be less balanced on average than those that include only extant taxa. Because fossil-inclusive character matrices used in phylogenetic analysis tend to have a high proportion of missing data and a low number of informative characters, the influence of the tree prior on the posterior distribution has the potential to be non-negligible. If balanced trees are preferred under the tree prior and the data are weak, trees in which extinct taxa group together may be erroneously inferred. The need for methodological improvements in Bayesian analysis of fossil data is recognized.

Technical Session XV, Wednesday 10:15  
**THE ORIGINS AND EVOLUTIONARY RELATIONSHIPS OF HYBODONT SQUALIFORMES: NEW INFERENCE BASED ON SKELETAL MORPHOLOGY**  
LANE, Jennifer, American Museum of Natural History, New York, NY, USA

‘Hybodonts’ (Hybodontiformes) have been proposed to represent the monophyletic sister group to Neoselachii (extant sharks and rays). Hybodontiformes have previously been considered to include the suborder Hybodontiodae, as well as two problematic taxa, *Tristiichus* and *Oncyochochelache*. However, classifications of Hybodontiformes have previously been almost entirely based on isolated dental elements, and skeletal material is known from only 17 hybodontiform species and 11 genera (out of a total of over 44 recognized species). New, exceptionally well preserved fossil material of the Lower Cretaceous hybodontiform shark *Trubiidae lineae* allows for the first complete description of skeletal morphology in this genus, and affords the opportunity for the first-ever comprehensive phylogenetic analysis of hybodontiform sharks, thus shedding new light on hybodontiform diversity and evolution- ary relationships. CT-scan based examination of a three-dimensional cranial bone of *Trubiidae* (one of a handful of complete fossil chondrichthyan neurocrania currently known), as well as reconstruction of its nerve and blood vessel foramina and cranial arterial circulation, provides new insights into the evolution of cranial morphology in crown-group chondrich- thyan. A revised reconstruction of the pectoral fin skeleton of *Trubiidae* resembles that of neoselachians, and numerous additional features strongly support a close evolutionary relationship between hybodonts and neoselachians. Examination of *Trubiidae* also reveals the presence of supportive endochondral “struts” in force-bearing regions of the jaws (similar to those found in extant batoids). Parsimony-based phylogenetic analysis on a matrix of 33 total taxa and 129 skeletal characters strongly supports the monophyly of Hybodontiformes (including *Oncyochochelace*) above *Tristiichus* and the sister-group relationship of hybodonts and neoselachians, but suggests that Hybodontiformes including *Tristiichus* is paraphyl-etic unless Neoselachii is included. The monophyly of Hybodontidi, Hybodontidae, and Hybodontinae is supported, as is the previously proposed sister-group relationship between *Trubiidae* and *Asteracanthus*. 

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Family Solenomyidae is a group of probable basal cryptodires known from the Barremian to the Maastrichtian preserved mainly as isolated shells and shell fragments. Easily identified based on their characteristic sculpture and textural pattern, this family is well known from Europe. The single named North American species, Naomichelys speciosa, is known from the late Aptian Cloverly and Trinity formations. All other known specimens from this family in North America (identified by their unique sculpture) have been too fragmentary to adequately describe. Here, we report a relatively complete shell of a solenymid from the marine Haslam Formation (Santonian) of Vancouver Island. Based on the morphology of the shell, this specimen is not referable to Naomichelys speciosa and represents a new genus and species. Other new specimens of the family include a complete plastron, as well as fragmentary costal, peripheral, and suprapygal plates from the terrestrial Milk River Formation (upper Santonian), as well as a hyoplastron from the paralic-to-terrestrial Foremost Formation (middle Campanian), that are distinct from the Haslam specimen, although they may be referable to the genus Naomichelys, or at least a clade of endemic North American solenymids. A fragmentary solenymid xiphio- plastron believed to be from the marine-to-nonmarine Dunvegan Formation (Cenomanian) would be the second documented species of turtle from this formation and among the oldest known in Alberta. These specimens extend the geographic and geologic range of the family and illustrate a greater potential North American diversity for this enigmatic family than has been previously documented.

Technical Session XVII, Wednesday 2:00

THE WINGED NON-AVIAN DINOSAUR MICRORAPTOR FED ON MAMMALS: IMPLICATIONS FOR THE JELHO BIOTA FROM THE LATE CRETA CEOUS CANADIAN SPECIMENS OF FAMILY SOLEMYDIDAE

LARRSON, Hans, Redpath Museum, McGill University, Montreal, QB, Canada; HONE, David, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; DECECCHI, T. Alexander, Redpath Museum, McGill University, Montreal, QB, Canada; SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LU, Xing, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Direct evidence for predator-prey interactions in the fossil record are rare. Dietary regimes and trophic interactions within extinct communities are usually inferred based on indicators such as body size, tooth shape, and coprolites. While these lines of evidence are useful, only gut contents provide direct evidence for an individual’s diet. We report here the first gut contents of a non-avian paravian within the small feathered theropod Microraptor. The holotype of Microraptor zhaoi is includes fragments of articulated dorsal vertebrae with regularly spaced ribs. Between the left and right ribs is preserved an articulated foot of a mammal. Other bones are also present and may include possible cranial, limb and axial elements of the mammal. The morphology of the foot is most similar to Eomaia and Sinodelphys; although this specimen lacks the level of arboreal adaptations seen in the taxa. The foot is relatively long, with a shortened first metatarsal and elongate phalanges possessing a phalangeal ratio of around 1. The preserved unguals are moderately recurved, the phalanges are straight and the ratio of proximal to distal phalanges does not indicate a dedicated arboreal lifestyle but suggests the animal was most likely scannorial. Body size and mass of the Microraptor and mammal specimens was estimated from metric comparisons to closely related taxa. The Microraptor specimen is estimated to have a snout-vent length of 140 - 150 mm and a body mass of between 100 and 150 g. The mammal is estimated to have had a snout-vent length of approximately 80 mm and a body mass of 20 - 25 g. We compare these values to those among extant tetrapod predators and prey. This new find provides valuable information regarding species interactions and trophic relationships within the Jehol Biota. This discovery, combined with other recent finds from these deposits, permits a more accurate reconstruction of the food web structure of this Lower Cretaceous ecosystem. These data suggest that like the earliest birds, which were either insectivorous or herbivorous (e.g. Archaeopteryx, Jeholornis), Microraptor was an active predator of agile, small-bodied vertebrates.

Poster Session II, Sunday 11:15

MASTICATORY MOVEMENTS TRIGGER CUSP MORPHOLOGY IN MAMMALIAMORPHA WITH RODENT-LIKE DENTITIONS

LAZZARI, Vincent, Université de Poitiers, Poitiers, France; SCHULTZ, Julia, Universität Bonn, Bonn, Germany; TAFFOREAU, Paul, European Synchrotron Radiation Facility, Grenoble, France; MARTIN, Thomas, Universidad Bonn, Bonn, Germany

Rodent-like Mammaliaform have developed highly convergent dentitions, not only limited to the partially evergrowing incisors and a diastema. Very successful clades such as the Tritylodonta, the cimolodont Multituberculata and the murine Rodentia exhibit a longitudinal grinding cycle of mastication associated with upper cheek teeth displaying three longitudinal rows of cusps. However, Cenozoic multituberculates such as Cimolodonta display masticatory movements involving two distinct cycles that greatly differ from those observed in rodents: an oral terminal crushing cycle associated with an enlarged lower fourth premolar precedes a palinal grinding cycle. With their plesiomorphic lower premolars and upper molars, the Late Jurassic/Early Cretaceous multituberculate family Paulchoffatiidae can provide the key for the understanding of the origin of the complex mastication cycle of the Cimolodonta. We digitized dental material of Paulchoffatiidae from the Kimmeridgian of the Guimarota Coal Mine (Leiria, Portugal) at the European Synchrotron Facility (Grenoble, France) using for the first time propagation phase contrast Synchrotron X-Ray microtomography to perform both microwear and topographic analyses. Paulchoffatiidae display two different cycles during their mastication, a puncture-crushing cycle (like in other Mammaliaform) and a grinding cycle that consists of two different phases. The first phase is obligate and can be interpreted, even if it is not orthodirectionally directed, as a phase of the slashing-crushing cycle of the Cimolodonta. The second phase is fully palinal and is homologous to the grinding cycle of the Cimolodonta.A strong relationship between individual cusp shape and direction of chewing has been observed in most rodent-like Mammaliaform. This relationship is not evident in Paulchoffatiidae, they exhibit derived upper premolars with
three longitudinal cusp rows. This can be explained by the fact that the lingual row of upper premolar cusps is not involved in attrition in Paucituberculata. The stronger the attrition, the more the direction of the masticatory movements influences the cusp morphology.

Poster Session II, (Monday)

POSTCRANIAL OSTEOSTY OF MINMI SP., A BASAL ANKYLOSAUROMPHR (DINOSAURIA: ORNITHISCHIA) FROM THE EARLY CRETACEOUS (ALBIAN) ALLARU MUDSTONE OF QUEENSLAND, AUSTRALIA

LEAHEY, Lucy, School of Biological Sciences, The University of Queensland, Brisbane, Australia; MOLNAR, Ralph, Museum of Northern Arizona, Flagstaff, AZ, USA; SALISBURY, Steven, School of Biological Sciences, The University of Queensland and Section of Vertebrate Palentology, Carnegie Museum of Natural History, Brisbane and Pittsburgh, Australia

Minmi is the only known genus of ankylosauroomorph from Australia. Seven specimens are known from the Early Cretaceous of Queensland. However, only two of these specimens have been described in the holotype Minmi sp. from Queensland and a nearly complete skeleton preliminarily referred to as Minmi sp. from Marathon Station near Richmond. The marathon specimen represents one of the world’s most complete Early Cretaceous ankylosauroomorphs and is the best-preserved dinosaur fossil of any age from East Gondwana. The majority of ankylosaurs have been found in Late Cretaceous sediments of Laurasian continents and thus the evolution of this group during that time and in this part of the world is well understood. Conversely, very little is known about ankylosaurs in the early stages of their evolutionary history (Jurassic-Early Cretaceous) and in the Gondwanan landmasses, due in part to the rarity and fragmentary nature of most known specimens. Minmi sp., with its Early Cretaceous age and unique state of preservation, is an ideal taxon with which to examine the early evolution of this distinct dinosaurian fauna. Previous work on the cranial osteology of Minmi revealed that the taxon is positioned basal to the traditional Ankylosaura (Ankylosauria + Nodosauria), but higher than Thyreophora. Phylogenetic analysis incorporating cranial data strongly supported the creation of the stem-based Ankylosauroomph, which includes all eurypods closer to Ankylosaura than Segosauauria. The description of the postcranium of Minmi sp. has resulted in the reassessment of some previous characters and the formation of new ones relating to the phylogenetic relationships of Ankylosauromph. Preliminary results reaffirm Minmi’s basal position within Ankylosauroomph. Minmi shows that basal ankylosauroomphs were similar to Scelidosauria, in that they were proportionally smaller and less robust, with a less well-developed dermal skeleton than ankylosaurs.

The Universal Temperature Dependence (UTD) model, which relates growth rate to body temperature, purported to solve the question of non-avian dinosaur thermophysiology by demonstrating a pattern of increasing body temperature with size across several species. These data suggested that dinosaurs were ectothermic poikilotherms and that only the largest ones could maintain their mass to attain homeothermy. We found that predicted body temperature was also size-independent for these taxa. This refutes the claim based on the UTD model that dinosaurs could attain homeothermy only by growing to large size. In contrast, the independence of size and body temperature in dinosaurs is consistent with published data on oxygen isotope fractionation and bone histology, together implying relatively tachymetabolic and endothermic homeothermy. The UTD model is insufficient to give information about extinct dinosaurs, and in particular for individual species, either living or extinct. However, its results for non-avian dinosaurs are broadly consistent with other evidence that dinosaurs were tachymetabolic, endothermic homeotherms.

The FIRST CERATOPS FROM KOREA

LEE, Yung-Nam, Korea Institute of Geoscience and Mineral Resources, Daejon, Korea; SOUTH, Ryan, Michael, Cleveland Museum of Natural History, Cleveland, OH, USA; KOBAYASHI, Yoshitsugu, Hokkaido University Museum, Hokkaido, Japan

In 2008, a new basal neoceratopsian was discovered in the Tondo Formation (Cenomanian–Tourian) of Tondo Basin in Korea. It represents the first ceratopsian dinosaur in the Korean peninsula and is an important datum for the paleogeographic distribution of ceratopsians. It represents the earliest occurrence of basal neoceratopsians in Eurasia and comes from a time period with a very limited fossil record for the group. Autapomorphies of the new taxon include: very tall neural spines over 5 times as high as the vertebral centrum in the distal caudals, and a unique astragalus divided into two fossae by a prominent cranio-caudal ridge on the proximal surface. A phylogenetic analysis indicates that the new taxon is more derived than Archacoceratops and is the sister group to Leptoceratopsidae + Graciliceratops and all more derived ceratopsians, and that the elongation of caudal neural spines is an important derived character in non-ceratopsid neoceratopsians. The very tall caudal neural spines of the new taxon, Montanoceratops, Udornaceratops, Protoceratops, and Bagaceratops appear to be homoplasious, suggesting an independently acquired adaptation that may be related to swimming. Skeletal evidence suggests that obligate quadrapedalism occurred gradually in neoceratopsians progressing from bipedal through facultative quadrupedalism, to complete quadrupedalism in Coronosauria with a progressive increase in body size and robustness, and a modification of unguals from claws to hoofs.

Technical Session I, Sunday 8:00

THE UNIVERSEAL TEMPERATURE DEPENDENCE MODEL FAILS TO PREDICT BODY TEMPERATURES ACCURATELY FOR EXTANT ANNIOTES AND EXTINCT DINOSAURS

LEE, Andrew, Ohio University, Athens, OH, USA; IRIMIS, Randall, Utah Museum of Natural History and University of Utah, Salt Lake City, UT, USA; WEDEL, Mathew, Western University of Health Science, Pomona, CA, USA; WERNING, Sarah, Univ. of California Museum of Paleontology and Univ. of California, Berkeley, Berkeley, CA, USA; PADIAN, Kevin, Univ. of California Museum of Paleontology and Univ. of California, Berkeley, Berkeley, CA, USA

The Universal Temperature Dependence (UTD) model, which relates growth rate to body temperature, purported to solve the question of non-avian dinosaur thermophysiology by demonstrating a pattern of increasing body temperature with size across several species. These data suggested that dinosaurs were ectothermic poikilotherms and that only the largest ones could maintain their mass to attain homeothermy. We found that predicted body temperature was also size-independent for these taxa. This refutes the claim based on the UTD model that dinosaurs could attain homeothermy only by growing to large size. In contrast, the independence of size and body temperature in dinosaurs is consistent with published data on oxygen isotope fractionation and bone histology, together implying relatively tachymetabolic and endothermic homeothermy. The UTD model is insufficient to give information about extinct dinosaurs, and in particular for individual species, either living or extinct. However, its results for non-avian dinosaurs are broadly consistent with other evidence that dinosaurs were tachymetabolic, endothermic homeotherms.

AVIAN EGGSHELL FRAGMENTS FROM A FRESHWATER FACIES OF THE SALINE WILKINS PEAK MEMBER OF THE EOCENE GREEN RIVER FORMATION

LEGGITT, V. Leroy, Department of Earth and Biological Sciences, Loma Linda University, Loma Linda, CA, USA

Abundant avian eggshell fragments occur in a nearshore freshwater facies of the saline Wilkins Peak Member of the Green River Formation near the southwestern edge of Eocene Lake Gosiute. The eggshell fragments are associated with Presbyornis (Aves: Anseriformes) bones and occur in multiple stratigraphic intervals between the layered tuff (a well known Wilkins Peak marker bed) and the base of the Laney Member of the Green River Formation. The eggshell fragments are associated with ostracods, caudicafell larvae, microbiotas and intraclast micrites (both calcimicroite and dolomicroite). Mudcracks are common on the surface of the intralast dolomicroite that contains the greatest concentration of eggshell fragments. Several eggshell fragments were studied by light microscopy (LM), by polarized light microcopy (PLM) and by scanning electron microscopy (SEM). The resultant micrographs were compared with published reports of modern and fossil “ornithoid”, “crocodiloid”, “tarsom” and “gukoid” eggs. The Wilkins Peak eggshell fragments show the following microstructure zones (from internal to external): 1) an organic core, 2) a zone of radial calcite plates, 3) a zone of tubular crystallette plates, 4) a zone of squamatric aggregates and 5) an external zone of vertical calcite crystals. Macrostructure zones (from internal to external) are: 1) wedges of the mammillary layer (diverging outward from the central core), grading into 2) long vertical columns of the prismatic layer. These findings are similar to the characteristics of modern neognath us eggshell.
Evolution of the Modern African Fauna, Wednesday 9:15

**EVOLUTIONARY HISTORY OF TUBULIDENTATA (MAMMALIA, AFROTHERIA) AND THE ORIGIN OF THE LIVING AARDVARK**

LEHMANN, Thomas, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany

The Tubulidentata is one of seven orders of placental Mammals grouped in the clade Afrotheria by molecular analyses. They are currently represented by a single living species: *Orycteropus afer*, the aardvark. The systematics of the Tubulidentata is poorly known because fossils of this order are scarce and only known for the last 20 million years (My). Over the last 30 years, several new fossils have been discovered in the Neogene of Eurasia and Africa but not extensively analysed. In addition, ongoing field work in Chad, Ethiopia, and Kenya continues to turn up new specimens. Finally, an extensive morphological database on the extant aardvark was set up new specimens. Finally, an extensive morphological database on the extant aardvark was set up.

Seventy years ago, the phylogenetic and paleobiogeographical relationships of the Tubulidentata were first assessed, and the Aardvark was shown to be the most derived of these taxa. Each tubulidentan group contains a single living species, and fossil evidence indicates that the Tubulidentata existed at least until the Miocene. The Aardvark, *Orycteropus afer*, is the only surviving species of the group. The aardvark is a large, terrestrial insectivore with a stout body and long, powerful forelimbs and hindlimbs. It is primarily nocturnal and feeds on ants and termites. The aardvark is found throughout sub-Saharan Africa and is listed as Least Concern by the IUCN.

However, the diversity of the Tubulidentata is much greater than that of the Aardvark. Several fossil species have been described from the Neogene of Asia and Africa, and some are believed to have been more diverse in the past. The Tubulidentata includes several families, including the Tupaiaidae, the family that contains the aardvark. The Tupaiaidae is a small family of arboreal insectivores that are found in Southeast Asia and Australia. The family is characterized by a long, prehensile tail and well-developed sense of smell.

The phylogenetic relationships of the Tubulidentata are still unclear, and more fossil evidence is needed to resolve the relationships among the various taxa. The molecular data suggest that the Tubulidentata is a monophyletic group, but the relationships among the families within the group are not well-supported. Further research is needed to better understand the evolutionary history of the Tubulidentata and the origin of the living aardvark.
Mass prediction in Chinese Mesozoic fossil birds

LIU, Di, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; CAMPBELL, Kenneth, Natural History Museum of Los Angeles County, Los Angeles, CA, USA; SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Body weight is a crucial biological parameter for an organism. Therefore, mass estimates for fossil species are important for many kinds of analyses. In this project, a bivariate regression analysis of different measurements of the appendicular skeleton plotted against live body weight in a data set of 422 individual birds, representing 254 species in 21 orders, revealed high correlations between several skeletal parameters and body mass. Bivariate equations were generated to describe the relationship between mass and each of twelve appendicular measurements. R-squared values for the equations ranged from 0.50 for tiibiotarsal length, indicating a relative poor fit, to 0.91 for humeral diameter. To test the 12 equations empirically, they were used to estimate body masses of an additional 64 extant bird specimens, and the accuracies of the various equations were compared. This predictive test showed that three parameters are generally most accurate as predictors of body mass: humerus length, ulna diameter, and tibiotarsal diameter. However, the humeral length (HL) tended to give accurate results for particularly songbirds, raptors and climbing birds. The tibiotarsal diameter (TD) tended to give accurate results for terrestrial birds, such like chicken and doves. It is probable that HL is the more accurate parameter for arboreal taxa, while TD is more accurate for terrestrial ones. Closer examination of the results showed that different measurements correlated best with body mass in different avian orders. This variation appeared to result from differences in habitat and functional morphology across the avian orders represented in the data set. The weights of some Chinese Mesozoic fossil birds were estimated using the equations generated for humeral length (HL) and tibiotarsal diameter (TD), because ulnar diameter was frequently difficult to measure. HL and TD yielded dramatically different mass estimates for some taxa, with estimates based on HL generally being lower. The results indicate that these Early Cretaceous birds experienced a significant diversification in body mass during evolutionary process.

The fossil catostomid Jianghanichthys from China and implications for the evolution of basal catostomids

LIU, Juan, University of Alberta, Edmonton, AB, Canada; CHANG, Mee-ann, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; WILSON, Mark, University of Alberta, Edmonton, AB, Canada

The Eocene cypriniform fish Jianghanichthys hubeiensis (Hubei Province, China) was originally assigned to the living genus Osocichilus within Cyprinidae. In subsequent revisions, Jianghanichthys was established as a distinct, monotypic genus, but its assignment to a family was left in doubt. A larger and more comprehensive collection from the type locality area allows for a re-examination of the morphology and taxonomy of J. hubeiensis. Jianghanichthys is represented by small individuals with body depth increasing through ontogeny (Body Depth/Total Length from 25% to 35% in juveniles vs. 35% in adults). Jianghanichthys is attributed to Catostomidae by the following family-level synapomorphies: 1) mouth border partially formed by maxilla; 2) dentary short but posteriorly deep; 3) frontal broad anteriorly and narrow posteriorly, resulting in exposed sphenoid; 4) opercular arm and auricular process developed, creating concave dorsal opercular margin. Jianghanichthys differs from all known Eocene Catostomids in having 12–14 principal dorsal fin rays, far fewer than in Pleiosmyxocypirinus (~50), Visaevus (20) and all but a few fossil Amazon (~12–33); this range is close to that of modern Catostomidae (~10–18). This character is here interpreted as a convergence, because Jianghanichthys is differentiated from Catostominae by a shorter angular process of the dentary and a relatively deeper body. In addition, Jianghanichthys retains several basal cypriniform characters: 1) sensory canals embedded in the frontal bone, unlike all known catostomids, but shared with cyprinids, silurinids, girozocheilids, and some cobitids; 2) pleisiomorphic principal caudal fin ray count (10–9), higher than all modern catostomids (9–9), but identical to that of most lower teleosts including cyprinids. Lastly, a short and slender 4th pleural rib in the Weberian apparatus is uniquely shared by Jianghanichthys and cyprinids. These characters indicate that Jianghanichthys is arguably the most basal catostomid known to date, sharing a suite of plesiomorphic features with cyprinids and therefore a key taxon for future studies of cypriniform relationships.
the biphasic and collinear expression of Hoxd13, which also regulates development of the genital buds and external genitalia in higher vertebrates (mammals) and is expressed in chondrichthyan cloaca. Sonic hedgehog (shh) is also expressed in the cloacal endoderm of chondrichthyans and teleosts and the cloaca-derived urethral plate of the mouse. Both Hoxd13 and shh are expressed in the distal tip of the posterior fin, the region from which the claspers. We propose that these genes were also expressed in the placoderm claspers and cloacal region, and support suggestions that the cloacal expression pattern is primitive relative to those required for external genital development, for example, in the mouse. Simi-
larities in distal limb/fin and genital bud development and in regulation of genes associated with these structures, such as Hoxd13 and shh, are well known. However, phylogenetically basal placoderms such as the Antiarchi lack both claspers and pelvic fins, suggesting that this developmental and genetic similarity may have evolved in a stepwise fashion at the base of the gnathostome clade, first appearing in the cloacal region, and subsequently in the posterior fin/claspers of pycnodont and arthrodiran placoderms and more derived gnathostomes.

Technical Session XI, Tuesday 3:30
SURVIVAL AND EXTINCTION AT THE K-T BOUNDARY: NEW EVIDENCE AND NEW PERSPECTIVES FROM THE VERTEBRATE FAUNA OF CONTINENTAL NORTH AMERICA
LONGRICH, Nicholas, Yale University, New Haven, CT, USA
The available evidence indicates that an asteroid was the primary, and probably exclusive, cause of the K-T mass extinction. However, the physical processes that resulted in the extinction remain poorly understood. A wide range of mechanisms have been proposed, including the cessation of primary productivity, cooling, a thermal pulse caused by reentry of ejecta, acid rain, and the breakdown of the ozone layer. These mechanisms must be tested against the fossil record. A new study of survivorship across the K-T boundary, drawing on the literature, collections study, and ongoing fieldwork, was undertaken to elucidate patterns of survival and extinction across continental North America, including sites from south Texas to central Alberta. The late Maastrichtian of western North America contains the most diverse known Mesoozoic terrestrial biota, indicating that the ecosystem was not stressed prior to the impact. Previous estimates of extinction levels are too low; in particular the assertion that amphibians were unaffected is false, and avians are shown to have suffered severe extinctions. The overall extinction rate is 70% or more. Remarkably, herbivores suf-
fered total extinction, suggesting a collapse of primary productivity. Geographic patterns in extinction rate are surprising. There is no evidence that northern biotas, further from the site of impact, are less affected. Remarkably, the evidence instead suggests that more northern biotas may have suffered higher extinction rates. However, there is an unexpectedly weak correlation between geographic range and extinction. Freshwater vertebrates suffered lower extinction levels than terrestrial forms; this pattern probably results from the ability of water to resist short-term temperature changes. This study indicates that loss of primary productiv-
ity is a major if not primary mechanism in the extinction, but temperature changes may have played a more important role than previously appreciated; in particular, severe global cool-
ing is consistent with a number of observed patterns.

Poster Session IV, (Wednesday)
A CLADISTIC ANALYSIS OF CTENODACTYLINE INTRARELATIONSHIPS
LÓPEZ-ANTOÑANZAS, Raquel, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; KNOLL, Fabien, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain
The subfamily Ctenodactylinae is known from the Lower Miocene up to the present. Today, this group comprises five species, which are restricted to north equatorial areas in Africa. However, by Miocene time, the ctenodactylines experienced their greatest diversification and widest distribution from Asia, their land of origin, to Africa where they entered during the Middle Miocene at the latest. So far 24 species can be referred to this group: Ctenodactylus gundi, C. valli, Massoutiera mazzeei, Felovia vae, Pectorin spekei, Plegerinia panormensis, Sayimys obliquipedia, S. baskini, S. giganteus, S. asassarenensis, S. intermedius, S. sivalensis, Metasarimys curvidens, Africanomys pulcher, A. major, A. minor, A. kettari, Iboudia bokhli, I. robinsoni, Pireddamys rayii, Sardomys dawsonae, S. antiquetiae, Achaetaspis mallos, and Prosayimys flynni. We carried out a cladistic analysis involving all these species. Prosayimys flynnii turned out to be the most basal species of the ingroup. The monophyly of the genus Africanomys is not well substantiated, whereas that of Sayimys is clearly unsup-
ported. This analysis also provided information about the origin of not only the African ct enodactylines, which is to be found in the Indian subcontinent, but also of the European ones, which is diverse. Thus, the Early Miocene Sardomys and Pireddamys from Sardinia have a southwestern Asian origin, whereas the Sicilian Pleistocene Pellegrinia originated from an African ancestor. Interestingly enough, the ctenodactylines established in Asia at the dawn of the Pliocene and never returned from Africa. The enigmatic sarcopoterigian group Onychodontiformes (or Struniiformes) is only repre-
sented by a few genera that lived during the Devonian period. Although the wonderfully preserved specimens of Onychodus jandemarrai have greatly advanced our understanding of the Onychodontiformes, the scarcity of the neurocranial features in the group hampers morphological comparisons between onychodons and other sarcopterygians. Recently, we described a new basal onychodont Qingmenodus from the Pragian (Early Devonian) of Yunnan, South China, which shows for the first time a well-ossified oticopetal braincase in onychodons and casts light on the feeding mechanism of onychodons. Here, we report a complete ethmosphenoid of Qingmenodus, which reveals general similarities with that of Onychodus. Its superb preservation renders us the possibility to utilize the new CT-scanning facilities at IVPP for the neurocranial anatomy. The digital endocast of the ethmosphenoid region provides the first comprehensive description of the anterior cranial cavity in ony-
chodonts, and helps to understand the brain evolution among early sarcopterygians. The primary results indicate that Qingmenodus has a distinctive neurocranium, in which the nasal capsule are elongated, the hypophyial fossa is dominant, and the mesencephalon region is sloped. Noteworthy is that the dominant hypophyial fossa in Qingmenodus extends rostrally rather than caudally, which recalls the condition in living coelacaths Latimeria. The most striking feature of the Qingmenodus neurocranium is that several denticrane-shaped canals lie between two olfactory canals, and give off branches into the endocranial and ectocranial boundaries. The morphology of these denticrane-shaped canals needs further investigation. Novel cranial architectures in Qingmenodus imply that onychodons had differentiated from other sarcopterygians and gained their specialization in neurocranial morphology as early as the Pragian.

Poster Session III, (Tuesday)
A NEW BASAL THERIZINOSAUROID FROM THE LOWER CRETACEOUS YIXIAN FORMATION OF LIAONING, CHINA
LÜ, Junchang, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; KOBAYASHI, Yoshitsugu, Hokkaido University, Sapporo, Hokkaido, Japan; XU, Li, Henan Geological Museum, Zhengzhou, China; PU, Hanyong, Henan Geological Museum, Zhengzhou, China; WU, Yanhua, Henan Geological Museum, Zhengzhou, China
Therizinosauroids are an unusual group of theropod dinosaurs, found mostly in the Creta-
ceous deposits in Mongolia, China and western USA. The basal forms of this group are rep-
resented by fragmentary or disarticulated material. Here, we report a nearly complete, articu-
lated skeleton of a new basal therizinosauroid from the Early Cretaceous Yixian Formation of Jinchang County, western part of Liaoning Province, which sheds light on understanding of anatomy of basal therizinosauroids. The new dinosaur shows some therizinosauroid fea-
tures (e.g., dentary shelf, tooth morphology, edentulous premaxilla, down-turned symphseal region, and large nares) and is characterized by 27 closely packed maxillary teeth, a large maxillary fenestra (separated from the antorbital fenestra by a vertical interfenestral bar similar to some troodontids), and short mandibular symphysis. This taxon bears many primi-
tive characters, which are not seen in other therizinosauroids; closely packed maxillary teeth, constant size of dentary teeth, weakly expanded proximal and distal ends of humerus, low ilium with horizontal dorsal edge, and the propubic condition with a shallow pubic boot. The combination of these plesiomorphic characters suggests that this taxon was placed as a basal therizinosauroid.

Poster Session IV, (Wednesday)
GIANT HADROSAUR FOOTPRINTS FROM THE UPPER CRETACEOUS FRUITLAND FORMATION, SAN JUAN BASIN, NEW MEXICO
LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; SULLIVAN, Robert, State Museum of Pennsylvania, Harrisburg, PA, USA; JASINSKI, Steven, State Museum of Pennsylvania, Harrisburg, PA, USA
The Upper Cretaceous (Campanian) Fruitland Formation in the San Juan Basin of northwest-
ern New Mexico yields many dinosaur skeletal remains, but few dinosaur footprints. This makes the recent discovery of numerous footprints as sandstone casts near the contact of the Ne-nah-ne-zad and Fossil Forest members of the Fruitland Formation on Split Lip Flats (Sec. 20, T23N, R12W) unusual. These are footprints of a biped that are tridactyl, as much as 30 cm maximum length, broad rounded heel imprints, and thick toes that terminate in short, narrow claw tips. Morphology supports assignment to the ichnogenus Caririchnii-
us, and geologic age and size indicate a hadrosaur as the most likely trackmaker. Indeed, the Fruitland Formation hadrosaur tracks are among the largest hadrosaur tracks known, even though their size may have been partly exaggerated by extramorphological expansion of the viscous, sandy substrate in which the footprints were impressed. Skeletal remains of large hadrosaurs are known from the Fruitland Formation (femur length ~ 1350 cm), and these are among the largest known North American hadrosaurs, though smaller than the Chinese Shantungosaurus, which has a femur length ~ 1650 cm. The presence of giant hadrosaurs in the New Mexican Upper Campanian strata represented by both bones and footprints is appar-
ently unique in the North American Western Interior and may be explicable by local paleo-
ecological conditions, though the exact nature of such conditions is unclear.
THE OREODONT RECORD OF THE UINTAN NALMA AND ITS IMPLICATIONS FOR THE BIOCHRONOLOGY OF THE MIDDLE EOCENE

LUDTKE, Joshua, University of Calgary, Calgary, AB, Canada

The Uintan NALMA includes a significant portion of the middle Eocene record of terrestrial North American fossils, and is important in ungulate palaeontology for having the first record of selenodont cedartoidactylids in North America. Recent publications have justified the existence of four distinct biochronological zones (Ui1a, Ui1b, Ui2, and Ui3) within the Uintan, indicating two (Ui1a and Ui2) that are not well-represented at the namesake Uinta Formation. This reorganization of the Uintan provided an opportunity to re-examine the known temporal distribution of oreodonts to see if these highly abundant organisms provide additional faunal support for the recognition of biochronological zones. Ui1a does not have any record of oreodonts. Localities assignable to Ui1b from California, Colorado, Texas, and Wyoming only include specimens of Protoroedron parvus, although these specimens can be distinguished from the type population of the Uinta Formation by a more bunolensedom aspect. Ui2 has been preserved in California, Utah, and Wyoming, with specimens identifiable as P. parvus and P. pumilus in the western interior and P. walschi on the Pacific coast.

Technical Session I, Sunday 11:30

A NEW BASAL CENTROSAURINE DINOSAUR (ORNITHISCHIA: CERATOPSIDAE) FROM THE UPPER CRETACEOUS OF UTAH: EVIDENCE OF A PREVIOUSLY UNKNOW CLADE OF SOUTHERN CENTROSAURINES FROM LARAMIDIA

LUND, Eric, University of Utah, Utah Museum of Natural History, Salt Lake City, UT, USA; SAMPSON, Scott, University of Utah, Utah Museum of Natural History, Salt Lake City, UT, USA; LOEWEN, Mark, University of Utah, Utah Museum of Natural History, Salt Lake City, UT, USA

Despite the abundance and diversity of ceratopsid dinosaurs in western North America (Laramidia), the early evolution of Ceratopsidae remains enigmatic, particularly in the southern portion of the Western Interior Basin. Recent work in the Late Cretaceous (Campanian) of southern Utah has yielded the remains of a new ceratopsian ceratopsid dinosaur from the Kaiparowits Formation of Grand Staircase-Escalante National Monument (GSEM). The new Utah taxon retains several symplesiomorphic characters shared with basal non-ceratopsid ceratopsids (Majungatherapsids, Protoroedroidea) including: low ridge on nasal rather than true horncore; ventral and caudal displacement of maxillary alveolar margin; hypertrophied epigauls; and rostrocaudally abbreviated, deep cranial fossa region of the skull. Additionally, the Kaiparowits taxon exhibits long robust supraorbital ornamentation, a character shared among basal ceratopsine ceratopsids (e.g., Avaceratops, Albertaceratops, and Diabloceratops). Autapomorphies of the Kaiparowits centrosaur include: an anteriad shift that compromises 75% of the preorbital skull length; pneumatic nasals; a unique premaxilla-maxilla contact; a double facette, medially directed flange on the maxilla contributing to a short hard palate; and supraorbital horns that extend past the front of the skull and are rostrolaterally directed, rostrally curved, and torsionally temporal. Temporally, the new Kaiparowits taxon represents the youngest member of the long-horned centrosaurines, distinct from more derived coeval centrosaurines in Montana and Alberta. Thus, these data, considered in unison with Late Cretaceous ceratopsian provinciality in Laramidia, provide direct insights into the mosaic evolution of characters early in the evolution of ceratopsids, and suggests the existence of a previously unknown clade of short-snouted, long-horned ceratopsian in the southern Western Interior Basin.

Technical Session XV, Wednesday 8:45

DIVERSITY AND DISTRIBUTION OF FISH IN A MISSISSIPPIAN BAY: THE BEAR GULCH FISH FAUNA

LUND, Richard, Carnegie Museum of Natural History, Mount Holly, NJ, USA; EMILY, Greenfield, University of Pennsylvania, Philadelphia , PA, USA; GROGAN, Eileen, Saint Joseph’s University, Philadelphia, PA, USA

This research reveals that the Bear Gulch Limestone of Montana provides an exceptional window into the ecology of Mississippian fish. The limestone lens preserves the highly diverse fish fauna of a small Late Mississippian soft bottom tropical marine bay. The lens is the last of a series of temporally and spatially separated bays that formed quickly under tectonic control before becoming geographically isolated. As such, the factors leading to the formation and preservation of this bay are analogous to those that resulted in the fluvial-lacustrine African Rift Valley lakes and helped drive the explosive adaptive radiations of their fishes. Quarrying of this bay from 1968-2009 permits a detailed examination of the habitats, patterns of occurrence, and the diversity of the fishes. This provides the basis for an investigation of the potential ecological drivers of the extensive speciation that underlies the fauna’s high diversity. Here, we present an overview of the preserved alpha diversity (n~5700 specimens; 106 genera) within localized habitats and compare assemblage structure among series of habitats within the bay. Despite striking trends in overall generic richness and total abundance across a geographic and ecological transect, individuals are remarkably evenly distributed (evenness >0.90) among genera in all localities. The large number of rare taxa (n=2 specimens) appears to reflect either the sparsity of the resources they were adapted for (coelodontids, petalodonts) or their ecological roles (apex predators). To facilitate cross-locality comparisons, the Bear Gulch fishes have been coded for 13 functional characters that have potential ecological significance. Eco-coded genera (n=85) were clustered and those grouped by shared sets of characteristics were assigned to 13 nominal ecological “guilds,” or groups of taxa that exploit the same class of environmental resources in similar ways. Taxonomic and guild associations were compared using standard measures of beta diversity to assess the similarity of local assemblages across the bay, revealing distinct differences in how the Acanthodii, Osteichthyes, and Chondrichthyes exploit the same habitats.

Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 9:00

MORPHOLOGICAL EVOLUTION OF THE DOUBLE CRANIOMANDIBULAR JOINT IN THE CYNOdont-MAMMALLIFORM TRANSITION

LUO, Zhe-Xi, Carnegie Museum of Natural History, Pittsburgh, PA, USA

The craniomandibular joint (CMI) formed by the dentary condyle and the squamosal glenoid is one of the most important evolutionary innovation of mammalian. This joint works with larger mandibular adductor muscles for more forceful action of the mandible, and for better control in the occlusion of the upper and lower teeth with matching crown surfaces. Characters of the dentary-squamosal joint are distinctive and reliable apomorphies for diagnosing all extant and for fossil mammals. Since the discovery of the triqueledontid Diarthrogenathus, several additional taxa through the cynodont-mammal transition, such as brasilodontids, have been shown to have the downsized manual and a temporal, but nonetheless functional quadrates-arterial joint co-exists, side-by-side, with the derived dentary-squamosal joint. The function of this double joint require both of the quadrate-articular articulation and the dentary-squamosal articulation co-axial, rotating around the same transverse fulcrum axis. This condition is retained in several Mesozoic mammaliforms and in the eutriconodont YanocYNodon. Another biomechanical requirement for the double joint is that the quadrate is mobile with regards to its receiving structure in the cranium. The mobility of the quadrate was enhanced by the loss of the quadratojugal, a bone that reinforces the cranial attachment of the quadrate in cynodonts, and by a medial shift of the quadrate to be located on the crista petrosa on the petrosal in mammaliforms, from the quadrate’s plesiomorphic location on the squamosal. In extant mammals, the craniomandibular joint is formed exclusively by the dentary and squamosal in adult, as the malleus and the tympanic (angular) have lost their embryonic connection via Meckel’s cartilage to the mandible, by the re-absorption of Meckel’s cartilage in late ontogeny. This is accompanied by a negative allometrical growth of the middle ear bones (incus, malleus and ectotympanum), and a medial displacement of the ear bones away from the mandible as seen in development in monotremes, or their posterior displacement away from the dentary-squamosal articulation as in development in didephid marsupials, or both. If mapped on any well-resolved phyloge phy of cynodonts and mammaliforms, almost all characters of the craniomandibular joint show some degree of homoplastic evolution, due to convergent functional evolution, or homoplastic evolution.

Poster Session I, Sunday

EVIDENCE OF A BACTERIAL ORIGIN FOR DINOSAUR “BLOOD VESSELS” FROM UPPER CRETACEOUS DINOSAUR BONE

LYNCH, Eric, Bucknell University, Lewisburg, PA, USA; NOVAK, Ben, McMaster University, Hamilton, ON, Canada; BRIDGES, Tyler, Montana State University, Bozeman, MT, USA

Recent claims of blood vessels extracted from dinosaur fossils challenge classical views of soft-tissue preservation. Alternatively, these structures may be post-depositional, diagenetic biofilms grown on fossil vascular surfaces. Well- and poorly-preserved Upper Cretaceous dinosaur fossils analyzed in this study produced similar hollow, tube-like structures. Integration of light and scanning electron microscopy, energy dispersive x-ray spectroscopy, and bacteria culture tests indicates that these “vessel structures” are derived from a red-orange, iron-rich material formed by bacteria that was observed to coat the fossil vascular structures. That vessel structures are intact cavity coatings is supported by: their finely ridged exterior matches that of coatings, appearing to have formed parallel to the bone surface, and their textures and elemental composition are nearly identical to coatings. That vessel structures and coatings are formed of biofilm is supported by: 1) framboids, as well as spheres and rods (< 2 µm), diagnostic of bacteria are embedded in vessel structure surfaces; 2) biofilms grown from fossils mimic the coatings within the fossils; 3) vessel structures and coatings are found in fossils of various taxa, geologic formation, geographic location, and taphonomy. That vessel structures and coatings are not diagenetic blood vessels is supported by: 1) coatings overlie secondary mineral crystals, confirming that they are secondary to the bone; 2) they show no layering consistent with blood vessels in cross-section; 3) no structures consistent with eukaryotic cells comprise them. Observed cross-cutting relationships, compositions, and textures at multiple scales indicate a diagnost ic origin for vessel structures linked to bacterial processes and biofilm formation. This also

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accounts for microstructures resembling osteocytes as some fossil lacunae are filled with the same iron oxide that comprises vessel structures and coatings. Results of this study show that systematic, high-resolution SEM analyses of vertebrate fossils can provide improved insight on microtaphonomic processes, including the role of bacteria in diagenesis.

Technical Session VII, Monday 2:30

VERBAL SITE OF THE TURTEX SHELTER GIRDLE PUSHES THE LIMITS OF MUSCULAR SCAFFOLD HOMOLOGY

LYSON, Tyler, Yale University, New Haven, CT, USA; BHULLAR, Bhart-Anjan, Harvard University, Cambridge, MA, USA; BEVER, Gabe, Yale University, New Haven, CT, USA; JOYCE, Walter, University of Tübingen, Tübingen, Germany; GAUTHIER, Jacques, Yale University, New Haven, CT, USA

Establishing primary homology between morphologically disparate structures remains a core issue in evolutionary biology. The “muscle scaffold” model proposes that whereas the topology and developmental history of a skeletal structure is relatively subject to evolutionary change, the identity of its muscle attachments is highly conserved, and thus a useful guide to homology. We apply this model to the anterior-most bones of the turtle shell and found the connections of the pleurodiran and osteochelidont amphibia complex to be highly conserved. The sternocleidomastoid originates from the epiplastron (clavicle) and entoplastron (inter-clavicle), inserts on the back of the skull, and is innervated by the spinal accessary nerve, as in other amniotes. The pleurodiran, which ancestrally originates from the clithrahum bone and is innervated by the vagus and spinal accessary nerves, extends from the nuchal bone of the carapace to its insertion on the back of the skull and exhibits the ancestral pattern of innervation. Thus, muscle connectivity supports the homology of the nuchal bone of turtles and the clithrahum of tetrapods. The nuchal bone and clithrahum are both derived from the neural crest, have a similar topology, form from two separate anlagen and ossification centers, and have a similar overall development, all of which corroborates this hypothesis. According to this model the second crest portion of the shoulder girdle girdle mate ventrally (clavicle and interclavicle) and act laterally (clithrahum to form a portion of the upper and lower turtle shell and frame the endochondral portion of the shoulder girdle.

Poster Session I, (Sunday)

NEW INFORMATION ON THE SKULL OF THE EARLY TRIASSIC PARAREPTILE SAUROPOREAN ANOPBUS

MACDOUGALL, Mark, Cape Breton University, Sydney, NS, Canada; MODESTO, Sean, Cape Breton University, Sydney, NS, Canada

A partial reptile skull collected from Lower Triassic (Induan) Barendskraal locality of South Africa is referable to the procolophonid paraepetile Sauroporean anopus. The specimen preserves the left side of the skull roof, palate, and mandible, and preserves areas not preserved or accessible in the skulls of previously published specimens, including fragmentary remains of the premaxilla, the anterior end of the maxilla, and the anterior end and lingual aspect of the mandible. The maxilla exhibits a maxillary depression that is similar in both shape and relative size to that seen in Procolophon trigoniceps, an anterotidial maxillary foramen that is indistinguishable from those seen in other procolophonids, and 11 conical teeth. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. Tooth replacement is seen in the mandibular aspect of the mandible. The maxilla exhibits a maxillary depression that is similar in both shape and relative size to that seen in Procolophon trigoniceps, an anterotidial maxillary foramen that is indistinguishable from those seen in other procolophonids, and 11 conical teeth.

Technical Session V, Sunday 2:45

MOCEAN MAMMALS OF PANAMA: TROPICAL REFUGIUS OR CRADLE OF BIODIVERSITY?

MACFADDERN, Bruce, National Science Foundation, Arlington, VA, USA

Recent excavations along the Panama Canal have recovered new faunal remains of Miocene mammals, now referred to the Centenario Fauna (CF), containing the previously reported Paraceras wardi. The specimen preserves the left side of the skull roof, palate, and mandible, and preserves areas not preserved or accessible in the skulls of previously published specimens, including fragmentary remains of the premaxilla, the anterior end of the maxilla, and the anterior end and lingual aspect of the mandible. The maxilla exhibits a maxillary depression that is similar in both shape and relative size to that seen in Procolophon trigoniceps, an anterotidial maxillary foramen that is indistinguishable from those seen in other procolophonids, and 11 conical teeth. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The dentary and the coronoid are fused together indistinguishably in lateral aspect. Tooth replacement is seen in the mandibular aspect of the mandible. The maxilla exhibits a maxillary depression that is similar in both shape and relative size to that seen in Procolophon trigoniceps, an anterotidial maxillary foramen that is indistinguishable from those seen in other procolophonids, and 11 conical teeth. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. The suborbital foramen is formed ventrally by the palatine and the ectopterygoid. Tooth replacement is seen in the mandibular aspect of the mandible. The maxilla exhibits a maxillary depression that is similar in both shape and relative size to that seen in Procolophon trigoniceps, an anterotidial maxillary foramen that is indistinguishable from those seen in other procolophonids, and 11 conical teeth.
Zeigler Geologic Consulting, Albuquerque, NM, USA; SUMIDA, Stuart, California State University-San Bernardino, San Bernardino, CA, USA

The lands belonging to the Pueblo of Jemez in north-central New Mexico includes exposures ranging from the Mississippian to the Pleistocene, but very limited documentation of these exposures exist currently. Late Triassic sediments of the Petrified National Forest Formation (Chinle Group: Norian) are present in the Jemez Reservation.

Metoposaurid material was recovered from a grayish-purple paleosol horizon in the lower Petrified Forest Formation (Chinle Group: Norian), approximately 7-8 m above the underlying Poleo Formation, in an area riddled with faults. The fossil-bearing horizon is comprised primarily of abundant metoposaurid fragments ranging from 1 to 10 cm diameter and contains moderately abundant fragments of metoposaur and phytosaur material. Metoposaurid material includes cranial and shoulder girdle elements and teeth. Phytosaur material includes teeth and osteoderms with high dorsal ridges. Taxa recovered from Jemez Pueblo Locality 15 (JP-15) include phytosaur material and postcranial material of a metoposaurid temnospondyl amphibian. The metoposaurid specimens, though fragmentary, are significant for their extraordinary size. A partial interclavicle is conservatively reconstructed as well over 450 mm in width. The largest specimen reported from Texas is 430 mm, whereas the largest known from New Mexico is 400 mm in width. Published sizes of metoposaurid interclavicles from the Chinle Formation of New Mexico and the Dockum Formation of Texas average 307 mm and 313 mm respectively. Thus, the Jemez metoposaur is one of the largest ever reported, approximately 47-48% larger than those published averages, and approximately 5% larger than the largest one yet reported. Although measurements of the thickness of dermal elements of the pectoral girdle are not commonly available, the Jemez metoposaur also appears remarkable in this regard, measuring over 2.5 cm from deep to superficial surfaces.

Poster Session II, (Monday)

STASIS IN LATE PLEISTOCENE FELIDS (SABERTOOTH CATS AND ICE AGE LIONS) FROM LA BRETA TAR PITS DURING THE LAST GLACIAL-INTERGLACIAL CYCLE

MADAN, Meena, University of California, Irvine, Irvine, CA, USA; PROTHERO, Donald, Dept. of Geography, Occidental College, Los Angeles, CA, USA; SUTYAGINA, Anastasiya, Dept. Geology, Occidental College, Los Angeles, CA, USA

One of the great puzzles of evolutionary biology is how organisms remain static in the face of dramatic climatic changes, contradicting the “Galapagos finch” model of organisms that are constantly changing in response to their environment. Such stasis was documented in Pleistocene mammals as early as 1863, and is widely recognized among most Pleistocene large mammals. We examined the two common felids, the saber-toothed cat Smilodon fatalis, and the Ice Age lion, Panthera atrox, from the Rancho La Brea tar pits in the Page Museum in Los Angeles. We measured large samples (more than 100 of each element) of several dimensions of the most common bones (typically leg or foot bones) from all the pits with good radiocarbon dates. Even though pollen, plants, snails, and isotopic studies provide evidence of dramatic climatic and vegetational change from the previous interglacial (40 ka-20 ka) to the peak glacial (20 ka-15 ka) to the glacial-interglacial transition (15 ka-10 ka) to the Holocene, none of these taxa show any statistically significant differences in size or shape of their bones from one level to the next. Such dramatic stasis has been documented among all the common La Brea mammals and birds over the late Pleistocene-Holocene, despite dramatic climatic changes. This casts doubt on the responsiveness of birds and mammals to environmental change, and suggests that intrinsic rather than extrinsic factors are more important in evolution.

Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 9:45

EXPLORING THE INFLUENCE OF FOSSORIALITY ON TETRAPOD CRANIAL ARCHITECTURE, A FOCUS ON CRANIAL JOINTS

MADDIN, Hillary, University of Calgary, Calgary, AB, Canada; WAKE, Marvallee, University of California Berkeley, Berkeley, CA, USA

The study of extant models to understand the correlation between form and function is critical to the formulation of paleobiological hypotheses involving the fossil record. Fossoriality, where the head is employed as the primary locomotor organ (i.e., head-first burrowing), has evolved multiple times independently within Tetrapoda. Among these, caecilians have evolved multiple times independently within Tetrapoda. Among these, caecilians have been shown to exert some of the greatest forces against the substrate during burrowing, and have evolved to accommodate this function. These forces are transmitted via the range-habitat link to test ideas about ecological niche conservatism through pronounced environmental change over geological time. I use the richly fossifilous beds of the John Day Basin, which contain series of paleosols, each representing at least ~100,000 years of soil development and till deposits that provide refined age constraints. With this exceptional palaeontological, temporal and paleoenvironmental data, I tracked Miocene mammal species distributions and changing local paleoenvironmental parameters through successive time slices represented by horizons in the upper John Day Formation (Haystack, Baln Creek and Rose Creek members) and the Masicall Formation. These deposits span the Miocene Climatic Optimum (MMCO), a period in which global temperatures rose ~3-4 °C, followed by decreasing temperatures and increasing aridification, thus providing an ideal setting for testing hypotheses about species-environment interactions in the face of pronounced climate change. Fossil localities were visited in the John Day Basin and placed within a recently published stratigraphic framework. Environmental parameters (e.g. precipitation, soil type) were collected from corresponding paleosols. Species distribution maps and environmental parameters were investigated to determine if and how the distribution of a species changed through time and whether there was a correlated environmental change. The use of a new analytical technique using GIS for reconstructing species distributions in the paleontological record is also demonstrated.

Technical Session I, Sunday 9:15

EVALUATION OF LOCOMOTOR MUSCULATURE IN ORNITHISCHIAN DINOSAURS


The earliest ornithischian dinosaurs were small and bipedal with forelimbs modified for grasping, but they radiated into a diverse range of body shapes. Quadrupedalism developed in three ornithischian lineages, resulting in profound musculoskeletal transformations. We use the extant phylogenetic bracket to reconstruct locomotor musculature in a range of bipedal and quadrupedal ornithischians to investigate musculoskeletal convergence and identify correlates for quadrupedalism. A well-developed scapula acromial process provides attachment for the deltoide musculature, which acts to protract the forelimb, while the prominent deltopectoral crest of quadrupedal ornithischians is a correlate of the pectoralis, the major humeral retractor and adductor. These features are well developed in quadrupedal thyreophorans and ceratopsians, but are less well-developed in hadrosaurs, suggesting that they relied upon the hind limb for locomotor propulsion with little input from the forelimbs. The development of a cranial locomotor of the ulna rotated the radius medially, resulting in pronation of the manus. An elongate iliac preacetabular process is developed in all ornithischian taxa, but in quadrupedal forms it is broadened transversely, providing a large surface area for attachment of the pubis-chiromeralis internus, the predominant femoral protractor. The elongate prepubis and transversely broadened ilium provides attachment for lower limb extenders, suggesting that protraction and anterobrachial extension become more important in quadrupedal locomotion than in bipedal locomotion. The retroversion of the pubis-chiromeralis internus would have resulted in the loss of the moment arm of the pubis-chiromeralis externus for femoral protection; the subsequent reduction of the postpubis in many ornithischians probably correlates with the loss of this muscle group entirely. This study is the first to reconstruct musculature in ornithischians from both a functional and phylogenetic perspective and is timely since biomechanical methods are being used increasingly to understand dinosaurian locomotion. It is essential to have a clear basis for myological reconstruction in such work.

Poster Session III, (Tuesday)

IMPLICATIONS OF A NEW LUNGISH FISH (DIPNO: CETARODONTIDAE) FROM THE CRETACEOUS (CENOMANIAN) WOODBINE FORMATION AT THE ARLINGTON ARCHOSAUR SITE, NORTH TEXAS

MAIN, Derek, University of Texas, Arlington, TX, USA; PARRIS, David, New Jersey State Museum, Trenton, NJ, USA; GRANDSTAFF, Barbara, University of Pennsylvania, Philadelphia, PA, USA

A significant number of new lungfish tooth plates are now known from the Cretaceous...
North American lungfishes. Its general morphology is similar to dental plate margins and crests confirm that the Woodbine species is distinct from all other specimens recovered to date from the AAS is greater than that from any other single Cretaceous coastal ecosystem within the carbonaceous shales and mudstones of a delta plain. The number of specimens recovered to date from the AAS is greater than that from any other single Cretaceous site in the eastern subcontinent. This species is similar to, and presumably descended from, another small species with sectorial tooth plate morphology that has been recovered from various formations of Albian age in eastern Texas. Measurements of the angles of the dental plate margins and crests confirm that the Woodbine species is distinct from all other North American lungfishes. Its general morphology is similar to Ceratodus guentheri, with obtuse inner angles, but lacks the flattened crushing platform associated with the third and fourth crests C. guentheri. All of the Woodbine specimens have high, sharp ridge crests that are interpreted as an adaptation for a slicing, or cutting feeding style. Two small specimens representing an earlier ontogenetic stage, display the same sectorial morphology as the larger specimens, suggesting that the diet of this small lungfish did not change ontogenetically. Although dipnoan evolution generally appears to have proceeded slowly, the taxa from the Cretaceous (Albian – Cenomanian) of Texas display enough morphometric variation between the earlier and later species to have some biostatigraphic utility.

Poster Session III, (Tuesday)

DEPOSITIONAL SETTING OF FISH-PART SANDSTONES AND CONGLOMERATES: A TAPHONOMIC INTERPRETATION OF A RARE LACUSTRINE STRAND LINE

MALENDA, Helen, Kutztown University, Kutztown, PA, USA; SIMPSON, Edward, Kutztown University, Kutztown, PA, USA; SZAJNA, Michael, Reading Public Museum, Reading, PA, USA; FILLMORE, David, Kutztown University, Kutztown, PA, USA; HARTLINE, Brian, Reading Public Museum, Re, PA, USA

Fish parts preserved in sandstones and conglomerates were recovered from the Triassic Lockatong Formation of the Newark Supergroup. Data recovered from this unique lacustrine strand line setting were examined using sedimentologic and taphonomic methods to accurately interpret conditions that caused (permuted) accumulation.

Within the Lockatong Formation, reoccurring Van Houten cycles are subdivided into three divisions (D): lake transgression (D1), highstand (D2), and regression or lowstand facies (D3). The Triassic fish-part sandstones and conglomerates are composed of disarticulated skeletal remains of multiple fish species. The fish-part sandstones and conglomerates occur at the transition from D1 to D2 and are found above a fluvial intraformational conglomerate composed of diverse mudstone clast types derived from the underlying D3. Fish-part sandstones and conglomerates occur as continuous or lenticular graded beds. Normal graded beds are prevalent and consist of both sedimentary clasts and disarticulated fish parts. Within a bed, the clasts and fish parts do not grade systematically due to density differences. Either wave ripples or current ripples cap the graded beds, indicating shallow water deposition. In addition, large fish pieces associated with rooted mudstones can be present in lieu of ripple facies, indicating subaqueous exposure. By using the fish kills in the Salton Sea as a modern taphonomic analogue we propose that a mass kill of Triassic fish species took place in the lacustrine Lockatong Formation. After death, decomposition of the fish led to the fish bodies being driven shoreward by waves, probably storm-generated. The remains were disarticulated and re-worked aslag fabric recorded in the normal grading of the sediments and fish part clasts. The intermixing of interformational clasts and fish parts reflects the impact of the storm washover into the associated fluvial systems.

Technical Session I, Sunday 9:30

AN ASSESSMENT OF DIFFERENTIAL FEEDING SELECTIVITY AMONG THE MEGHERIBRYCHIDAE Dinosaur Fossils FROM THE DINOSAUR PARK FORMATION (LATE CAMPANIAN) OF ALBERTA, CANADA

MALLON, Jordan, Dept. of Biological Sciences, University of Calgary, Calgary, AB, Canada; ANDERSON, Jason, Dept. of Comparative Biology and Experimental Medicine, University of Calgary, Calgary, AB, Canada

The Late Cretaceous dinosaur faunas of North America contained a rich diversity of large herbivores, including ankylosaurs, ceratopsids, and hadrosaurids. It has been suggested that competition for food between and within these groups was alleviated by differential feeding selectivity, as evidenced by their different muzzle shapes. We tested these hypotheses by analyzing differences in the herbivorous dinosaurs of the Late Cretaceous Dinosaur Park Formation of Alberta in two ways. First, we applied a geometric model previously used to assess muzzle shape in ungulates, wherein the muzzle is fit within a triangle of fixed proportions and a muzzle shape index (MSI) is calculated. A one-way ANOVA showed that the MSI differs significantly between ankylosaurs, ceratopsids, and hadrosaurids (n=51,F=220,p<0.05), with the ankylosaurs having squarer muzzles and the ceratopsids having the most pointed ones. We found no differences within these groups, including among sympatric species, except between the ankylosaurs Euoplocephalus and Edmontonia (n=12, t=3.99, p<0.05), of which the former has a squarer muzzle. Second, we performed an eigenshape analysis on muzzle shape (n=51). The first two eigenvalues best describe the square-nose of the muzzle and together account for 25% of the shape variation. taxa are best separated along the second eigenshape axis, particularly between the broad-muzzled ankylosaurs and narrow-muzzled ceratopsids. Resolution does not improve at lower taxonomic levels, even among sympatric species. The MSI and eigenshape analyses both suggest minimal ecological separation of the Dinosaur Park Formation herbivores except at the broadest taxonomic levels. Based on muzzle shape alone, ankylosaurs were the least selective feeders and ceratopsids were the most selective. Hadrosaurids were intermediate in their feeding selectivity. It appears that at lower taxonomic levels, sympatric species must have partitioned food in ways other than feeding selectivity, if they did at all.

Poster Session III, (Tuesday)

TOWARDS A STABLE PHYTOSAUR TAXONOMY: DISTINGUISHING CHARACTERISTICS BETWEEN PSEUDOPALATUS AND REDONDASAURUS (PHYTOSAURIAE: PSEUDOPALATINAE)

MANNING, Mark, Mesalands Community College, Tucumcari, NM, USA; HUNGERBEUHLER, Axel, Mesalands Community College, Tucumcari, NM, USA

The systematics of phytosaurs is a complex and confusing issue. The Pseudopalatinae, the stratigraphically latest and most derived clade within Phytosauria, is no exception. Known from dozens of skulls, the genera Pseudopalatus and Redondasaurus have been distinguished on the basis of the width of the squamosal bar and the visibility of the supratemporal fenestra. Nevertheless, the genera have been frequently confused. We demonstrate that the type species P. pristinus and R. gregorii, on the basis of their respective type specimens, can be distinguished by discrete states in a total of eight cranial characters: shape of the supratemporal shelf; thickness of the parietal rim; extension of the parietal rim; degree of gradation between the dorsal and the ventral surfaces of the squamosal; degree of closure of the supratemporal fenestra; sharpness of postorbital-squamosal bar; width of the postorbital-squamosal bar; and shape of the posterior process of the squamosal. Hence, it is safe to conclude that on the basis of their type specimens, Pseudopalatus and Redondasaurus represent two distinct taxa. However, we show that skulls referred to other species of Pseudopalatus and new cranial material do not provide such easily recognizable distinctions. The data suggests that an evolutionary grade between Pseudopalatus and Redondasaurus exists. The findings of our case study may provide one reason with which to explain the confusing status of phytosaur taxonomy.

Poster Session III, (Tuesday)

DINOSAURS WALK TALL: A CROCODILIAN TRACE FROM THE LANCE FORMATION (UPPER CRETACEOUS) OF WYOMING

MANNING, Phillip, University of Manchester, Manchester, United Kingdom; MILAN, Jouke, University of Copenhagen, Copenhagen, Denmark; FALKINGHAM, Peter, University of Manchester, Manchester, United Kingdom

A 1.5 m long, double sinusoidal trace from the Lance Creek Formation (Wyoming) has been previously described as a potential dinosaur track drag mark. The trace is located on a track-bearing outcrop in association with a number of dinosaur and bird tracks and trackways. The track assemblage includes large dinosaur tracks (> 60 cm), of both theropod and ornithopod origin, mid-sized (~30 cm) tracks of likely theropod origin, and small (~5 cm) bird tracks. The trace discussed here is closely associated with a trackway consisting of two tracks of probable hadrosaurian origin (ichnogenus Hadrosauripodus). By comparing the fossil trace with trackway of extant crocodiles, we propose that the trace was made by another animal prior to the ornithopod trampling the substrate. The hourglass-shape trace, in association with two ornithopod tracks, is interpreted as the double sinusoidal trace from the tail and body of a crocodile, which was later crossed by the path of an ornithopod dinosaur. This double sinusoidal trace is preserved with scute marks and associated claw impressions as a single track, in modern crocodile trackways. This interpretation is further supported by the presence of crocodile fossils from within this facies in the Lance Formation. The hourglass-shaped trace from the Maastrichtian Lance Formation, is interpreted to be a trace of a crocodilian, rejecting the earlier dinosaurian origin. This expands the already diverse ichnofauna from the Lance Formation to include crocodile tracks as well as tracks from multiple taxa of dinosaurs and birds. Given the intimate association of dinosaur tracks with river bank/lake shore facies, the authors also suggest caution when attributing similar hourglass-shaped traces to the tail drags of dinosaurs.

Technical Session III, Sunday 2:30

TARSAL BONES OF NORTH AMERICAN PALEOCENE LEPTACODON (MAMMALIA; EULIPOTYPHLA) AND EVIDENCE FOR SCONARIALITY IN NYCTITHERIDAE

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; BOYER, Doug, Brooklyn College, City University of New York, Department of Anthropology and Archaeology, Brooklyn, NY, USA

Nyctitheriids are an extinct family of insectivorous mammals found in the Paleogene of Europe, Asia, and North America. These animals are known to mostly have uncertain phylogenetic relationships within Eutheria, often linked to Chiroptera (bats) or Eulipotyphla (shrews, moles, hedgehogs, solenodons). Tarsals attributed to the late Eocene European Nyctitherium Cryptotopus were described to have scansion morphology suggesting a close relationship to Euarctoa (tree shrews, flying-lemurs, primates). Here we describe the first
nyctitheriid astragali and calcanea from North America. Paleocene tarsals from the Bighorn Basin, Wyoming, are clearly associated with partial skeletons of *Leptacodon* and are similar to those of *Cryptotopos*. Scansorial features indicative of a mobile foot able to navigate sub-strates of variable diameters and orientations include 1) strongly curved, unequal areas of articular facets on the calcaneum and astragali allowing a wide range of movement, 2) a rounded, concave calcaneal cuboid facet and a uniformly convex astragalar navicular facet allowing rotation at the mid-tarsal joint, 3) a strong groove for the flexor digitorum fibularis on the sustentacular process associated with grasping and 4) robust distal plantar and peroneal tubercles of the calcaneum for ligament attachment and tendon pathways, respectively, to help stabilize, evert and invert the ankle. Nyctitheriid tarsals have possible euarchontan synapomorphies including confluent sustentacular and navicular facets on the astragalar neck and a calcaneal distal sustentacular facet articulating with part of the astragalar navicular facet. Some of these traits are also in late Cretaceous *Deccanolesostes* and Paleocene adap-soricids, both proposed as euarchontans based on tarsal characteristics. Nyctitheriids differ in having a fibular facet, a more deeply grooved lateral tibial facet that forms a sharper angle with the fibular facet, and in lacking an astragalar foramen. Similarities between nyctitheriids and these taxa may be due to a close phylogenetic relationship, convergence, or even a shared primitive boreoeutherian morphology with scanorial adaptations.

**Technical Session IX, Tuesday 9:30**

**LATITUDINAL DIVERSITY GRADIENT OF NORTH AMERICAN MAMMALS WAS NOT CONSTANT OVER THE CENOZOIC**

MARCOT, Jonathan, University of Illinois, Urbana, IL, USA; FOX, David, University of Minnesota, Minneapolis, MN, USA

The latitudinal diversity gradient (LDG) is among the most salient biogeographic patterns of life on Earth. A decline in taxonomic richness from the equator to the poles characterizes a diversity of clades in marine and terrestrial environments at most spatial scales. A few studies have examined past LDGs using the fossil record of marine invertebrates and generally found it to be similar to that of extant taxa and consistent over time. Fewer studies have addressed the LDG of terrestrial vertebrates in the geologic past. Recent research demonstrates that the LDG of Paleocene mammals of North America differed from the modern gradient. We extended this research to the entire Cenozoic to determine how, if at all, the LDG of mammals changed over time. We estimated the LDG of all terrestrial North American fossil mammals throughout the Cenozoic using occurrence data from the Paleobiology Database. We estimated the slope of the LDG in each of 23 three million year intervals, controlling for variable sampling over latitudes. The LDG was calculated as the slope of a linear regression of the logarithm of (rarefied) taxonomic richness vs. the midpoint of the latitudinal band. Estimated slopes for each interval were compared statistically to that of the most recent interval. The LDG of North American mammals varied over time. Most notably, many intervals show a positive relationship between richness and latitude – the opposite of the pattern seen today. LDGs become increasingly negative throughout the Neogene, broadly correlated with falling global temperatures over the same interval. Specifically, interval-to-interval variation in the slope of the LDG is correlated with 180 values of benthic foraminifera throughout the Neogene. This suggests an influence of global climate on the slope of the LDG, indicating that the LDG might be a more transient and labile feature than has previously been acknowledged.

**Poster Session IV, (Wednesday)**

**THE ZEGDOUNYIDS (RODENTIA, MAMMALIA) FROM THE EARLY PALEOGENE OF ALGERIA: NEW DENTAL EVIDENCE ON STEM ANOMALROID RODENTS**

MARIVAUX, Laurent, Institut des Sciences de l’Evolution de Montpellier, UMR-CNRS 5554, Département de Paléontologie, Université MONTPELLIER 2, Montpellier, France; ADACI, Mohammed, Laboratoire de recherche n°25, Département des Sciences de la Terre, Université Abou Bekr Belkaid, Tiemcen, Algeria; MEBROUK, Fateh, Département des Sciences de la Terre, Faculté des Sciences, Université de Jijel, B.P. 98 Ouled Aissa, Jijel, Algeria; TABUCE, Rodolphe, Institut des Sciences de l’Evolution de Montpellier, UMR-CNRS 5554, Département de Paléontologie, Université MONTPELLIER 2, Montpellier, France; MAHBOUBI, Mohammed, Laboratoire de Paléontologie stratigraphique et Paléoenvironnement, Université d’Oran, B.P. 1524 El M’naouer, Oran, Algeria

The Paleogene fossil record of rodents in Africa is dramatically scarce compared to that of North America or Eurasia. Despite this, Africa has long appeared as being a centre of adaptive radiation of two different groups of Rodentia: Hystrognathini and Anomaluridae. The >45-million-year-old enigmatic Zegdounyidae is the oldest and only rodent family known of this age from Africa. Although poorly documented, zegdounyids have been tentatively regarded as a possible early African stem group for Anomaluridae – a link that has never been clearly established because of major temporal and morphological gaps between zegdounyids and the first anomalurids from the late Eocene. Since 2003, we focused some of our African fieldwork in the Gour Lazib, a region situated in the Sahara of Western Algeria. About 200 rodent teeth have been sorted after acid-etchings of the indurate sediments of several new localities dating from the late early or early middle Eocene. These new fossils allow us to better describe the morphology of the Zegdounyidae (especially *Gilibia* and *Zegdounys*) and to identify a new taxon. With this material, we investigated the phylogenetic position of the Zegdounyidae in a high-level rodent phylogeny in performing a cladistic assessment of the dental evidence. Our analyses have yielded 40 equally most-parsimonious trees in which zegdounyids represent the earliest offshoots (pocinetomorph) of a clade that embraces Eocene anomalurids plus stem and crown Anomaluridae. This phylogenetic assumption underscores the great antiquity of the Anomaluridae clade in Africa – an issue that was expected given the high morphological divergence of the late Eocene African anomalurids. From a high-level phylogenetic perspective, the source of the Zegdounyidae is still unclear inasmuch as there is no well-identified sister-group among early Paleogene rodents. Zegdounyids seem to share a common ancestry with both stem Myodonta and North American sciurids. Given the high degree of dental specialization of zegdounyids, we cannot exclude the possibility that zegdounyids are rooted in a more primitive, yet unknown, African rodent lineage older than the early-middle Eocene.

**Romer Prize Session, Monday 9:30**

**AGE AND RELATIONSHIPS OF THE MODERN AMPHIBIANS (TETRAPODA: SALIENTIA, CAUDATA, GYMNOPHONIA, ALBANERPETONTIDAE)**

MARJANOVI, David, UMR-CNRS, MNHN, Collège de France, Paris, France

Despite decades of intensive research, the origin of the frogs (Salientia), salamanders (Caudata) and caecilians (Gymnophiona), together with that of the extinct Albanerpetontidae, remains controversial. Three groups of hypotheses persist in the literature: the aforementioned taxa may form a clade (Lissamphibia, a crown-group of which Albanerpetontidae may be lepospondyls (polyphyly hypothesis/PH)), or among the lepospondyls, making the lepospondyls stem-amniotes (temnospondyl hypothesis/TH), or among the temnospondyls, making the lepospondyls a possible early African stem group for Anomaluridae – a link that has never been clearly established because of major temporal and morphological gaps between zegdounyids and the first anomalurids from the late Eocene. Since 2003, we focused some of our African fieldwork in the Gour Lazib, a region situated in the Sahara of Western Algeria. About 200 rodent teeth have been sorted after acid-etchings of the indurate sediments of several new localities dating from the late early or early middle Eocene. These new fossils allow us to better describe the morphology of the Zegdounyidae (especially *Gilibia* and *Zegdounys*) and to identify a new taxon. With this material, we investigated the phylogenetic position of the Zegdounyidae in a high-level rodent phylogeny in performing a cladistic assessment of the dental evidence. Our analyses have yielded 40 equally most-parsimonious trees in which zegdounyids represent the earliest offshoots (pocinetomorph) of a clade that embraces Eocene anomalurids plus stem and crown Anomaluridae. This phylogenetic assumption underscores the great antiquity of the Anomaluridae clade in Africa – an issue that was expected given the high morphological divergence of the late Eocene African anomalurids. From a high-level phylogenetic perspective, the source of the Zegdounyidae is still unclear inasmuch as there is no well-identified sister-group among early Paleogene rodents. Zegdounyids seem to share a common ancestry with both stem Myodonta and North American sciurids. Given the high degree of dental specialization of zegdounyids, we cannot exclude the possibility that zegdounyids are rooted in a more primitive, yet unknown, African rodent lineage older than the early-middle Eocene.

**Poster Session IV, (Wednesday)**

**RELIABILITY OF IMAGE BASED FINITE ELEMENT MODELLING IN VERTEBRATE PALEOONTOLOGY**

MARGETTS, Lee, University of Manchester, Manchester, United Kingdom; MANNING, Phillip, University of Manchester, Manchester, United Kingdom; MUSTANSAR, Zartasha, University of Manchester, Manchester, United Kingdom; JOHNSON, Mark, University of Manchester, Manchester, United Kingdom

Finite element analysis (FEA) is a computational method used by engineers to evaluate the response of a structure to a physical stimulus. Image based FEA uses finite element models that have been created from 3D X-ray computed tomography scans. In recent years, image based FEA has seen growing use in Vertebrate Palaeontology, particularly because high resolution scans of fossil bones can reveal details of the internal microstructure. These details help interpret how the bone was loaded when the animal was alive.

The purpose of this paper is to report on the various factors that can affect the reliability of FEA results and therefore assess their usefulness. These are technical and methodological limitations for this study: (a) Biomechanical structures are more complicated than the engineering structures for which FEA has been traditionally used; (b) there is uncertainty regarding the properties of the original constituent materials in fossilized bones and (c) it is not possible to study in-vivo how the structures were originally loaded.

For two case studies, the humerus of *Tyrannosaurus rex* and a velociraptor claw, the authors will present a critical analysis of how finite element stress computations are affected by model resolution; accuracy of image segmentation into various structures; values for material properties and the type and location of boundary conditions. The authors also examine how the results of similar element simulations using micro-structurally faithful models compare with those obtained using abstract geometrical shapes: beams for the humerus and curved conical cylinders for the claw. Insights regarding form and function of these two examples will be presented in light of the study.
The Early Permian Bromacker Horizon, located in the middle part of the Upper Rotliegend Tambach Formation, near Gotha, central Germany, is a highly prolific site that yields terrestrially adapted invertebrate and vertebrate fossils. They far surpass in numbers of individuals, diversity of taxa, and quality of preservation those of all other European sites of comparable age. Whereas the Bromacker taxa are unique to Europe, they are identical or very closely related to forms known elsewhere almost exclusively from the Lower Permian of the U.S. To date, thirteen vertebrates, eight to ten invertebrates, and four invertebrate and six vertebrate traces have been identified. The unique commonality of all vertebrates with those of North America has been relevant in resolving important areas of inquiry: 1) accurately assessing the biostratigraphic position and age of the Tambach Formation and therefore the base of the Rotliegend; 2) providing the first irrefutable, biological evidence of a prédrift, continuous landmass of Laurasia during the Early Permian; 3) contributing significant new information about the global distribution patterns of Early Permian tetrapods across southern Laurasia; and 4) providing direct evidence that faunal interchange across southern Laurasia of many terrestrial species during this time was not impeded by biological, environmental, and physical barriers. Geological evidence indicates that the Tambach Basin during Tambach Formation deposition represented a ‘truly upland’ paleoenvironmental setting, which is supported by the Bromacker Horizon fauna: 1) lack of any obligatory aquatic or semi-terrestrial forms (fish and most amphibians); 2) the amphibia, which include two to four dissorophoids and Seymouria, are widely viewed as highly adapted to an active, terrestrial existence; 3) presence of four taxa of terrestrial herbivores presumably capable of consuming high-fiber vegetation doubles that for any assemblage of comparable age; 4) herbivores outnumber the only two top predators by a ratio of 7:1; 5) herbivores represent nearly 50% and top predators 7% of the total number of specimens collected; 6) presence of the ephemeral-adapted vertebrate Conchostra.
logic convenience, and spuriously precise correlations. We have precisely plotted tetrapod biostatigraphic data on detailed and accurate Upper Triassic lithostratigraphic frameworks for two areas in the western United States: Petrefied Forest National Park in northeastern Arizona, and southern Garza County in western Texas. These detailed and accurate bio-

stratigraphic maps provide a basis for how Triassic vertebrate biochronologies must be approached to reliably answer questions about faunal change. The Late Triassic “land vertebrate faunas (lves)” are most useful when treated as provincial biozones (rather than global biozones) incorporating precise biostatigraphic data with alpha taxonomy derived independent of stratigraphic information. It is important to distinguish between how the “lves” are defined (based on the superpositional relationships of first appearances for particular taxa) and characterized (based on overall faunal content). Confusing these concepts has caused the rejection by some of distinct Adamanian and Otischalkian “lves”. Dense biostatigraphic sampling is critical for accurately placing “lve” boundaries, and for understanding faunal changes. Due to patchy sampling, the apparent position of the Otischalkian-Adamanian boundary is probably too high in both localities. In Petrefied Forest, the Adamanian-Revuelta transition seems most abrupt for the most common taxa with the densest sampling, making a mass extinction and rapid faunal replacement plausibly. How-

ever, the general lack of detailed biostatigraphic range data, combined with the paucity of precise radiometric dates, currently makes it impossible to either identify or refute globally synchronous Late Triassic mass extinctions, or to reliably characterize faunal turnovers as being either competitive or opportunistic.

Poster Session IV, (Wednesday) TESTING THE CONSISTENCY OF THE LATERAL SEMICIRCULAR CANAL AS A COMPARATIVE COORDINATE SYSTEM FOR CRANIOFACIAL DESCRIPTIONS IN SAURISCHIAN DINOSAURS MARQUET-BODIN, Jesus, DI, Natural History Museum L.A. County, Los Angeles, CA, USA; CHIAPPE, Luis, DI, Natural History Museum L.A. County, Los Angeles, CA, USA A long standing challenge in comparative morphology has been to find a coordinate system that helps make anatomical descriptions consistent among taxa. Craniofacial morphology in fossil dinosaurs has been described using the lateral semicircular canal—one of the three ca-

nals of the labyrinth within the inner ear—as a reference system for skull orientation. In land vertebrates, while the three semicircular canals are spatially nearly-orthogonal, available data from extant taxa do not support the assumption that their orientation as a whole is inter-

specifically consistent (i.e., that the canals specify the same spatial directions within the skull in all taxa). Thus, using the lateral canal as a fixed orientation baseline, and consequently, rotating a skull in a magnitude equivalent to the canal’s real orientation, may yield an inac-

curate perception of craniofacial organization. Here we argue that geometric morphometrics allows a more consistent coordinate system based on the superimposition of homologous landmarks. We illustrate this method by assessing the orientation of the semicircular canals in an inter-specific sample of fossil and extant saurischian dinosaurs including sauropods, theropods, and ornithischians. Our results show that fossil sauropods spanned a striking range of labyrinth orienta-

tions, even larger than what had been reported for extant birds (ca. 70°, ranging between 20° to -50° relative to the horizon). Our conclusions strongly demonstrate that in dinosaurs the spatial coordinates defined by the labyrinth are inter-specifically very variable, and indicate that the lateral semicircular canal is an inconsistent reference system for descriptive purposes.

Physical Drivers and Marine Tetrapod Evolution, Monday 11:45 LEVIATHANS SPARRING ON THE FOWLING WAVES - AN INTEGRATED VIEW OF BALEEN WHALE DIVERSITY, DISPARITY AND EVOLUTIONARY RELATIONSHIPS MAJORS, Simon, Intermountain Paleo-Consulting, Vernal, UT, USA; SANDAU, Stephen, Intermountain Paleo-Consulting, Vernal, UT, USA; BURK, Daniel, Intermountain Paleo-Consulting, Vernal, UT, USA; KRUZENACKER, L.J., Intermountain Paleo-Consulting, Vernal, UT, USA Late in 2009, a Crocodylian was collected during a reconnaissance survey in the Uinta Basin of northeastern Utah. The specimen was recovered from light-green floodplain deposits consisting of sandy silstones and mudstones in the Uinta B (Wagonhound Member) of the Uinta Formation. Approximately 60% of the skull is present yet poorly preserved with substantial dorso-ventral crushing. The specimen consists of the semicircular canals through anterior jugal, partial dextral premaxilla, maxilla, nasal, the greater portion of both dentaries, broken in situ teeth, numerous isolated partial teeth, posterior pterygoid wing, numer-

ous other cranial fragments, two near-complete articulated dorsal vertebrae, and associated vertebrae and limb fragments. Partial fusion of the neural arches and centra of the articulated vertebriform suggest the animal was a subadult. The incomplete skull is 22 cm long with an estimated length of 32 cm. The measurement across the snout at the anterior edge of the nar is 4.5 cm and 6.5 cm near the distal end of the maxilla. Preserved length of the semicircular dentary is 22 cm with a total estimated mandible length of 35 cm. These measurements suggest an elongate skull in contrast to the more robust and triangular skulls of other Uintan Crocodylians. An additional difference from other Uintan Crocodylians includes: sculpted rugosity of the cranial elements as opposed to the pitted rugosity found in “Crocodylus” affi-

nis, Baurusuchus, or Procamainosuchus utahensis. Dissimilar to known Uintan Crocodylians, the teeth are diminutive, blade like, and splayed laterally beyond the anterior margins of the dentary and premaxilla. We interpret this specimen to be an undescribed Crocodylian. Preliminary morphological comparisons suggest a close affinity to Listronosuchus. This specimen has been repositioned in the Brigham Young Museum of Paleontology.

Poster Session I, (Sunday) A NEW, NEARLY COMPLETE SPECIMEN OF PETROLACOSAURUS KANSENSIS (DIAPSIDA: ARAEOCEILIDAE) THE EARLIEST KNOWN DIAPSID FROM THE UPPER PENNSYLVANIAN OF KANSAS MAZIERSKI, David, University of Toronto Mississauga, Mississauga, ON, Canada; REISZ, Robert, University of Toronto Mississauga, Mississauga, ON, Canada The rich Pennsylvanian faunal assemblage of the Barnett locality, in central Kansas, contin-

ues to provide important information about the morphology of early terrestrial amniotes and their environment. This locality has yielded the skeletal remains of six synapsids as well as the diapsid reptile Petrolosaurus kansensis. Trackways have also provided evidence for the presence of at least two more terrestrial tetrapods: a tiny captorhinomorph reptile and...
a large diadectid corythosaur. Earlier descriptions of *Petrolacosaurus kansensis*, the oldest known diapsid, were based on 26 incomplete specimens, many of them representing immature individuals. For the first time, a nearly complete mature skeleton of this taxon has been discovered, providing an opportunity to analyze the anatomy and body proportions in a single individual. The skeleton consists of a complete, flattened skull, complete presacral vertebral column, and one complete semi-articulated fore and hind limb. Although clearly an adult, the long neck and the elongate, slender limbs underscore the overall gracile configuration of this species. Precise skeletal measurements taken from a single adult individual are particularly important for determining overall body and limb proportions, making it possible to compare this basal diapsid with other basal amniotes. For example one characteristic feature of early amniotes is the 20-30% greater length of the femur than the humerus, probably associated with front and hind limb stride length. In this regard, *Petrolacosaurus* is distinct from most other early amniotes in having femora and humeri of equal lengths. This suggests that these proportions may be related to increased agility in this basal diapsid reptile, yet it is surprising to find that humeri of equal or even greater length than the femur is a characteristic feature of another group of early amniotes, the large, barrel-shaped herbivorous cased synapsids.

Poster Session III, (Tuesday)

**DISCOVERY OF THE JUGAL BONE IN THE HAITIAN GROUND SLOTH NEOCNAS (MAMMALIA, PILOSA, MEGALONYCHIDAE) AND THE IMPLICATIONS FOR DIETARY RECONSTRUCTION**

MCARTEE, Robert, University of Missouri, Columbia, MO, USA

The jugal bone is a diverse element within sloths that fails to form a complete zygodic arch in all but the largest forms of extinct ground sloths and exhibits a variety of elaborations in the projections for muscle and ligament attachment. The varied patterns of this bone are linked to adaptive shifts in the musculature lines of action for feeding, which specifically affects M. masseter and M. zygomaticomandibularis. The Haitian species of the Pleistocene ground sloth Neocnus heretofore lacked known jugal elements and it was predicted to be greatly reduced in size and shape, giving the sloth a weakened mandibular closing or bite via the masseter. The discovery of jugals with an associated skull, along with numerous individual jugals, provides the first basis for description of this element in the Haitian species of Neocnus and enables analysis of potential feeding mechanisms for this taxon. Reconstruction of masticatory musculature follows muscle patterns for the extant tree sloths, Bradypus and Choloepus. Analyses of estimated bite forces were carried out via calculation of moment arms for M. temporalis and M. masseter, which were compared against the lever arm forces applied at each tooth in the mandibular series. The jugals in Neocnus are larger than predicted with a slender, elongate dorsal process extending nearly to the postorbital bar, a middle process that is blunt and that nearly merges with the short ventral prong that sweeps posteriorly and does not extend below the mandible. Bite force analyses and muscle reconstruction portray Neocnus as a strong masticator that emphasized crushing-grinding movements over speed, via a more vertically aligned M. temporalis, M. zygomaticomandibularis, and M. pterygoideus medialis. During the masticatory cycle, Neocnus had greater anterolingual movements due to the horizontal alignment of M. pterygoideus lateralis in a pattern more reminiscent of Bradypus than the labiolingual movements employed by Choloepus. Overall patterns of bite force and dental wear suggest Neocnus had a folivorous diet, like Bradypus, preferring older shoots and leaves that are more effectively processed by strong, grinding bite forces.

Poster Session II, (Monday)

**A NEW FOSSIL SNAKE ASSEMBLAGE FROM THE LATE EOCENE OF THE FAYUM DEPRESSION, EGYPT**

MCCARTN, Jacob, Stony Brook University, Stony Brook, NY, USA; SIMONS, Elwyn, Duke University Lemur Center, Durham, NC, USA

The Fayum Depression in northern Egypt is well known for its Paleogene mammalian fauna, but ongoing fieldwork has expanded our comparatively limited knowledge of the non-mammalian fauna. A new collection of snakes from the latest Eocene (earliest Priabo- nian, ~ 37 Ma) Birket Qarun Locality 2 (BQ-2) greatly increases our knowledge of snakes from this time period in Africa. At least six species have been recovered from BQ-2. Two of these, the madreoid Giganthops and the paleocholeid Pterosphes, are already known from younger horizons in the overlying Qasar el-Sagha Formation. Three basal alethinophidians and a colubroid have also been identified. Most are represented by multiple vertebrae, from younger horizons in the overlying Qasar el-Sagha Formation. Three basal alethinophidians and a colubroid have also been identified. Most are represented by multiple vertebrae, including vertebrae from overlapping regions, thereby allowing direct comparison of the skeletal morphology suggesting no particular ecological specializations, although they differ con- siderably in size. This apparent ecological diversity suggests a complex snake fauna in the Eocene of the Fayum with niche partitioning allowing a diverse snake assemblage.

Romer Prize Session, Monday 9-45

**INTERPRETING RECENT SMALL-MAMMAL RANGE SHIFTS IN YOSEMITE IN LIGHT OF THE QUATERNARY FOSSIL RECORD**

MCGUIRE, Jenny, University of California—Berkeley, Berkeley, CA, USA

Paleontology provides a historical record to test the significance of modern reactions to climate change. A central challenge in interpreting recent, short-term changes in species distributions is setting them in the context of past climate change. For testing 1) whether changes are in fact climate-driven and 2) whether historical rates of range change exceed background rates. In recent surveys of Yosemite National Park’s mammalian fauna, three species in the genus Micros (voles) each exhibited a different response to climate change over the last 100 years. The upper range boundary of M. californicae moved 500 m upslope, the lower boundary of M. lonicus ascended 600 m, and M. montanus did not change. Here I use the fossil record to test the significance of these changes. While a rich paleontological record of Micros exists, resolving species-level changes has remained difficult due to the challenge of identifying fossil specimens (usually isolated teeth) to species. Using geometric morphometrics of tooth shape for identification, I track the presence of five Micros species across western North America throughout the Quaternary. This provides a high-resolution map of their reactions to past climate change, identification of the first fossil Micros oregoni and Micros townsendi, and the first Quaternary extra-limital records of Micros species in California. Five species demonstrate range retractions that reflect prehistoric climate shifts and document patterns that help sort the signal from the noise in recent range shifts. M. lonicus is today exhibiting similar response to climate warming as it did in the past. However, the historic shift is apparently exceeding past rates. The average range over the past century has been ~6 m/yr in Yosemite, whereas the rate approximated during Pleistocene warming is ~0.1–1.2 m/yr. These results suggest that climate change in the past cannot alone is already altering biogeographic patterns comparable to those of the end-Pleistocene warming. Overall, the use of quantitative, highly resolved morphological data provides a powerful tool to assess species responses to past environmental events.

Technical Session XVIII, Wednesday 2:00

**A SPECIES-LEVEL PHYLOGENETIC ANALYSIS OF TEMENTSPONDYLI (VERTEBRATA: CHOANATA)**

MCHUGH, Julia, University of Iowa, Iowa City, IA, USA

Tementspondyli was the most species-rich group of non-ammniote tetrapods during the late Paleozoic and early Mesozoic. They achieved a worldwide distribution early in their history and crossed two major mass extinction boundaries: the Permo-Triassic and Late Triassic. Previ- ous attempts to describe tementspodid evolutionary history have predominantly focused on the intrarelationships of subclades (e.g. Brachiopioidea, Dissorophoidea) or higher-level interrelationships amongst these subclades for either a portion or for the entire group. In doing so, exemplar taxa or composite taxa were used to streamline analyses. These methods are advantageous when the goal is a broad look at relationships between groups, but they cannot account for large areas of evolutionary history, minimize morphological complexity, and require specific assumptions of monophyly, all of which are disadvantageous when trying to reconstruct a comprehensive picture of the group’s evolution. Here, results are presented from a species-level phylogenetic analysis that is exhaustive in scope and does not rely on exemplar or composite taxa. A maximum parsimony analysis of 53 taxa coded for 295 characters supports the monophyly of a number of clades, including Eryposoida, Dissorophoidea, Brachyopioidea, Stereospodidae and Archegosauromorpha, but the monophyly of Eusiokia and Rhinosuchidae are called into question. These results have serious implications for the use of exemplar and composite taxa. These patterns are also corroborated with stratigraphic range data to illustrate ghost lineages and speciation events spanning the Late Permian and Early Triassic, with direct implications to the stress levels of terrestrial ecosystems at the Permo-Triassic boundary.

Poster Session IV, (Wednesday)

**THE POSTCRANIAL SKELETON OF EMBOLOTHIERUS (BRONTOTHERIIDAE) FROM THE MIDDLE AND LATE EOCENE OF CENTRAL ASIA**

MCLAUGHLIN, Benjamin, New York College of Osteopathic Medicine, Old Westbury, NY, USA; MICHBAHLER, Matthew, New York College of Osteopathic Medicine, Old Westbury, NY, USA; ELLISON, Mick, American Museum of Natural History, New York, NY, USA

In the 1920s, the American Museum of Natural History amassed a large collection of Eocene Brontotheriidae from Inner Mongolia, a family that had not previously been documented in Asia. Current hypotheses of bronotherio phylogeny are driven solely by craniodental data, largely because there is a dearth of literature on the postcranial of Asian bronotheres. The unstudied AMNH collection of Asian bronothere postcrania is an untapped resource for needed data. Here we describe, for the first time, postcranial elements representing a very large brontotherid from the middle Eocene Shara Murun Formation and late Eocene Baron Sog Formation of Inner Mongolia. The only bronothere identified (from a skull) in the Bar- on Sog unit is *Embolotherius andrewsi*. Giant postcranials from this unit that undoubtedly belong to *Embolotherius* include an atlas, a partial femur, several ulnae, patellae, and a large
assortment of manus and pes elements. Shara Murun deposits contained forearm, manus, and pes elements of a morphologically similar bronthotheriid, probably also representing *Embolotherium*. Rhinotitan, also common in the Shara Murun Formation, and known from articulated skeletons, can be distinguished from *Embolotherium* by its more slender limb bones and metapodials, its more elongate astragal and neck, and other features characteristic of a more cursorial animal. The postcranial skeleton of *Embolotherium* suggests a powerful, graviportal animal with close resemblance to the late Eocene North American bronthotheriid *Megacerops*. Remarkably, previous phylogenetic analyses, based on craniodental data, sug- gest that *Embolotherium* and *Megacerops* were distantly related genera, having evolved very large body size and exaggerated cranial appendages independently. However, the numerous derived postcranial similarities shared by these two taxa, and not seen in *Rhinotitan* or other bronthothere species, seem to support a different phylogenetic arrangement in which *Embo- lotherium* and *Megacerops* are more closely related. A possibly closer relationship between these two taxa, from separate continents, has important implications for North American-Asian faunal relationships during middle Eocene time.

**Poster Session IV, (Wednesday)**

**MORPHOMETRIC ANALYSES OF TITANOSAUR CAUDAL VERTEBRAE: IMPLICATIONS FOR NAMING “MALAGASY TAXON B”**

MCNULT, Kieran, University of Minnesota, Minneapolis, MN, USA; CURRY ROGERS, Kristina, Macalester College, St. Paul, MN, USA; RUDLOFF, Owen, Macalester College, St. Paul, MN, USA

Caudal vertebrae have played an important role in the identification of Malagasy titanosaurids since the first discoveries of prococial caudal caudal in Madagascar more than a century ago. Fieldwork in the Upper Cretaceous Maevaron Formation has since yielded more than 100 caudal vertebrae and vertebral fragments. Preliminary identifications recognized two separate morphotypes, one corresponding to the known morphology of *Rapetosaurus krausei* and the other thought to belong to the still unnamed “Malagasy Taxon B.” Here we present the first statistical support for the existence of two or more titanosaurids in the Maevaron Formation. To quantify vertebral shape, 3D landmarks and semi-landmarks were collected from the centra and neural spines of 85 titanosaur caudal vertebrae. Only posterior caudal vertebrae were represented by both morphotypes, so these were subjected to a generalized Procrustes analysis to superimpose all configurations within the same shape space; aligned coordinates were then used in multivariate statistical analyses. Principal components analysis confirms two distinct vertebral morphs corresponding to the preliminary morphological identifications. This was tested statistically using a non-parametric permutation test of the Procrustes distance between group means, which found significant differences between two morphotypes. Interestingly, despite morphological indications that all of these specimens were from posterior-most posi- tions among posterior caudal vertebrae, those attributed to “Malagasy Taxon B” were substan- tially more variable than those of *Rapetosaurus*. This was confirmed by a second permutation test based on difference in the morphometric equivalent of group variance: average Procrustes distance of all specimens in a group to the group mean. These results, along with new discover- ies of braincase and appendicular material, support the designation of at least two titanosaur taxa in the Maevaron Formation. They also highlight the fact that, unlike caudal vertebrae in *Rapetosaurus krausei*, posterior caudal vertebrae in the mysterious “Malagasy Taxon B” ex- hibit substantially greater morphological diversity.

**Technical Session XIII, Tuesday 3:00**

**CHANGES WITHIN CARNIVORE GUILDS FROM THE PLEISTOCENE AND HOLOCENE OF NORTH AMERICA**

MEACHEN-SAMUELS, Julie, National Evolutionary Synthesis Center, Durham, NC, USA

Guilds are made up of species within a community that perform similar ecological roles. Competition among guild members can bring about character displacement through morpho- logical changes or resource partitioning. Mammalian carnivore guilds partition their ecologi- cal niches by diet specialization, but also by body size or habitat separation. Here, I examine the niche partitioning that occurs in carnivore guilds from contemporary communities, and use these findings to examine patterns of guild structure and niche partitioning in carnivores from the early Holocene and Pleistocene of North America. Extant localities examined include: Serengeti of AFRICA, Yellowstone of the U.S., Kasha of India, and the Pantanal of South America. Fossil localities include: Rancho La Brea Tar Pits in California (40-9 Ka), Middle Butte Cave (~ 8 Ka) and Moonshiner Cave (~ 8 Ka) in Idaho. Morphological measurements of cranial, postcranial, and average species masses (or mass estimates) were gathered for each species. Analysis of variance (ANOVA) and linear regression were used to examine the degree of morphological separation between co-occurring carnivore species in extant and fossil sites. Additionally, species that are present in Pleistocene, early Holocene, and contemporary communities were compared using ANOVA to examine if their morphol- ogy has changed over time due to competition pressures or faunal turnover. Results show extant carnivore guilds display similar structures despite having distinct taxa. Additionally, within dietary categories, niches are not always separated by size, but more often are distin- guished by postcranial morphology, indicating habitat partitioning. In North American extant carnivore guilds display similar structures despite having distinct taxa. Additionally, smaller carnivores, such as badgers and bobcats showed no morphological differentiation between contemporary, early Holocene, and Pleistocene populations.

**Poster Session IV, (Wednesday)**

**MASS DEATH ASSEMBLAGES OF HYPERTRAGULUS CALCATUS (ARTIODACTYLA: RUMINANTIA)**

MEEHAN, TJ, Marquette University, Milwaukee, WI, USA

The extant Tragulidae is the most primitive living ruminant artiodactyl, and its sister group, the extinct Hypotragulidae of North America, is the most primitive ruminant family. A common species of the White River Group (latest Eocene-Early Oligocene), *Hypertragulus calcatus*, is known from a few blocks with many individuals. *Hypertragulus* is a bullet deer closely related with an arched back and gracile, sagittalaurial limbs, as in modern chevrotains. Three fossil blocks with more than 10 individuals each from the White River were studied for information on cause of death and accumulation mode. These blocks are monotypic with individuals that are partially articulated and associated; the bone surface is smooth with little to no desiccation cracking and exhibits no predatory or scavenging marks from insects or vertebrates.

A Carnegie Museum block specimen that had been mostly prepared has a right mandibular MNI of 32 and a right tibial MNI of 30. Other MNIs from skulls and limb elements, includ- ing carpals and tarsals, range from 12-24. Individuals are jumbled and tightly packed with small and large bones, indicating little to no transport. This block was collected and prepared decades ago, and unfortunately, there is little sedimentary and taphonomic information preserved. Except for one specimen, these individuals are all young adults. The third molar is erupting or erupted and exhibits no to little wear. Epiphyseal lines, such as in the distal femur, are distinct, or in some, the epiphysis has not fused to the shaft. Tooth morphology in specimens from the other two blocks indicate a range of adult ages. The high concentration and consistent taphonomy indicate mass death, but likely not predatory. The hypotragulid Hypotragulus of the White River is known from two blocks, but whether *Hypertragulus* used bur- rows is not known. The three monotypic blocks suggest that at least seasonally, *Hypertragu- lus calcatus* was social, while modern bullet deer are solitary. Few upper canines were preserved, but there is no indication of sexual dimorphism in tooth size (or in other skeletal morphology).

**Technical Session XV, Wednesday 9:15**

**HIGH RESOLUTION EXAMINATION OF THE ECOLOGY, EVOLUTION AND BIOGEOGRAPHY OF MARINE VERTEBRATES IN THE POST KT-EXTINCTION INTERVAL IN EASTERN TEXAS**

MENASCO-DAVIS, Lauren, Texas A&M University, College Station, TX, USA; STIDHAM, Thomas, Texas A&M University, College Station, TX, USA

The basal 5 meters of the Kincaid Formation exposed on the Brazos River preserves rocks from the first ~300,000 years of the Paleocene (P0-P1b foraminiferal zones). Intensive sevm demanded a thorough and complete history of the biological communities and their evolutionary history. Over 1,000 individual fishes were collected over the course of 1,000 hours in the field. A morphologically controlled, identified vertebrate specimens from ~30 taxa of sharks, bato, and teles (17 sharks, 4 bato, 9 teles). Using an apomorphy-based identification approach, approxi- mately 15 of those taxa are new undescribed species (9 sharks, 2 stingrays, and 4 fish) and include a new species of *Dasyatis* (represented by over 700 teeth of both sexes) that is the most common single taxon. The teles exhibit a mixture of aliform, percomorph, and amniiform taxa, and percomorph taxa are not the most diverse clade (as they are in the Paleocene). Only aliforms and possibly one species of *Enchodus* appears to have survived the end of the Cretaceous locally. The abundance of vertebrate specimens (and individual taxa) appears to correlate with the sequence stratigraphy (i.e. relative water depth). Marine vertebrate alpha diversity rebounds to Cretaceous levels within 200,000 years, and that fast recovery appears to be related to regional and possibly more widespread post-extinction dis- persal into Texas. That is demonstrated by the presence of *Phylodus paucikatus* and *Dasyatis variegatus* outside Texas beyond their Cretaceous limits in Montana. Cretaceous seas were domi- nated by lamniforms (e.g., *Squalicorax*), but that changed in the early Paleocene to small- bodied carcharhiniforms (triakids locally; 77% of all shark species). That taxonomic shift should reflect the change in marine vertebrate foodwebs with the loss of Cretaceous
top predators and the expansion of diversity at lower intermediate trophic levels (of much smaller body sizes). The Texas vertebrate fauna exhibits relatively low evenness similar to other early Paleocene faunas around the world. However, differences in taxonomic composition among Paleocene marine vertebrate faunas seem to indicate that survivorship increases with distance from the Chicxulub impact as observed in other marine and terrestrial taxa. 

Technical Session XVIII, Wednesday 3:45
WHEN IS AN ASTRAGALUS NOT AN ASTRAGALUS? TARSAL FUSION IN HYLONOMUS, THE EARLIEST KNOWN ANNIOTE
MEYER, Tarun, University of Calgary, Calgary, AB, Canada; ANDERSON, Jason , University of Calgary, Calgary, AB, Canada

A key synapomorphy of anniotes is the presence of an astragalus (fusion of three tarsals: intermedium, tibiale, and proximal centrale). Anniotes display a fused astragalus, but sutures indicating a multipartite origin have been described in several Palaeozoic sauropod taxa, in particular the captorhinids, where the composition has been interpreted as large, proximal intermedium and smaller, distal tibiale and proximal centrale. Interestingly, no cases of astragali demonstrating sutures have been reported for the synapsid or parareptile lineages. The tendency towards tarsal fusion has been documented in a number of tetrapod lineages in addition to anniotes, including gehyropodostegids and microsaurs; however, only in the microsaur Tiditanus can the astragali be shown to comprise the same three tarsals as anniotes. A variety of tarsal fusions have been described for diadectomorphs, including the progressive fusion of an anniote-style astragalus.

As the earliest known anniote, Hylonomus has the ability to provide insight into the early evolution of the anniote astragalus. Surprisingly, there have been conflicting reports in the literature regarding the nature of the astragalus in Hylonomus, including suture presence as well as suture absence. We re-examined the holotype specimen of Hylonomus and found clear evidence of sutures dividing the astragalus into three portions; interdigitation and surface detail confirm that these are sutures, not cracks. There are two large adjacent components and a single smaller, terminal component. However, the relative proportions of the contributing bones are different from those in captorhinids and most closely resemble the pattern described for the microsaur Tiditanus (large proximal intermedium and tibiale, and smaller distal centrale). We conclude that astragalus morphology and composition varies both between and within cotylosaur lineages, and this variation may influence assessments of the homology of fused tarsal complexes. The evolutionary history of the astragalus remains incompletely known; however, in light of the data presented here, it appears this history is more complex than previously thought.

Poster Session I, (Sunday)
COMPARISON OF TWO PLEOCENE (BLANCA) VERTEBRATE FOSSIL ASSEMBLAGES: PANACA LOCAL FAUNA (LINCOLN COUNTY, NEVADA) AND HAGERMAN LOCAL FAUNA (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

The Pliocene Epoch was a significant time in North America for intercontinental dispersal of mammals and climatic fluctuations. The Pliocene transitioned from a warmer to cooler climate, which influenced environmental changes from an open forest to grasslands in the continental mid-latitudes of North America. The Panaca local fauna within the Panaca Formation of southwestern Nevada and the Hagerman local fauna within the Glenns Ferry Formation of south central Idaho are inland mid-latitude terrestrial Pleocene fossil sites. The Hagerman fauna within the Hagerman Fossil Beds National Monument (HAF0) is well known and significant in its diversity, quantity, and quality, while the Panaca local fauna has been sporadically studied. The Panaca Formation in Nevada represents an excellent interval for the study of mammals found only at HAFO and diversification of cricetid rodents. Seasonal climates of both localities are probable, but the Panaca local fauna is characterized by a staggering diversity of shapes, inclinations, and associations. These findings reveal that a gradual and progressive change from the paleoaloid condition of an inclined preoperculum with a close association to the maxilla to a more advanced condition in holostean and teleost fishes is an oversimplification. For instance, there are numerous paleoaloid fishes with vertical preopercula. The preopercular bones of these fishes, and a subset of Paleozoic, Mesozoic, and Recent fishes, will be presented in order to discuss the diversity of preopercular conditions in actinopterygians. Results include summaries of the number, shape and inclination of preopercular bone(s), associations to the maxilla, suborbital and infraborital bones, and paths of sensory canals. The hypothesis regarding the evolution of the actinopterygian preoperculum will be critiqued by mapping the preopercular condition for various fishes onto previously published phylogenetic trees.

Poster Session II, (Monday)
REVISITING THE ACTINOPTERYGIAN PREOPERCULUM
MICKLE, Kathryn, Department of Ecology and Evolutionary Biology, Natural History Museum and Biodiversity Research Institute, University of Kansas, Lawrence, KS, USA

The preoperculum has been considered an important bone in the evolution of actinopterygian fishes. It has been proposed that there are different configurations of preopercular bones in paleoaloids, more advanced subholosteans, and holosteans. Paleoaloids are described as the most “primitive,” with a tight association between an inclined preopercular bone, maxilla, and suborbital, and it has been hypothesized that this tight association developed gradually, only allowing for a change in the jaw suspensorium, and in turn, feeding mechanisms. A problem with this hypothesis is that it has never been examined in a systematic fashion. Past publications dealing with the preopercular bone provide few examples of the condition of Paleozoic, Mesozoic, and Recent fishes and do not fully investigate the diversity of the preoperculum. The Pliocene transitioned from a warmer to cooler climate, and the Panaca local fauna has been examined to determine if the preoperculum is characterized by a staggeringly diverse array of shapes, inclinations, and associations. These findings reveal that there is a gradual and progressive change from the paleoaloid condition of an inclined preoperculum with a close association to the maxilla to a more advanced condition in holostean and teleost fishes in an oversimplification. For instance, there are numerous paleoaloid fishes with vertical preopercula. The preopercular bones of these fishes, and a subset of Paleozoic, Mesozoic, and Recent fishes, will be presented in order to discuss the diversity of preopercular conditions in actinopterygians. Results include summaries of the number, shape and inclination of preopercular bone(s), associations to the maxilla, suborbital and infraborital bones, and paths of sensory canals. The hypothesis regarding the evolution of the actinopterygian preoperculum will be critiqued by mapping the preopercular condition for various fishes onto previously published phylogenetic trees.

Poster Session I, (Sunday)
APPLICATIONS FOR PLEISTOCENE PALEONTOLOGY
MHLBACHLER, Matthew, New York College of Osteopathic Medicine, Old Westbury, NY, USA; BEATTY, Brian, New York College of Osteopathic Medicine, Old Westbury, NY, USA; CALDERA-SIU, Angela, New York College of Osteopathic Medicine, Old Westbury, NY, USA; CHAN, Doris, New York College of Osteopathic Medicine, Old Westbury, NY, USA; LEE, Richard, New York College of Osteopathic Medicine, Old Westbury, NY, USA

In dental microwear (DM) analyses of fossil taxa, DM features are categorized by size and shape, counted in a standard area at a standard magnification, and their average frequencies are commonly compared to data from extant taxa with known diets. DM features are generally categorized without explicitly defined size or shape criteria, and the data are often collected by multiple observers. For these reasons, observer bias is a potential source of error. We investigated the influence of observer bias by comparing DM data collected by 5 individuals from the identical set of digital images of molar wear surfaces from a variety of extant browsing and grazing ungulates. Photos were taken at 100x through a light microscope and DM features were identified and traced by each observer in identical zoarch plots. DM features were classified by each observer into standardized scratch-and-pit diameter categories. Three of the observers had no previous experience with DM and were required to work through a tutorial before beginning. None of the observers were aware of the species identity or diets of the specimens. Correlation coefficients of interobserver data were initially low and often insignificant. After undergoing an extended training session, in which all 5 observers were present, correlation coefficients improved significantly for DM features of all size- and shape-categories. However, the numbers of DM features of all categories counted in each photo significantly differed even after extended training. These results suggest that experienced observers may be able to consistently find relative differences between species, however the total number of DM features identified in each specimen can be heavily influenced by observer bias. Statistical comparisons of fossil and extant DM data are questionable when the data are collected by multiple observers. We caution investigators against comparing their data with other published data without considering observer bias. We further suggest that researchers adopt the practice of tracing or labeling DM features on photographs and making them available when the data are published so that observer bias can be evaluated.

Poster Session I, (Sunday)
ACTUALISTIC TAPHONOMY OF COLD AND TEMPERATE CLIMATES: APPLICATIONS FOR PLEISTOCENE PALEONTOLOGY
MOLVEO, Lauren, Penn State University Department of Geosciences, University Park, PA, USA

Abstract The field of actualistic taphonomy has an extensive body of well-established data for the analysis of paleontological and archaeological sites. Data include bone weathering patterns, carnivore bone damage, and bone accumulation and dispersal models in modern temperate and tropical climates. Climate can substantially affect taphonomic pathways; I am thus performing actualistic research in temperate cold climates which is relevant for Pleistocene paleontology and archaeology in North America and Eurasia. My research for this project focuses on decomposition, scavenging and dispersal of white tail deer carcasses in central Pennsylvania (PA). Scavengers include turkey vultures, American crows, coyotes, and various insects. This research began in January 2010 and continues to date. I am also

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studying an actualistic assemblage from the ecologically- and climatically-different Black Hills (South Dakota - SD). Mountain lions are among the scavengers here and absent in PA; bears are absent in SD but black bears are present in PA. Carcasses in SD include bison, mule and white tail deer, pronghorns and elk. Taxa in this study are analogous to many of those in the North American Pleistocene. Both identity of scavengers and order of access are significant in determining how a carcass is processed. Season of death affects the speed and nature of scavenging; insects are inactive in winter but may be the sole scavengers of spring- and summer-derived carcasses. Decomposition processes occur more slowly, or are suspended, in colder weather. In warmer weather, processes occur rapidly; a carcass may be consumed within days in summer, whereas a winter-derived carcass may remain essentially intact for months. Once scavenging commences, however, it will continue despite cold and snow. Snow over up to 13" deep does little to deter scavenging if scavengers had already discovered a carcass prior to burial. In contrast, even if turkey vultures or crows have begun consuming a carcass, insect infestation will curtail all other scavenging activities.

Poster Session III, (Tuesday)

PALEOENVIRONMENTAL RECONSTRUCTION OF BULUK, EARLY MIocene, KENya
MILLER, Ellen, Wake Forest University, Winston Salem, NC, USA; WOOD, Aaron, University of Michigan, Ann Arbor, MI, USA
Early Miocene deposits at Buluk, northern Kenya, contain an important record of mammalian evolution during the initial stages of East African rifting. Buluk is a well known site for primate evolution, as the locality yields remains of primitive Old World monkeys and apes. In addition, recent work at Buluk has documented the presence of several productive vertebrate aggregations, or bone beds, which both further characterize the mammalian fauna and also help refine the paleoenvironmental reconstruction of Buluk. The bone beds are matrix-supported conglomerates with vertebrate remains, occasional plant fragments, and reworked tuff and paleosol deposits. Collections from these bone beds include disarticulated elements of hominomorphs, homotheres, rhinoerotics, suoids, small artiodactyls, carnivores, creodonts, and primates (both cercopithecoid and hominoid). Preliminary work indicates that each bone bed represents a high magnitude fluvial discharge, perhaps implying seasonal, or longer term patterns in precipitation associated with changing topography during early stages of East African rifting. Isotopic analysis of large mammal dentitions is underway to detect potential seasonal patterns in stable isotope composition, testing this hypothesis inferred from the sedimentological record. Work at Buluk forms part of the Turkana Basin Institute’s larger initiative into the “Origin of Rift Valley Ecosystems” (ORVE), a research program comprising a number of paleontological projects sharing data to address larger, regional issues in mammalian, primate and human evolution. Studies at Buluk contribute to the goals of ORVE by providing: 1) a more comprehensive understanding of the effects of rifting on the distribution of Miocene mammalian and primate faunas; 2) better documentation of the transition from archaic to modern African animals; and 3) a more complete understanding of the origin and evolution of apes and catarrhine monkeys. Results from work at Buluk are important because tectonically-driven habitat fragmentation during the Miocene may be at the root of the evolution of modern primate and human forms.

Technical Session IX, Tuesday 11:15

SPATIAL DYNAMICS AND STRUCTURE OF THE NORTH AMERICAN PLEISTOCENE MEGAFAN FAUNAL EXTINCTION
MILLER, Joshua, Wright State University, Dayton, OH, USA; BAINH, Volker, Wright State University, Dayton, OH, USA
Changes in the geographic distributions of taxa prior to extinctions can provide insight into the mechanisms and velocities of those events. Here, we investigate the spatial structure of Pleistocene megafana for significant changes in the distributions of genera (and species of Mammutthus) across the contiguous United States immediately prior to their extinction. Analyses concentrate on genera with the most prolific record at the terminal Pleistocene (Nothrotheriops, Camelops, Equus, Mammut, Mammutthus). Stratigraphic and radiocarbon-dated occurrences of extinct genera are obtained from the Neotoma and Paleobiology Databases. Radiocarbon-dated occurrences defining the terminal Pleistocene are collected from the literature and vetted for temporal reliability. Occurrence data are divided into three periods; Early/Middle Pleistocene, Late Pleistocene, Terminal Pleistocene (TP: 12,000 - 10,000 radiocarbon years), and spatially standardized to remove geographic biases. We use Monte Carlo simulations to test the spatial distribution of genera in the TP relative to earlier periods, allowing differentiation of biological processes from sampling effects. Simulations develop null expectations for changes in range size (minimum convex polygons), location, and range overlap between taxa. Ecological Niche Models (MAXENT) provide a separate test of the ecological (environmental) significance of range divisions/overlap among taxa. Simulations show that many previously reported species range shifts leading to the TP are indistinguishable from changes in sampling. Large-scale spatial reorganizations at the TP are evident, however, particularly for species within Mammutthus and an abrupt, significant geographic differentiation between Mammutthus and Mammuth. Niche models support these ecological divisions. For many genera, spatial distributions at the terminal Pleistocene are not distinguishable from earlier times. While further work is required to test for finer-scale shifts in distribution, many non-Proboecidan taxa may not have had a significant geographic response prior to the TP; experiencing spatially-uniform extinction across baseline Pleistocene ranges.

Poster Session IV, (Wednesday)

SAMPLE ANALYSIS OF ARCHAEOETHERIUM (ARTIODACTYLA: ENTELODONTIDAE) FROM THE CONATA PICNIC GROUND “BIG PIG DIG”, BADLANDS NATIONAL PARK, SOUTH DAKOTA
MILLER, Matthew, South Dakota School of Mines and Technology, Rapid City, SD, USA
Cranial variation in members of Archaeotherium (Mammalia, Entelodontidae) has caused wide discrepancies in the diagnoses of many included species. Since 1993, thousands of associated elements of Archaeotherium have been excavated from the lower Scenic Member of the Conata Formation (Orellan North American Land Mammal Age) at the Conata Picnic Ground “Big Pig Dig” site in Badlands National Park, South Dakota. Better understanding of the variation in Archaeotherium from the Conata Picnic Ground, through principle component analysis (PCA), revealed new insights into the taxonomy of the genus. The specimens of Archaeotherium represent a sample population and were analyzed utilizing PCA and statistical analyses, and given ontogenetic stages based on tooth wear. Morphologic features previously thought to be taxonomically significant (shape and size of the subbullar process, and mandibular tubercles) are discussed and refuted to be of any taxonomic importance for Archaeotherium. Rugosity above the orbits and on the frontals is thought to be characteristic of "male" Archaeotherium and is absent in "female" specimens. Crania from the "Big Pig Dig" have been referred to Archaeotherium mortoni and Archaeotherium waneski. This analysis indicates the first instance of multiple species of Entelodonta from a single locality.

Technical Session VII, Monday 2:15

ONTOGENY AND PHYLOGENY IN PROCOLOPHONIDS - EVIDENCE FROM A NEW LEPTOLEPONTID FROM THE MIDDLE TRIASSIC OTTER SANDSTONE FORMATION OF SIDMOUTH DEVON
MILNER, Andrew, The Natural History Museum, London, United Kingdom; MILNER, Angela, The Natural History Museum, London, United Kingdom
A new procolophonid specimen raises the possibility that some characters used in phylogenetic analyses of the group may have changed during ontogeny. It comprises an isolated small skull and attached mandibles from the Middle Triassic Otter Sandstone Formation near Sidmouth, Devon, England. The specimen was partly prepared and then studied using X-ray microCT imaging. The taxon appears generally similar to the later Leptolepontus from the Lossiemouth Sandstone Formation of Scotland. The presence of quadratojugal and supratemporal spikes, the massive first dentary incisor and the absence of maxillary depression, all suggest a derived leptolepontine. However it is more primitive than all other leptopleuronines in the possession of rows of vomerine teeth and the absence of the jugal spikes found in some derived taxa. The small size of the specimen, together with the open sutures and absence of jugal spikes suggest that it may be a juvenile, although the supratemporal and quadratojugal spike array is fully developed. The presence of vomerine teeth may thus also be a juvenile character. The absence of the back of the skull, combined with the mandibles clamped in place, suggests that it may have been bitten off and rejected during predation.

Poster Session IV, (Wednesday)

NEW EARLY EOCENE PERISSODACTYL FAUNAS FROM THE CONTINENTAL UPPER GHAZIJI FORMATION OF BALOCHISTAN, PAKISTAN
MISSAIAEN, Pieter, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA; GUNNELL, Gregg, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA; GINGERICH, Philip, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA
The phylogenetic and biogeographic origins of the mammalian order Perissodactyla remain elusive despite a long history of research. Many studies have focused on Asia, with at least some recent hypotheses suggesting a prominent role for poorly known faunas of the Indian subcontinent. Two or possibly three early Eocene perissodactyl faunas are known from the upper Ghazij Formation in Balochistan (Pakistan), and these include both dental and post-cranial remains. The most abundant are small forms, including 108 dental specimens from a single locality, Gandhera Quarry, that belong to two closely similar species of Litolophusidae. Among larger taxa, the most common elements represent a puzzling group of bunodont perissodactyls that display some similarities to both the supposed anthropocinid Nakisia from the marginal-marine middle Gliace Formation and to the enigmatic middle Eocene perissodactyl Hallensia from Europe. Bontothrinidae are represented by three species in two genera that are morphologically similar to primitive forms known from the North American middle Eocene (Bridgejar. A Lophialetes-like ceratotherom and Litolophus-like chalicotheria are rare elements in the faunal assemblage, but they do indicate affinities with middle Eocene Asian assemblages. Ghazij mammals, together with those from Vistan (India), are currently the only early Eocene taxa from the Indian Subcontinent. With the possible exception of the Cambaytheriidae described from Vistan, the Ghazij material represents the oldest known perissodactyls from this region. Taken as a whole, the new Ghazij perissodactyls represent a broad taxonomic diversity, and further study promises to increase our understanding of perissodactyl phylogeny. Ghazij perissodactyls clearly suggest faunal exchange between the Indian subcontinent and most or all of the northern continents, and they thus have biogeographic importance as well.
Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

THE FUNCTION AND EVOLUTION OF CANALS IN THE TEETH OF THE TRIASSIC ARCHOSAURIFORM UATCHITODON
MITCHELL, Jonathan, Appalachian State University, Boone, NC, USA

A rash of recent discoveries has revolutionized our understanding of the evolution of oral toxins, showing that these complex biological systems are far more widespread than previously appreciated. Despite this increase in research, the driving forces behind the evolution of such costly systems are still poorly understood. I report here on a detailed analysis of the venom duct system of Uatchitodon, known only from the Upper Triassic of Virginia, Arizona, and North Carolina, with comments and comparisons on the variation seen in tooth shape between the three sites from which it is known, and rigorous statistical analyses of the coordinated morphological characters within the teeth from the Moncure, North Carolina locality. The new material from North Carolina allowed the confirmation of three autapomorphies of the genus (teeth that are three times taller than wide, compound serrations, and a median fulcrum on the lingual and labial surfaces) that support the previously suggested assignment of the Arizona specimens to the genus Uatchitodon but not to the species Uatchitodon kroekleri. The different hypotheses for the origin and function of the canals in Uatchitodon and several other taxa were rigorously evaluated, and several explanations (wear, developmental, and mechanical) for the canals in Uatchitodon were rejected, leaving venom-conduction as the most likely hypothesis. A methodology was established to quantify relative tooth position in the jaw based on the angle of the canine, and this measure was used to reject a positional explanation (N: 20, R^2 adj: 8.7%, p = 0.79). Further, a model was created to predict total tooth size in Uatchitodon from fragmentary teeth and used this to reject an ontogenetic/developmental (N: 25, R^2 adj: 9.0%, p = 0.140) explanation for the observed canal shape variation. The only remaining hypotheses are thus regional differentiation or evolutionary adaptation, though qualitative evidence suggests regional differentiation should be rejected. As such, I propose that the morphotypes of Uatchitodon represent a good model for testing hypotheses about the evolution of venom delivery systems in amniotes.

Technical Session XV, Wednesday 11:45

MICRO-CT SCANNING TECHNOLOGY REVEALS DEVELOPMENT OF DIPLOSPONDYLID IN AMIA CALVA
MIYASHITA, Tetsuto, University of Alberta, Edmonton, AB, Canada; SNIVELY, Eric, Ohio University, Athens, OH, USA; MURRAY, Alison, University of Alberta, Edmonton, AB, Canada

Amia calva is a modern representative of largely extinct fishes that have two centra per vertebral segment (=diplospondylid) in the posterior part of the trunk. Diplospondylid is also prominent among basal tetrapods, and developmental understanding of this morphologically enlighten the origins of tetrapod lineages that independently achieved a monospondyloous axial column. We used a Micro-CT (CT–X-ray computer tomography) scanner to image skeletogenesis of Amia. The CT technique provides the following advantages that complement classic staining methods: 1) 3D data for purposes not restricted to the detection of a single tissue type; 2) slice-by-slice digital imaging as a non-destructive alternative to histological sectioning; and 3) quantitative comparison of tissue densities. In Amia, a morphological identity of the pre- and postcentra suggests that morphogenesis of individual centra is independent from the axial patterning. Therefore, this is not a homologous condition with basal tetrapods, in which vertebral morphogenesis requires information from the axial patterning. The pre- and postcentra are already separate at the initial stage of ossification. The vertebral centra form from the dorsal and ventral centres that are eventually connected by the chordacentral layer. We hypothesize that the diplospondyly of Amia arises from delayed resegmentation of the sclerotic elements. Vertebrate axial morphogenesis undergoes resegmentation, during which the posterior half of one sclerotome and the anterior half of the next join to make a vertebral segment. Ephrin (eph) establishes the polarization within a somite and promotes the epithelial boundary between the sclerotomal halves. Therefore, prolonged expression of eph may delay resegmentation with respect to vertebral skeletogenesis, and each ossification centres in an isolated sclerotome half would take on the morphology of a centrum. A further test would be to stain the motor neurons, which are morphologically marked for eph-mediated somite polarization, and to line this up with the clear-stained vertebral centrum. A further test would be to stain the motor neurons, which are morphologically marked for eph-mediated somite polarization, and to line this up with the clear-stained vertebral centrum.

Technical Session XVII, Wednesday 4:00

LATE CRETACEOUS PALEENVIRONMENTS OF THE GOBI DESERT: RECONSTRUCTIONS FROM STABLE ISOTOPE DATA OF DINOSAUR FOSSILS
MONTANARI, Shaena, American Museum of Natural History, New York, NY, USA; NORELL, Mark, American Museum of Natural History, New York, NY, USA

Lithological descriptions indicate that the depositional environment of the Late Cretaceous Djadokhta Formation of the Gobi Desert of Mongolia was a sparsely vegetated, semi-arid dune field. The relatively structureless red sandstones of this formation have yielded a high diversity of exquisitely preserved Cretaceous reptiles (including dinosaurs) and mammals. To date, the remains of most Mesozoic vertebrates, especially dinosaurs, have not been analyzed using oxygen and carbon stable isotopes, despite the fact that this method is commonly used to help determine the paleoecosystems of Cenozoic mammals. To begin remedying this deficiency, we analyze carbon and oxygen isotopes (±13C and ±18O) of dinosaur tooth enamel and eggshell, composed of biopatite and calcium carbonate respectively, from the Djadokhta Formation. Specifically, we analyze eggshells of predominantly herbivorous oviraptors, including eggs associated with skeletal specimens of Citipati osmolskii, and the teeth of ubiquitous herbivorous dinosaurs such as Protoceratops andrewsi. Carbon isotope values provide information about the local vegetation structure through diet (plant consumption), while oxygen isotope values indicate the characteristics of the dinosauers’ drinking water sources, which reflect regional precipitation and climate. Statistical comparisons of the isotope ratios between different types of material, such as tooth dentine, tooth enamel, bone, and eggshell, along with cathodoluminescence analysis of dinosaur eggshell are used to demonstrate that primary isotopic data are preserved in these samples and that diagenesis has not overwhelmed the original isotopic signals. Carbon isotope values indicate that the dinosaurs were subsisting on plants that fall within the ±13C range of modern C, plants and drinking from pools with highly evaporated water, both of which are potential indicators of a semiarid climate.

Technical Session XII, Tuesday 2:15

A NEW BAURUSCHID (CROCODILOIDFORMES, SERRACOSUCHIA) FROM THE BAURU GROUP, LATE CRETACEOUS OF MINAS GERAIS, BRAZIL
MONTEFELTO, Felipe, Universidade de Sao Paulo, Ribeirao Preto, Brazil; LANGER, Max, Universidade de Sao Paulo, Ribeirao Preto, Brazil
Baurusuchids are deep-snouted crocodyliforms typical of the South American continental Late Cretaceous. They are traditionally included in Sebecosuchia, a group with controversial composition and phylogenetic relations. This leads to ambiguity in the establishment of their temporal and geographic ranges, hampering evolutionary inferences. The new baurusuchid reported here was collected near the town of Campina Verde in Gerais, Brazil, from sandstone deposits that may be assigned to the Vale do Rio do Peixe Formation. This stratigraphic unity corresponds to most of the Adamantina Formation in more traditional subdivisions of the Bauru Group, which has been alternatively dated as Turonian-Santonian or Campanian-Maastrichtian. Among other possibly associated specimens, the material comprises a nearly complete skull, lacking only the premaxillary portion of the rostrum. It can be assigned to Baurusuchidae based on traditionally recognized traits of the group, i.e.: deep and laterally compressed rostrum, reduced maxillary dental formula, and ziphodont dentition (teeth strongly compressed laterally, with finely serrated mesial and distal carinae), as well as on putative synapomorphies such as, a median crest in the posterior portion of frontal, and a median approximation of the prefrontals, a distinct depression on lateral surface of the quadrate body, and the existence of a median depression on the palatine flanked by rows of foramina. These shared traits correlate the new taxon to forms such as Baurusuchus pachecoi, B. salgadoensis, Stratiotostachys marxehchi, and Margosuchus australis. In addition, the skull exhibits a combination of features not previously recognized among sebecosuchians, including a depression on the anterior portion of frontal, a foramen between the palpebrals, the ectopterygoid reaching the posterior margin of the pterygoid wings, one ventral pterygoid fenestra, and two ventral pterygoid depressions. Finally, a remarkable autopomorphy (a deep depression on the dorsal surface of the pterygoid wings) justifies the referral of the skull to a new species of Sebecosuchia, enlarging the available morphological data for this group of Crocodyliformes, the understanding of which has been considered to suffer from the paucity of well preserved fossil material.

Poster Session III, (Tuesday)

ASSESSING THE CHARACTERISTICS DEFINING THE TAPHONOMIC MODE OF VERTEBRATE FOSSIL ASSEMBLAGES USING ORDITION ANALYSIS

MOORE, Jason, Texas A&M University, Dept. of Geology and Geophysics, College Station, TX, USA; KRUNENACKER, L. J., Brigham Young University, Department of Geological Sciences, Provo, UT, USA; VARRICCHIO, David, Montana State University, Department of Earth Sciences, Bozeman, MT, USA

A taphonomic mode has been defined as a recurring pattern of preservation of organic remains in a particular sedimentary context, accompanied by characteristic taphonomic features, produced by the sum total of the taphonomic processes acting on a particular fossil assemblage. By examining the suites of taphonomic characteristics shared by all fossils preserved in assemblages from a range of different sedimentary contexts, it is possible to identify which, if any, taphonomic signatures are characteristic of those sedimentary contexts. With this information it becomes possible to test whether the concept of taphonomic modes can be applied to vertebrate fossil assemblages, or whether the taphonomic histories of each fossil assemblage are so unique that every assemblage must be treated as a separate taphonomic entity. Using non-metric multidimensional scaling (NMDS) ordination of taphonomic characteristics from five samples drawn from the Scenic Member of the Brule Formation, the Waylan, Blackleaf and Judith River Formations, it is possible to show that the assemblages that were preserved in point-bar or other channel deposits do show a different taphonomic signature to the assemblages deposited on floodplains. Much of this difference, however, is attributable to the differing size of the taxa comprising the assemblage, a characteristic that is at least partially a product of ecological rather than preservational factors. In addition, despite potential variation in palaeocology and development, the ranges of taphonomic characteristics shown by all of the floodplain assemblages are very similar.

Technical Session XVI, Wednesday 3:45

SACRAL FUSION IN MODERN AND FOSSIL CETACEA

MORAN, Meghan, NEOCOM, Roorsttown, OH, USA; TWEISSEN, J.G.M., NEOCOM, Roorsttown, OH, USA; BAIPAL, Sunil, University of Roorkee, Uttar Pradesh, India

The functional morphology and vertebral fusion pattern of the mammalian sacrum changed during the evolution of marine mammals from land mammals. We use paleontological and molecular data to analyze the morphological and genetic changes in the evolution of the cetacean sacral region in fossil and modern cetaceans. The sacrum in land mammals plays a major functional role in anchoring the hindlimb to the vertebral column. Cetaceans lack the functional hindlimb, lack articulation between the pelvis and the vertebral column, and the sacrum in land mammals has a functional role in anchoring the hindlimb to the vertebral column. Paleontological evidence for the evolution of the cetacean cladogram: Pakicetus, Ambulocetus, and Kutchicetus. In basalsaurids, the sacrum consists of a single vertebra lacking a bony connection to the pelvis. In some remingtonocetids and proelodonts, sacra with fewer vertebrae occur; and with auricular surfaces placed laterally, far from the centrum. Some modern cetacean species, such as Stenella attenuata (pantropical spotted dolphin), at fetal stage 21/22, exhibit larger vertebral ossification centers adjacent to the pelvis in the spinous processes and centra. This vertebral ossification pattern is continued through fetal stage 23. This suggests that the molecular signals responsible for forming the sacrum are still present in the modern cetacean vertebrae, advancing the ossification in the sacral region, without ever developing a sacrum. The gene expression responsible for sacral development can be identified using molecular techniques, such as immunohistochemistry, on modern cetacean vertebral samples. Combining paleontological, embryological, developmental, and anatomical evidence can greatly improve our understanding of functional pattern and process in whale evolution.

Technical Session XVII, Wednesday 3:30

PRELIMINARY DETRITAL ZIRCON AGES FOR THREE STRATIGRAPHIC UNITS OF THE CEDAR MOUNTAIN FORMATION AND STATISTICAL ANALYSES OF ITS FAUNAS

MORI, Hirotsugu, Brigham Young University, Provo, UT, USA; BRITT, Brooks, Brigham Young University, Provo, UT, USA

The Cedar Mountain Formation (CMF) spans some 25 Ma and contains a diverse record of Early Cretaceous dinosaurs that records a shift from a North American/European fauna to an Asian influenced fauna. Studies of the formation’s faunas, however, are hindered, in part, because the stratigraphy and geochronology are in the early stages of development. The CMF has been parcelled into five members. The basal members (Buckhorn Conglomerate, Yellow Cat and Poisson Strip Sandstone) represent different facies of a single depositional system, which is overlain by a middle member (Ruby Ranch), and an upper member (the Mussentucht). To help resolve correlation problems LA-ICP-MS detrital zircon (DZ) ages were obtained. Ages indicate basal strata in eastern Utah are no older than 124 to 122 Ma (early Aptian) and contain Ushdraptor, Fulacarias, Gastonia and diverse sauropods. Preliminary data suggest the Ruby Ranch Mbr. with a sparse fauna that includes a brachiosaurid (e.g. Long Walk Quarry) ranges from ~116-112 Ma (early-mid Albian). The Mussentucht fauna is diverse and includes, in part, Abydosaurus, Eolambia, and large ankylosaurs (e.g., Cedarpelorus & Peloroplites). The basal Mussentucht is no older than 104.5 Ma (late Albian) and the upper Mussentucht dates to 97 Ma (early Cenomanian) or younger based on DZ and 40Ar/39Ar dates. Faunas of each member were analyzed by multivariate analyses utilizing Simpson and Raup-Crick similarity indices and pair-group moving algorithms resulting in the recovery of only two faunas—a basal fauna and a Ruby Ranch-Mussentucht fauna. These faunas were compared with coeval faunas from North America, Europe and Asia as well as the Morrison Fm. Results indicate the basal CMF fauna shares a weak link with the Morrison and corroborates long-standing hypotheses that the Yellow Cat fauna has European ties and the Mussentucht fauna has ties with other North American faunas and Asia. The Yellow Cat equivalent European fauna is characterized by Spinosaursaure and Polacanthidae, while the Mussentucht-North America equivalent Asian fauna is characterized by Tyrannosauridae, Troodontidae, Ornithomimosaurus, Nodosauridae, Ankylosauridae, and Ceratopidae.

Technical Session XI, Tuesday 3:15

EXPERIMENTAL DIAGENESIS OF BONE: IMPLICATIONS FOR RARE EARTH ELEMENT UPTAKE AND STABILITY

MOSES, Randolph, South Dakota School of Mines and Technology, Museum of Geology, Rapid City, SD, USA

Geochemical taphonomy of vertebrate fossils is a growing field in the disciplines of geology and paleontology. Proper experimental characterization of the early stages of fossilization and diagenesis is required to make accurate interpretations when studying fossilized vertebrate remains. The primary goal of this research was to characterize the early fossilization process with respect to rare earth element (REE) uptake and stability in bioapatite. To investigate the early fossilization of buried bone, an 18-month, controlled taphonomic experiment was conducted. Sections of Bos taurus femora were prepared and processed into experimental reactors (32 oz. sealable jars) containing artificial soil and buffered to a range of pH conditions. REE chemistry of bioapatite samples at the termination of the experiment were compared to initial conditions so that interpretations could be determined regarding uptake rates and stability of REE in bioapatite samples. Results suggest that REE concentrations in

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fossil bone are not stable if it is subjected to a new diagenetic environment. However, the primary REE signatures and their usefulness as taphonomic proxies may be retained. The pH conditions of the sediment pore water upon immediate burial have a greater influence on the REE concentrations and signatures than do the pH conditions at the end of the experiment, indicating that the initial conditions fractionated and controlled the availability of REE and the interactions between bone and the burial microcosm for the duration of the experiment. Noticeable elevation in REE concentrations in fresh bioapatite samples occurred between the 6th and 9th months of the experiment, coinciding with the diminishment of obvious microbial activity and the beginning of slow and steady increases in pH. This study demonstrates the importance of experimental studies in geochemical taphonomy and has important implications for interpretations utilizing the geochemistry of bioapatite.

Technical Session I, Sunday 8:45

PHYLOGENETIC BIAS IN FORM-FUNCTION RELATIONSHIPS AND ITS IMPLICATION TO THE FREQUENCY OF NOCTURNAL DINOSAURS

MOTANI, Ryosuke, University of California, Davis, Davis, CA, USA; SCHMIDTZ, Lars, University of California, Davis, Davis, CA, USA

Phylogeny is deeply pertinent to comparative biology because common ancestor mandates that characters in sister species covary at least partly. This violates the regular statistical assumption that data points are independent of each other, requiring bias removal using methods such as Phylogenetically Independent Contrasts or Phylogenetic Generalized Least Squares. Functional morphologists often assume that functional characters are devoid of phylogenetic bias because the morphology of such characters is strongly governed by biological 'requirements' to perform functions. We tested this hypothesis by using the relationship between eye morphology and Diel Activity Patterns (DAP, such as diurnal versus nocturnal) in amniotes. It is known that ocular morphology reflects the typical light level of the animal. We previously found that a tight correlation between the two allowed discrimination of DAP based on ocular dimensions of amniote. Soft tissue dimensions in particular revealed a very high discrimination success rate, suggesting an unusually tight form-function correlation.

We devised a phylogenetically informed discriminant analysis and measured the strength of phylogenetic bias using Pagel's . Results suggest that a small degree of phylogenetic bias exists in this form-function relationship. Soft-tissue dimensions exhibited the highest correlation with DAP when 6% of phylogenetic bias expected from Brownian motion was removed. The value for hard-tissue data was 10%, indicating a slightly stronger bias. Given that even the soft-tissue data had phylogenetic bias, the hypothesis was rejected. We further examined how much effect such a small degree of phylogenetic bias may have on discrimination of DAP. Using the hard tissue data, we found that discrimination success rate did not improve when phylogenetic bias was removed but the membership of each functional category in the resulting classification changed. This affected our inference of DAP in fossil archosaurs. Most significantly, the number of nocturnal dinosaurs increased from one to eight. It now appears that it was not uncommon for dinosaurs to utilize the nocturnal niche.

Technical Session IX, Tuesday 10:45

EARLY HOLOCENE FAUNA FROM A NEW SUBFOSSIL SITE:
CHRISTMAS RIVER, SOUTHCENTRAL MADAGASCAR

MULDOON, Kathleen, Dartmouth Medical School, Hanover, NH, USA; RASOAMARANAMA, Armand, Université d’Antananarivo, Antananarivo, Madagascar; ARONSON, Adam, Stony Brook University, Stony Brook, NY, USA; SIMONS, Elwyn, Duke University, Durham, NC, USA; WRIGHT, Patricia, Stony Brook University, Stony Brook, NY, USA

The subfossil record of Madagascar demonstrates that several extant species currently restricted to humid forests once had more widespread geographic distributions. An east–west distance effect in extant mammal distributions has likewise been interpreted as evidence that faunal exchange routes once crossed the southern portion of the Central Highlands, although no subfossil localities have previously been known from this region of the island. We report on faunal remains recovered during recent exploration at Christmas River, south-central Madagascar. Christmas River is the only subfossil locality known from Madagascar’s south-central plateau. All fauna recovered from this locality are therefore first known regional occurrences. Christmas River is also unique among previously known subfossil localities because it offers stratigraphic resolution. The deepest stratigraphic layer reached was a grey-green clay containing the bones of several extinct taxa dated to approximately 10 thousand (kyr) B.P., including crocodiles, tortoises, the elephant bird 
Aepyornis
, and abundant remains of the dwarf hippopotamus, 
Hippopotamus lemerlei
, a subfossil species previously recovered almost exclusively from coastal areas in eastern and western Madagascar. The extinct lemur 
Megaladapis
 was recovered from lower levels, but did not have enough collagen to produce an accurate date using radiocarbon methods. The presence of 
H. lemerlei
 and forest-adapted 
Megaladapis
 sp. species at Christmas River supports the hypothesis that forest once extended across the Central Highlands towards the west. It has been hypothesized that this corridor was fragmented by shifts in vegetation associated with climatic change, but given that much of the natural habitat across this zone no longer exists, it is difficult to reconstruct its former extent. The faunal material from Christmas River thus provides a remarkable opportunity for deciphering ecological changes that have taken place in south-central Madagascar during the Holocene.

Poster Session IV, (Wednesday)

NEW FUNCTIONAL SIGNIFICANCE OF THE PREDENTARY BONE IN HADROSAUROID MASTICATION

NABAVIZADEH, Ali, Johns Hopkins University School of Medicine, Center for Functional Anatomy and Evolution, Baltimore, MD, USA

The predentary is a single bone found in all ornithischian dinosaurs. Located anterior to the paired dentary bones of the mandible, it occludes with the premaxilla (or rostral bone in ceratopsians). Although universally accepted that the predentary was used like the lower incisor in herbivorous mammals in nipping vegetation before processing it, its absence in fossil and extant herbivorous mammals and many other fossil herbivores (including sauropod-morphs) indicates that we have yet to fully understand the functional significance of this element. The articular surfaces between the predentary and dentary and other mandibular elements as well as tooth wear orientation under light microscopy were examined in various hadrosaurids. Widened expansions and bifurcated processes on the predentary as well as an anterolateral flange of the dentary, clapping junction with the dentary (or between the dentaries themselves) allow mobility at this junction. A distinct medial curvature of the anterior portion of the dentary, medially recurved coronoid processes, and ball-and-socket articulation between the quadrate and mandible suggest a rotating surface and range of movement with cartilage and/or ligaments at the predentary-dentary junction, which in turn allow medial torsion or rotation of both dentary bones independent of the predentary. Two different orientations of tooth wear on the serrated edges and occlusal surfaces suggest both propalinal jaw movement to shear vegetation initially and a bolt-cutter-like medial rotation of the dentaries against the maxilla. This would maneuver the vegetation into the oral cavity independently on both sides for more efficient processing. To simulate this mechanism, casts of 
Parasaurolophus
 tooth batteries were manipulated to recreate this motion using a cedar branch as modeled food. This showed positive results in simultaneously shearing bar and plhoem, much like a circular saw blade, as well as cutting the needles and manipulating them into the mouth. Predentary evolution, at least in hadrosaurids, is likely linked to selection for more efficient oral processing.

Technical Session III, Sunday 3:15

NEW PRIMATES (OMOMYIDEA) FROM THE GREAT DIVIDE BASIN, WYOMING

NACHIMAN, Brett, The University of Texas at Austin, Austin, TX, USA; BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, USA; ANEMONE, Robert, Western Michigan University, Kalamazoo, MI, USA

Recent fieldwork by a team of paleontologists and geologists working in Eocene deposits of the Great Divide Basin (GDB), Wyoming, revealed an exceptional new locality preserving a large and diverse mammalian fauna. This new locality (WMU-VP-2009-01) preserves a rich primate assemblage that consists of more than 30 jaws and numerous isolated teeth. Taphonomically, the locality is unique in the GDB. The vast majority of GDB localities are comprised of isolated teeth and fragmentary jaws, with the presence of small-bodied mammals being rare. This locality, in contrast, is dominated by small-bodied mammalian fossils and the preservation quality is excellent, with most of the jaws preserving 3-5 teeth. Geologic study of the locality suggests rapid deposition in a high-energy flood environment. In addition to the differences in taphonomy, there are also differences in faunal composition. WMU-VP-2009-01 is quite different from other Wasatchian localities in the GDB that the primate fauna is not dominated by adapids. Though one species ofadaptispresent (Caninus cf. mckennai) the overwhelming majority of the primate fossils are omomyids. Taxonomic study of the omomyid fossils recovered from WMU-VP-2009-01 has identified three distinct species of omnomyid. The first of these is a primitive, possibly new species of 
Anomonyxis
 (n=4). The second species is similar to 
Teilhardina
 (n=9), though it shows some intriguing similarities to the washakini. The third, 
Tetoniops
 sp. (n=19), closely resembles Stage 2 of the proposed anagenetic 
Tetoniops-Pseudotetoniops transition. Placement of the 
Tetoniops specimens within Stage 2 is an important biostratigraphic marker for this assemblage. In the Bighorn Basin, located to the NE of our study area, Stage 2 of the 
Tetoniops-Pseudotetoniops transition is located in the lower part of Wa-4.

Poster Session I, (Sunday)

FOSSIL VERTEBRATES FROM THE UPPER CRETACEOUS HARTLAND SHALE IN SOUTHEASTERN COLORADO

NAGRODSKI, Matt, DePaul University, Chicago, IL, USA; SHIMADA, Kenshu , DePaul University, Chicago, IL, USA; SCHUMACHER, Bruce, USDA Forest Service, La Junta, CO, USA

The Hartland Shale Member of the Greenhorn Formation is a sedimentary rock unit that was deposited under the middle of the Western Interior Seaway in North America approximately 94.3 Ma (Late Cretaceous: middle Late Cenomanian). Fossiliferous rock samples were collected from the Hartland Shale in southeastern Colorado in order to analyze the taphonomic composition of its vertebrate fauna. Vertebrate remains were extracted through acid treatment of rock samples. Twenty-six marine vertebrate taxa are identified including chondrichthyan, osteichthyan, and reptilian taxa. Chondrichthyans are represented by eight species: 
Psychodas anonymus
, 
Squalicorax curvatus
, 
S. falcatus
, 
Carcharias saskatchewanensis
, 
Aechaeolamna kopingeriensis
, 
Cretosyrhina mantelli
, 
Cretomanta canadensis
, and 
Rhinobatos sp.
. Osteichthyan fishes consists of 17 taxa, including 
Micropycnodon kansae
, 
Palaeobalistum sp.
, 
Protosphyraena sp.
, 
Pliothiodae indet., 
Eloposis sp.
, and 
Pachyrhizodus minimus
.
Preparers’ Session, Monday 9:45

ADDRESSING A CRITICAL NEED WITHIN THE COLLECTIONS AT HAGERMAN FOSSIL BEDS NATIONAL MONUMENT: REFINED AND IMPROVED TECHNIQUES AND MATERIALS FOR THE PRODUCTION OF MULTI-SIZE, CLAM SHELL SPECIMEN CRADLES

Nelsen, Thomas, Hagerman Fossil Beds National Monument, Hagerman, ID, USA; Grasso, Jennifer, Hagerman Fossil Beds National Monument, Hagerman, ID, USA; Haulton, Kenneth, Hagerman Fossil Beds National Monument, Hagerman, ID, USA; Gensler, Philip, Hagerman Fossil Beds National Monument, Hagerman, ID, USA

Hagerman Fossil Beds National Monument (HAFO) in southern Idaho contains the world’s richest PA sequence ofestival ages fossil deposits yet discovered. Since the monument was established in 1988 the museum collections have grown to well over 50,000 paleobiological specimens. Many of the larger specimens represent several hundred skeletal elements belonging to the extinct horse, Equus simplicidens. Though the preparation backlog of this material is far from being complete a large number of cranial and postcranial elements are prepared and stored in museum cabinets. A critical need in regards to the storage of collections identified by the Chief Preparator and the Curator at HAFO is that many specimens are stored on standard ¼” thick ethafoam drawer liners most requiring additional support for long term preservation and protection. A considerable number of specimens, primarily cranial and vertebral material, are exhibiting deterioration and breakage due to stress from inadequate support. A very large scale project was designed and put into action to address this critical need. The goal of this project was to not only provide adequate support and protection for the specimens, but also to allow the specimens to be viewed from all sides to facilitate research and exhibition, without removing the specimen from its cradle. This project started with a unique, clam-shell cradle design developed previously by myself and others. The design was modified and refined to accommodate the needs of the HAFO specimens. By utilizing different materials and procedures, while combining technique changes, we improved the design, reduced materials, and reduced processes while in turn increasing production rates. The end result is a refined design that provides an ultra strong, lightweight housing that protects fossils, allows for easy access, is suitable for transportation and is an aesthetically acceptable option for exhibition. The presentation will focus on the design and production of the specimen cradles with a strong emphasis on specific materials and methodology. This will be a step by step coverage from start to finish utilizing in process photos along with text.

Technical Session X, Tuesday 10:30

A STEM FROGMOUTH (AVES: PODARGIFORMES) FROM THE EARLY EOCENE GREEN RIVER FORMATION AND THE EARLY DIVERSIFICATION OF STROSIRES

Nesbitt, Sterling, University of Texas at Austin, Austin, TX, USA; Ksepka, Daniel, North Carolina State University, Raleigh, NC, USA; Clarke, Julia, University of Texas at Austin, Austin, TX, USA

The early Eocene Green River Formation avifauna preserves the earliest unambiguous members of many extant avian subclades. Here, we present the second specimen of the enigmatic neovarian bird Flaviornivores avitus platyrhamphus, a large-headed and short-footed taxon from Fossil Lake near Kemmerer, Wyoming. Although the species has been previously considered of uncertain affinities in Nouchovia, the new specimen is shown to share the derived presence of a large, rounded mandible, wide, dorsoventrally compressed beak, a completely ossified palate, and dorsally projected nares with extant Podargidae (frogmouths). The systematic position of *F. platyrhamphus*, was evaluated in a parsimony-based combined phylogenetic analysis using morphology (osteology and soft tissue) and molecular sequence data (cytochrome b, c-enzyme c3, and RAG-1) and including species of Steatornithidae, Podargidae, Gigantopatagia, Nycticidae, Aegothelidae, and taxa without teeth, and the fossil forms *Paratethys* *kelleri* (Messel Formation), *Prefica nivea* (Green River Formation), and *Masillopodargus longipes* (Messel Formation). We recover *F. platyrhamphus* and *M. longipes* as successive sister taxa to Podargidae (the frogmouth crown clade). Furthermore, the phylogenetic analysis supports a sister taxon relationship between Podargidae and Steatornithidae (oilbirds) within Strisores (=Steatornithidae + Podargidae + Caprimulgidae + Nycticidae + Aegothelidae + Apodiformes). *Flaviornivores avitus platyrhamphus* and *M. longipes* reveal that stem frogmouths, a much wider group than the extant taxa shown to be characteristic for the first time, whereas crown taxa are restricted to Australasia. The mandible and palate of *F. platyrhamphus* and *M. longipes* demonstrate that most of the unique characteristics of the skull that have been linked to the broad gape and diet in living frogmouths are weakly influenced by the number of sampled localities, as well as other factors. Four distinct bioprovinces are identified. First, in contrast to previous research, the degree of endemism in the Spanish mammals until ~9.5Ma distinguishes these faunas from the rest of Western and Southwestern Europe. Similarly, the endemic Italian faunas previously grouped with France and Spain are considered here to belong to their own distinct bioprovince. An expansive Central Europe bioprovince, stretching from France to Romania, as well as an Eastern Eu- rope-Western Asia bioprovince broadly correspond to the previous studies. The patterns of endemism and dispersal in these bioprovinces have important applications as a framework to clarify the biogeography of mammals with less complete fossil records, such as carcharid primates.

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Banner Session III, (Tuesday)

A REAPPRAISAL OF BIOPROVINCIALITY IN MIDDLE AND LATE MIOCENE EURASIAN MAMMALS

Nargolwalla, Mariam, Department of Anthropology, University of Toronto, Toronto, ON, Canada

Previous studies of Miocene land mammals have identified a number of bioprovincial regions dividing Europe and Western Asia. The most recent of these studies was published 14 years ago and a significant number of new localities have been recognized since. Here, the results of these studies are reconsidered in light of new data. Relative completeness (CI) of Eurasian Middle and Late Miocene mammals was calculated to evaluate sampling quality, and data independence was assessed to ensure that the CI were in fact reflective of data quality, rather than a proportionate measure of sampling interval or number of localities per interval. Faunal similarity was measured to determine the distribution of bioprovinces and changes in constituent faunas over time in response to environmental change including regression and transgression of the Paratethys, orogeny and climate. The results of these analyses indicate that Eurasian large mammals are relatively completely sampled throughout the Middle and Late Miocene, while small mammals are incompletely sampled during two intervals when a strict measure of completeness is implemented. Among the large mammals, there is no significant relationship between either the duration of tempo-

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Pachyrhizodus sp., Albulidae indet., Caturidae indet., Cinolichithys nepalotheca, Enchochus gladius, E. Shumardi, Apatodotes sp., and four unidentified teethes. The only reptilian so far recognized is a small aquatic lizard Coniasaurus crusssidens (Dolichosauridae). Most of these taxa have been reported from the basal Greenhorn Formation (Lincoln Limestone Member) in Kansas and Colorado in which the Kansas fauna is chronologically comparable to the Hartland Shale of Colorado. Because the identified vertebrates are mostly carnivores, including forms that fed on fishes and shelled animals, the trophic structure of the paleocom-
of Sirenia from the Green River Formation and the Messel Shale indicates that most deep divergences within Sirenia had already occurred by the early-middle Eocene.

Poster Session IV, (Wednesday)

**EVOLUTIONARY CHANGE IN PORCUPINES IN THE LATE MIocene TO PLEISTOCENE OF CENTRAL MYANMAR**

NISHIoka, Yuichiro, Primate Research Institute, Kyoto University, Inuyama, Japan; MAUNG, Thein Zin, Zin-Maung, Primate Research Institute, Kyung University, Inuyama, Japan; HTIKE, Thaung, Primate Research Institute, Kyung University, Inuyama, Japan; EIGI, Naoko, Primate Research Institute, Kyung University, Inuyama, Japan; TAKAI, Masanaru, Primate Research Institute, Kyoto University, Inuyama, Japan

The Neogene Irrawaddy sediments, mainly composed of fluvialite deposits, are widely distributed in central Myanmar. Since the early 20th century it has been known that these sediments yield silicified fossil woods and many vertebrate fossils. Here, we report new discoveries of Old World porcupine (Hystricidae; Rodentia) specimens from the Irrawaddy sediments in central Myanmar. The biometric characteristics of the mammalian assemblages of these two localities suggest the latest Miocene to early Pliocene for the Chiangrauk fauna and the Pliocene to early Pleistocene for the Gwebin fauna. The Chiangrauk sediments yielded two mandibular fragments of hystricids that are assigned to a new species of *Hystryx*. This species is characterized by huge, semi-hyposodont, bacularlyngually wide cheek teeth and robust mandibular corpus. These diagnostic features indicate the species to be phylogenetically close to the Mio-Pliocene *H. depereti* from Europe, than to any fossil living *Hystryx* species from Asia. On the other hand, the Gwebin sediments yielded four isolated teeth, probably representing two species: one of them is a comparative- large and semi-hyposodont species that best resembles *H. zhongi* from the late Pliocene of China and *H. depereti* from Europe, but differs from the Chiangrauk specimen in having the smaller crown base. This species likely fills the geographical and chronological gap between *H. zhongi* and *H. depereti* from Europe. The other species is comparatively small and very hypodont, referring to extant Asian *Hystryx*, *H. brauniana*. It appears that the extant lineage of *Hystryx* occurred in Southeast Asia during the Plio-Pleistocene. Also, the present discoveries indicate that the smaller higher-crowned species replaced the larger lower-crowned species during the Pliocene in central Myanmar. We infer that this succession was caused by an environmental transition from rather wet to dryer conditions in this area, which has been suggested by the changes in the composition of the mammalian fauna and by the stable isotope data.

Poster Session IV, (Wednesday)

**IGUANODONTIAN DINOSAURS FROM THE WEALDEN GROUP OF ENGLAND: TAXONOMIC CONUNDRUMS**

NORMAN, David, University of Cambridge, Cambridge, United Kingdom

Various disassociated fossil reptile remains collected from the Grinstead Clay Member of the Tunbridge Wells Sand Formation exposed in quarries at Whitman’s Green near the village of Cuckfield in Sussex, England, were described and named in the eighteenth and nineteenth centuries. Some of this material was named *Iguanodon* but neither a specific name nor a holotype for this taxon were provided. Subsequent discoveries of similar dinosaur material from the Cuckfield area as well as from quarries, or eroding sea cliff sections scattered more widely across the Weald of south-eastern England, were added without a great deal of discrimination to anatomical remains attributed to the genus *Iguanodon*; these were often assigned to the species *I. mantelli*. By the mid 1870s new discoveries began to call into question the range and variety of the dinosaurian material attributed to *Iguanodon*. New specific and generic names began to be suggested and discussed on the basis of both new and earlier discoveries; however, their comparative value and statuses were never reviewed thoroughly. As a result, iguanodontian taxonomy has been aptly described as chaos. Here, the status of Wealden Group iguanodontians is critically reviewed on the basis of type and referred material; taxonomic assignments are assessed and an overview of taxonomic diversity of these dinosaurs within the Wealden Group is provided.

Poster Session II, (Monday)

**EVIDENCE FOR CORRELATED EVOLUTION BETWEEN LONG BONE COMPACTNESS, SWIMMING BEHAVIOR AND BODY MASS IN ARCTOIDEA (MAMMALIA: CARNIVORA)**

NORTHOVER, Joanna, Carleton University, Ottawa, ON, Canada; RYBCZYNSKI, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada; SCHRODER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada

Many aquatic amniotes exhibit an increase in bone density, which can result in the animal having a higher overall density. For a swimming animal this trait counteracts buoyancy and may be adaptive during diving and underwater foraging. An increase in bone density can arise from a thickening of cortical bone and/or reduction of the medullary cavity. The resulting internal bone compactness can be expressed as $K$, the ratio between the medullary cavity and external bone diameter. Previous work has shown a positive relationship between compactness and aquatic specialization in many amniotes including sirensians (dugongs, sea cows), ancestral whales, beavers, sea otters and marine reptiles. Here we evaluate the hypothesis that long bone compactness is correlated with swimming behavior in Arctoidea. This group of carnivores includes members which are highly swimming specialized, such as Pinnipedia (seals, sea lions, walrus); moderately specialized, such as Lutrinae (otters) and others which are exclusively terrestrial (weasels, badgers etc.). If there is evidence for evolutionary correlation between compactness and swimming behavior, then $K$ could be used to predict the benefit of prey from extinct arctoids. The six major limb bones from male individuals representing 43 species of extinct arctoids were visualized using computed tomography scanning and digital x-rays. Then $K$ was calculated for each species. This indicator of swimming behavior, each species was scored for its morphological specialization, habitat preference, diet and diving ability. These four scores were averaged, resulting in a continuous variable representing their behaviour. To test for correlated evolution between $K$, swimming behaviour and body mass, we used phylogenetically independent contrasts. The results showed a significant positive relationship between swimming behaviour and $K$ for the ultra, fibula and humerus. The findings also showed evidence for correlated evolution between swimming behaviour and body mass, as well as bone mass and $K$ for the humerus, radius, ulna and fibula. Further work will be required to understand if there is a relationship between swimming behavior and long bone compactness that is independent of body mass.

Poster Session III, (Tuesday)

**GEOMETRIC MORPHOMETRIC ANALYSIS OF THEROPOD MANUAL UNGUALS: EVOLUTIONARY AND ECOLOGICAL IMPLICATIONS**

NOTO, Christopher, Grand Valley State University, Allendale, MI, USA

The functional morphology of theropod forelimbs and interpretation of their use in behavior remains an active area of research, particularly because the forelimb morphologies of theropods lack extant analogs. Recently published research on the talon morphology of living avian raptores shows that differences in predatory strategy between taxa are correlated with differences in the size and shape of the pedal unguals. While these taxa may sometimes overlap behaviorally, this study suggests that avian raptor claws are adapted to a particular type of prey and predatory strategy. A similar approach to theropod forelimbs may yield insights into their predatory behavior. Theropod manual unguals are similar to the pedal unguals of living birds in that they vary greatly in overall morphology (size, length, curvature), and played a larger role in prey acquisition than locomotion for many species. It is therefore expected that differences in claw shape will follow ecological and/or evolutionary patterns. A series of 14 coplanar landmarks were applied to photographs and published figures representing taxa from the major theropod clades. When possible, claws from all digits were used. Procrustes superimposition and thin-plate splines were used to study shape variation. Multivariate ordination was then used to explore patterns of shape change. Preliminary results show that shape variation is concentrated in the curvature of the nail, projection of the flexor tubercle, and nail size relative to the ungual body. Notably, certain features of shape variation appear related to evolutionary differences at higher taxonomic levels. For example, coelurosaurs differ significantly from non-coelurosaurs in claw shape. This work opens up many potential avenues of future research. First, it allows one to explore ecological differences between theropod species and higher taxa (and the evolution thereof). Second, this approach may help in understanding the evolution of the theropod manus, yielding character data useful for cladistic analyses. Third, these results suggest that covariation among certain shape parameters could aid in assigning taxa to unidentified isolated unguals.

SQUAMATA FROM THE CONIACIAN THROUGH EARLY CAMPAIGNIAN OF SOUTHERN UTAH

NYDAM, Randall, Midwestern University, Glendale, AZ, USA; NYDAM, Randall, Midwestern University, Glendale, AZ, USA

The Cretaceous-aged portion of the sedimentary rocks in southern Utah form a nearly continuous series of terrestrial and interbedded marine facies that are becoming increasingly well-known for producing a spectacular and highly diverse fauna of fossil vertebrates. With regard to squamates (lizards and snakes) the most intensely studied faunas have been those from the Cenomanian (Dakota Formation), Turonian (Smoky Hollow Member of the Straight Cliffs Formation) and the Campanian (Kaiparowits Formation). Screen wash and surface collecting of microvertebrate-rich localities in the John Henry Member of the Straight Cliffs Formation (Coniacian) and the Wahweap Formation (Santonian-Early Campanian) has resulted in the recovery of numerous morphotypic squamate specimens that partially fill in the gap between the Smoky Hollow Member of the Straight Cliffs Formation and the Kaiparowits Formation. Taxa recovered from the John Henry Member of the Straight Cliffs Formation include a new species of paracellodoid/cordylid-grade lizard, an indeterminate scincomorph, two morphotypes of varanoid lizards, and associated lacertilian skull and osteodermal elements. In addition to the lizards, several vertebrae referable to the enigmatic serpentian *Coniophis* and a partial dentary of an indeterminate snake have been recovered. Squamate specimens from the Wahweap Formation include scincomorph jaws and osteoderms, anguimorph osteoderms, and vertebrae referable to *Coniophis*. These specimens provide additional evidence of the apparent persistence of paramacellodid/cordylid-grade lizards into the Late Cretaceous of North America, the iterative presence (but apparently low diversity) of snakes in the Cretaceous of Utah, and the regional endemicity of squamate taxa in the southern regions of the Western Interior of North America.

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A NEW LOOK AT ‘OLD’ BIRDS FROM THE JEHOL FAUNA
O’CONNOR, Jingmai, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ZHOU, Zhonghe, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ZHANG, Fucheng, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Starting in the early 1990’s, new species, genera, subclades, and lineages of archaic birds were uncovered from the Early Cretaceous Jehol Group in northeastern China. This geologic unit has revealed higher Early Cretaceous avian diversity than any other. While it is not exciting, or unusual discoveries that draw our attention, a reappraisal of early discoveries – most of which are fragmentary and poorly preserved – in light of the currently available information, can also provide new informative data, and serves to clarify current hypotheses often based on outdated published information. Several of the earliest-named species from the Jehol are reinterpreted here. The new interpretations of these taxa drastically change their phylogenetic positions in avian phylogeny. In addition to not only the known morphological disparity of a given clade, but also its diversity, range, known ecological specializations, etc. We reinterpret Liaoningornis as an enantiornithine based on the morphology of the sternum (comparable to Eoalulavis) and pedal morphology, and use the morphology of the elongate corpus of the premaxilla and hypertrophied pygostyle to assign Bolococha to Lonigipterygidae. The phylogenetic placement of other more fragmentary taxa is discussed, and we include a phylogenetic hypothesis through cladistic analysis to support our morphological findings.

RECONNAISSANCE PALEONTOLOGY IN THE LATE CRETACEOUS OF DAKHILA AND KHARGA OASES, WESTERN DESERT, EGYPT
O’CONNOR, Patrick, Ohio University, Athens, OH, USA; SERTICH, Joseph, Stony Brook University, Stony Brook, NY, USA; SALLAM, Hesham Mohamed, Mansoura University, Mansoura, Egypt; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA

The majority of our knowledge of post-Cenomanian continental vertebrate diversity in Gondwana is based largely on faunal assemblages from limited localities in South America, Antarctica, India, and Madagascar. By contrast, the African record of continental vertebrates from this temporal interval is vastly undersampled, precluding any meaningful comments regarding supercontinent-level faunal patterns. In an attempt to ameliorate this sampling bias, we have initiated palaeontological survey efforts in Upper Cretaceous units exposed near Dakhila and Kharga Oases in the Western Desert of southern Egypt. Although vertebrate remains have long been known from Campanian- to Maastrichtian-aged deposits in southern Egypt, the recovery of continental vertebrates has been relatively limited. Reconnaissance expeditions in 2008 and 2010, working under the auspices of the Mansoura University Vertebrate Paleontology (MUVP) initiative, have been undertaken with the following goals: (A) identify fossil-bearing sequences within the target strata, particularly within the Quseir Formation; (B) establish the local geological context of fossil-bearing localities; and (C) recover voucher specimens from target sequences in order to begin documenting faunal diversity in this critical time interval. Fossil vertebrates recovered thus far include abundant shark, fish, and marine reptile fossils from the Dwi Formation and fish, turtle, crocodyliform, pterosaur, and dinosaur remains from the nearshore-marine to fluvial Quseir Formation. Of particular note is the recovery of a partial mosasaur skull, a partial neosuchian crocodyliform, and some of the first saurischian dinosaur remains from the Campanian of Africa. These expeditions highlight the potential for the recovery of continental vertebrate material from one of the most poorly sampled temporal intervals on the African continent. Ongoing field research in southern Egypt by the MUVP and collaborating institutions will no doubt yield additional vertebrate remains that will directly impact current models of vertebrate biogeography during the Late Cretaceous Period.

CRANIODENTAL MEASURES OF DIRE WOLF POPULATION HEALTH IMPLY RAPID EXTINCTION IN THE LOS ANGELES BASIN
O’KEEFE, F. Robin, Marshall University, Huntington, WV, USA; VAN VALKENBURGH, Blair, University of California Los Angeles, Los Angeles, CA, USA; BINDER, Wendy, Loyola Marymount University, Los Angeles, CA, USA

Previous work on population-size samples of dire wolves from Rancho La Brea suggested that those living at the Last Glacial Maximum (LGM) experienced severe nutrient stress relative to other populations. However, lack of data, and of adequate accuracy and precision in extant data, limited the utility of this system. Here we report a new analysis of dire wolf dental morphology integrating refined age data, complete data for wear and breakage, and hypothesis-driven morphometrics that allows strong inferences concerning overall population health at the end-Pleistocene. Of special interest are Pt 13 and 61-67, as these date to this interval. Dating for these pits was refined by tabulating all known dates and calibrating this interval. Dating for these pits was refined by tabulating all known dates and calibrating the terminal LGM. Pit 61-67 is younger, dating to 13.75 kya, within the Bolling-Allerød (BA) warm period. Breakage and wear data demonstrate that pit 13 has significantly greater measures for both. Analysis of centroid size data extracted from 27 3D landmarks shows that mean body size was significantly smaller in pit 13, and that the associated size distribution is right-skewed. Distance-based morphometrics establish that pit 13 wolves are neotenic, with unusually short snouts; however, analysis of tooth row shape indicates that only pit 61-67 differs markedly from earlier wolves. Evidence for nutrient stress at the LGM is compelling, based on congruent signals from breakage/wear, body size and size distribution, and shape analysis. In contrast, during the BA breakage/wear and size distribution data indicate low nutrient stress, while size and shape data suggest successful adaptation to a warmer climate. Just prior to the end-Pleistocene mass extinction La Brea dire wolves were not food-stressed, suggesting prey was abundant; their extinction therefore may have been rapidly local. This contrasts with recent findings from the Sporormiella system indicating that herbivore extinction was gradual through the BA interval in more northern areas. These findings are not mutually exclusive; extinction rapidity or causality need not be homogeneous geographically or temporally.

A NEW SPECIMEN OF AGRIOTHERIUM (MAMMALIA, CARNIVORA) FROM THE LATE MIOCENE-EARLY PLIOCENE IRRAWADDY SEDIMENTS, MYANMAR
OGINO, Shintaro, Kyoto Univ. Primate Research Inst., Inuyama, Japan; EGI, Naoko, Kyoto Univ. Primate Research Inst., Inuyama, Japan; TAKAI, Masanaru, Kyoto Univ. Primate Research Inst., Inuyama, Japan; MAUNG-THEIN, Zin-Maung, Kyoto Univ. Primate Research Inst., Inuyama, Japan; HTIKE, Thaug, Kyoto Univ. Primate Research Inst., Inuyama, Japan

A hemi-mandible of a bear was found in the Lower member of Irrawaddy sediments in the Chaingzauk area, central Myanmar. The Chaingzauk fauna comprises 15 genera of mammals, including three carnivores (Agriotherium, Ictitherium, and Amphicyon), and at least two genera of reptiles, and a faunal comparison with Siwalik and China indicates its age as the late Miocene to early Pliocene. The specimen was identified as Agriotherium based on the characteristics such as a distinct premaxillary fossa and buccolingually wide lower teeth. Agriotherium is an extinct, short-faced bear that was commonly present in the Africa, Eurasia, and North America during the late Miocene to Pliocene. This genus is considered to have a close relationship to the middle Miocene Ictitherium, which had a distribution similar to that of Agriotherium. The presence of Agriotherium at the Chaingzauk area agrees with the late Miocene to early Pliocene age assignment made for this fauna. The specimen from the Chaingzauk area likely represents a new species of the genus based on the following characteristics: a short mandible, a rectilinearly-shaped inferior border of the mandibular corpus, a reduced m1 talonid, and an m1 metacristid larger than the entocristid-entocristid ridge. The specimen differs from those of other Agriotherium in having an extremely short mandible. The diastema between canine and p4 is short, it lacks p1-p3, and the four existing cheek teeth (p4-m3) are very crowded. The Irrawaddy form is relatively large compared to other species of the genus. All Chinese Agriotherium species are smaller than the present specimen. Siwalik Agriotherium are similar to the present specimen in size but differ in morphology. Except the extreme shortness, the morphology of the mandible is the most similar to that of an European Agriotherium, A. inexpect, suggesting that the presence of Agriotherium in the Chaingzauk fauna is not associated with the dispersal of the known Siwalik and/or Chinese forms but resulted from another dispersal event from the European lineage.

DEVELOPMENTAL FEATURES OF MICROSUARS (LEPOSPONDYLI), AND CONSEQUENCES FOR THE EVOLUTION OF DEVELOPMENT AND PHYLGENETIC RELATIONSHIPS WITHIN TETRAPODA
OLORI, Jennifer, The University of Texas at Austin, Austin, TX, USA

The complex mosaic of morphological features expressed by lepospondyl microsaur ossicles the placement of microsaur taxa among other early tetrapods. As a step toward resolution, I documented ontogenetic data for the microsaur Hyloplestes and Microbrachiias and investigated relationships among microsaur and other extinct and extant tetrapods. Allometric changes in the skeleton of Hyloplestes and Microbrachiias were quantified using both traditional and geometric morphometric analyses. In addition to more traditional thickness-based methods, Ontogenetic Sequence Analysis (OSA), a size-independent method of ossification sequence reconstruction, was applied to fossils for the first time. I used Parsimov-based Genetic Inference (PGI) of ossification sequence data for 33 tetrapods to quantitatively evaluate the three main hypotheses of living amphibian ancestry (Lepospondyl, Temnospondyl, and Polyphyletic). Skeletal growth in Hyloplestes and Microbrachiias is primarily isometric and ossification is rapid and complete at relatively small size. However, both taxa exhibit lateral lines, and the latter has gills. That pattern is congruent with expectations for stem amniotes, many of which potentially could have possessed amniote-like skeletal development but still retained reproductive ties to aquatic environments. Consistent with the placement of microsaur as stem amniotes, PGI indicated the Temnospondyl Hypothesis to be the most parsimonious explanation of tetrapod relationships. However, those results contrast with my prior Parsimov Analysis of ossification sequences that favored alternative hypotheses. Overall, no one hypothesis of amphibian evolutionary relationships was supported with significance. The equivalent support for all three hypotheses suggests that despite new sources of data and improved taxonomic sampling, the problem of early tetrapod relationships persists because of significant gaps in the fossil record and millions of years of independent evolution.
Dietary Behavior of Astrostomus Stockii from the Late Hemphillian of Central Mexico Using the Mesowear Method

Olviera-Badillo, Pablo, Licenciatura en Biología, Universidad Autónoma del Estado de Hidalgo, Carretera Pachuca-Tulacongo Km 4.5, CP 42184, Pachuca, Hidalgo, Mexico; Cacho-Alfaro, Nueyel, Licenciatura en Biología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico; Bravo-Cuevas, Víctor, Museo de Paleontología Area Académica de Biología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico

A sample of upper cheek teeth belonging to Astrostomus stockii was used to investigate the dietary behavior of this horse by means of the extended mesowear method. The sample analyzed here comes from strata belonging to the Rancho Viejo beds at Rancho El Ocoté, latest Hemphillian (H4b) of Guanajuato in Central Mexico. A cluster analysis using a comparative set of 27 recent species with typical diets and the population of A. stockii from Guanajuato was performed. The mesowear pattern of this equine species is distinguished by a combination of high and low relief, and round cusps; a comparable mesowear signature is observed in the recent grass-dominated mixed feeders Alcelaphus bennettianus (hartebeest) and Connochaetes taurinus (blue wildebeest). This suggests that A. stockii from Guanajuato included in its diet a great number of abrasive items (grass and/or extrinsic grit), however it would be capable of consuming other succulent resources. The results are in agreement with previous isotopic studies regarding to the dietary behavior of populations referable to A. stockii from the late Hemphillian of southern Great Plains, Gulf Coast and Southern Great Basin. Our observations give additional evidence about the dietary behavior of this equine horse, given that is categorized as a variable grazer.

Technical Session IX, Tuesday 9:15

Body Size, Climate and Time: A Paleontological Test of Bergman’s Rule

Orcutt, John, University of Oregon, Eugene, OR, USA; Hopkins, Samantha, University of Oregon, Eugene, OR, USA

One of the earliest ecological variables to be studied, mammalian body size remains enigmatic in many ways. In particular, debate still rages among ecologists about the forces that have shaped the geographic body mass trends apparent in most extant mammalian taxa. The first explanation to be offered (by Carl Bergmann, whose name has been associated with the hypothesis ever since) is that body size evolution is driven primarily by temperature, with large animals favored in cold climates and small animals favored in warm climates. In the subsequent century and a half, other causal mechanisms, both climatic (e.g. precipitation, seasonality) and biotic (e.g. food availability, competition), have been proposed as well. None of these mechanisms is universally accepted, in part because the variables in question (particularly climatic variables) are often tightly coupled in modern ecosystems. However, given sufficiently well-resolved fossil and paleoclimate records, temperature, precipitation, and seasonality can be decoupled and their influence on body size can be analyzed from a perspective unavailable to neontologists. We have analyzed body size trends in three families (suids, camids, and sciurids) of North American Oligo-Miocene mammals. Body mass was estimated from dental measurements and was tracked within biogeographic regions and along geographic transects (one running from Washington to southern California, the other from Oregon to Nebraska). Body size was regressed against climate variables from previously published reconstructions based on paleopedological, isotopic, and paleobotanical proxies. Body size does not track temperature through time and there is no evidence for latitudinal body mass gradients similar to those observed within many modern taxa. There is a relativehip between temperature and body mass at any given biome level, counter to the predictions of Bergmann’s rulesensu stricto, nor does any one climatic variable appear to drive body size evolution. Instead, body mass is likely driven by biotic interactions or a combination of variables, the effects of which may vary widely across taxa.

Technical Session III, Tuesday 9:15

Preliminary Analysis of Dipnoi (Osteichthyes: Sarcopterygii) Fossils from Driefontein, South Africa

Ortiz, Daniela, Sam Houston State University, Huntsville, TX, USA; Lewis, Patrick, Sam Houston State University, Huntsville, TX, USA; Kennedy, Alicia, Villanova University, Villanova, PA, USA; Bhattar-Bhat, Anjan, Harvard University, Cambridge, MA, USA; Hancock, John, University of the Witwatersrand, Johannesburg, South Africa

A recent collection from Driefontein, located in the main Karoo Basin, South Africa, has yielded a rare assemblage of freshwater Triassic micro fossils, including a large sample of Dipnoi (lungfish) elements. Sedimentary rocks corresponding to the upper Beaufort Group (Burgersdorp Formation) and biostратigraphic placement of the site in the lower Cynognathus Assemblage Zone support an Early Triassic (Olenekian) age of ca. 242 mya. A sample of 239 juvenile dipnoan tooth plates identified to the extinct family Ptychoceratodontidae was surface collected from fluvial deposits. Current research aims to identify dipnoan species at the Driefontein site to better understand the freshwater Early Triassic habitat. Tooth plates were identified by the number and morphology of ridge crests, which radiate from a fused anteromediapinal point, and the presence of denticles on the occlusal surface. Specimens range from 1 to 13 mm in length, with widths between 3 and 6 mm. Pterygopalatine (upper) tooth plates were identified by the presence of five ridge crests, while prearticular (lower) tooth plates have four. A preliminary analysis has identified tooth plates as upper left (n=23) and right (n=30), and lower left (n=29) and right (n=25), and has tentatively assigned orientations to 41 worm specimens. Also identified were 42 single ridge crest and 49 small unspecified fragments. Based on resemblances to tooth plates previously collected from the northern Karoo Basin, and from localities in similarly aged strata in Poland and Australia, the specimens from Driefontein are referable to the genus Ptychocerodus. The lack of known apomorphies for preserved elements, in addition to wear and fragmentation of the majority of the sample, prevents a confident identification to a lower taxonomic level. The total number of dipnoan species present at Driefontein will be differentiated once apomorphies and the ontogeny of Ptychocerodus are determined. Studying the taxonomic diversity of lungfish from this site will result in an improved understanding of the Early Triassic paleoenvironment that led to the recovery and expansion in faunal diversity in Gondwana following the Permian extinction.

Jaw Mechanism, Dental Occlusion and Effective Oral Food Processing in Heterodont Crocodyliforms: An Unexpected Variability

Osi, Attila, Hungarian Academy of Sciences - Hungarian Natural History Museum, Research Group for Paleontology, Budapest, Hungary

Based on new discoveries of the last few years it is evident that within the Crocodyliformes complex heterodont dentition sometimes including multicuspids crowns appeared in numerous fossil forms through all main lineages of the group. Teeth in these complex dentitions frequently bear extensive wear facets that are the best indicators of occlusion between the upper and lower teeth which refer to oral food processing. Besides dental features, specializations of the jaw apparatus, cranial adductor musculature and jaw movement can also be detected, all reflecting a high variability of jaw mechanism and of intraracial food processing within the group. Comparative study of these features in various taxa revealed at least four different types of jaw mechanism and indicated that some of these mechanisms evolved independently in several lineages of the Crocodyliformes. The most common type is the isognathous orbital jaw closure characteristic for all heterodont forms possessing bulbous, crushing posterior teeth (dominantly among neosuchians). Here, the crushing mechanism is supported by the developed pterygoid muscles, the elevated jaw articulation and the rough wear facets. Anteroposterior mandibular movement during jaw opening and closing appears to have occurred exclusively among the principally Gondwanan neosuchians. Posterior (posterior) movement detected in the African Malawisuchus is supported by features such as the position of saricna, wear facets on the tooth crowns, and developed pterygoid muscles suggested to be responsible for the protrusion of the mandibles during jaw closure. Propalinal (fore- aft) jaw movement can be characterized for a high number of South American genera. The dental morphology, the enamel–dentine interface and the developed external adductors are the main indicators of a retractive power stroke that might have been completed by lateromedial component in these forms. The last type of jaw movement has been detected in the eusuchian Eusthenopteron characterized by lateromedial rotation of the mandibles, as supported by the extensive horizontal wear facets and the unfused mandibular symphysis.

Atmospheric Hypoxia Increases Bone Robusticity in the American Alligator

Owerkowicz, Tomasz, UC Irvine, Irvine, CA, USA; Andrade, Fernando, UC Irvine, Irvine, CA, USA; Irvine, CA, USA; Elsey, Ruth, Rockefeller Wildlife Refuge, Grand Cherry, LA, USA; Middelton, Kevin, California State University, San Bernardino, CA, USA; HickS, James, UC Irvine, Irvine, CA, USA

Body mass of extant vertebrates is often estimated from their limb bone geometry. Scaling relationships of limb bone cross-sectional area and/or length to body mass are based on data derived from extant vertebrates. This method, however, is applicable only to vertebrates raised under modern-day atmospheric conditions. During vertebrate evolution, atmospheric oxygen O2 level may have varied from as high as 30% in the Permian, to as low as 12% in the Late Triassic/Early Jurassic. To date, no studies have considered the effect of ambient O2 on skeletal plasticity in vivo. We incubated eggs and subsequently grew hatchlings of the American alligator under chronic hypoxia (12% O2), normoxia (21% O2) and hyperoxia (30% O2). Animals received monthly injections of fluochrome dyes to determine periskeletal deposition rates. After three months, animals were sacrificed and their femora either sectioned at mid-diaphysis, or ashed. Despite exhibiting slower growth, hypoxic alligators had significantly greater mass-specific cross-sectional area (+15%), second moment of area (+20%) and polar moment of inertia (+23%) of the femoral midshaft than their normoxic or hyperoxic hatchlings. Mineral content was also significantly higher (+6%) in bones of hypoxic animals. This suggests that exposure to chronic hypoxia, but not hyperoxia, resulted in increased resistance to compressive, bending and torsional stresses on the skeleton. Furthermore, the relationship between femoral perimortem deposition and body mass growth was different between treatments groups, with hypoxic animals accruing more bone per unit body mass. We suggest that prevalent atmospheric O2 level need be considered when reconstructing size and growth curves of extinct vertebrates. Specifically, body masses of crocodiliforms from the Late Triassic/Early Jurassic, when the atmospheric O2 was at its nadir, may have been overestimated in the literature and should be revised.
HOW A SYNERGY OF SPECIES RECOGNITION AND SOCIAL SIGNALING EXPLAINS CRANIAL ANATOMY AND ONTOGENY IN SEVERAL GROUPS OF DINOSAURS

PADIAN, Kevin, University of California Museum of Paleontology, Berkeley, CA, USA; HORNER, John, Museum of the Rockies, Bozeman, MT, USA; FOWLER, Denver, Museum of the Rockies, Bozeman, MT, USA; SCANNIELLA, John, Museum of the Rockies, Bozeman, MT, USA

In previous work we showed why most functional explanations of “bizarre” structures in dinosaurs fail on several grounds, including mechanical, ontogenetic, and phylogenetic (e.g., no functional improvement in a lineage, so no grounds for claiming adaptation by natural selection). We also showed that the hypothesis of sexual selection fails so far because, by Darwin’s definition, sexual dimorphism (and not mere sexual difference) has never been convincingly demonstrated in these structures. Social selection has also been proposed. It hypothesizes competition for some social resource, for which both sexes can evolve unusual traits that can evolve rapidly. The problem is that so far these structures have not been tested for social selection. The argument has been made by analogy to animals such as hornbills, but bizarre structures in dinosaurs develop and vary among related species quite differently. Mate recognition has also been hypothesized, but we regard this as a subsidiary function of a more general hypothesis of species recognition.

Here we propose that a combination of species recognition and social signaling explains more of the available data than do other hypotheses. Two forms of variation need to be explained: those that relatively quickly develop and mature more or less allometrically with growth, and those that drastically modify and even reverse growth trajectories especially as skeletal maturity is reached. The first is exemplified by general features of crest shape in lambeosaurines as well as accessory horns and spikes in centrosaurines. The latter is exemplified by the changing shape and direction of brow horns in the ontogeny of Triceratops and by the growth and reduction of nuchal spikes and the eventual development of the cranial dome in the ontogeny of Pachycephalosaurus. The first kind of variation signals membership in a species, with its general benefits of protection, social interaction, and mating appropriateness. The second signals an individual’s status in the group, juvenile, pre-sexual, sub-adult, mating adult). This hypothesis, if valid, establishes dinosauromorphs as highly complex in behavior and social structure.

DISPARITY IN ABUNDANCE OF THE DWARFed EQUiD ARChEOHippUs IN MiDDLe MiOCeNE DEPOSeTS OF SOUTHeRN CAlIfORNiA

PAGNAC, Darrin, South Dakota School of Mines and Technology, Rapid City, SD, USA; REYNOLDS, Robert, LSA Associates, San Bernardino, CA, USA

Archaepohippus is an early to medial Miocene genus of brachydont, North American equid that exhibits dwarfism with evolutionary development. Archaepohippus remains, although generally lower in abundance than those of other contemporary equids, show a cosmopolitan distribution throughout the continent. Archaepohippus is an ever-present faunal constituent in Miocene assemblages, particularly those of southern California.

Archaepohippus occurs in the fault separated, Cajon Valley and Crowder formations on the northern flank of the San Bernardino Mountains, and in the Barstow Formation in the Mojave Desert. Both formations contain faunal assemblages of approximately equivalent age, from the late Hemingfordian (He2) through the early and late Barstovian (Ba1-Ba2). However, the Cajon Valley/Crowder Formation contains over two dozen specimens of Archaepohippus, including numerous juvenile individuals, from units Tcv-3, Tcv-5 and Tcv-6. In contrast, the Barstow Formation contains only six verified specimens of the same genus, restricted to the unnamed middle member. The notable disparity in abundance of Archaepohippus between these time-equivalent deposits suggests environmental preferences for this diminutive equid.

The Barstow and Cajon Valley/Crowder formations were deposited at about the same time, but under considerably different conditions. The presence of palaeosols in the Cajon Valley and Crowder formations represents stable, vegetated surfaces during depositional gaps that appear to have provided vegetated habitats that favored Archaepohippus. Deposition of the fluvio-lacustrine Barstow Formation was apparently at a slow, continuous rate, as indicated by the absence of palaeosols. Deposition on the stoss side of the Victorville highlands to the west likely created a nominal rain shadow effect, the resulting aridity proving less hospitable for Archaepohippus.

LOSS OF HABITAT AND BIODIVERSITY DURING TERMINAL PLEISTOCENE WARMING: WHAT SMALL MAMMAL FOSSILS TELL US ABOUT THE EFFECTS OF CLIMATE CHANGE

PARDI, Melissa, University of New Mexico Department of Biology, Albuquerque, NM, USA; GRAHAM, Russell, The Pennsylvania State University, Department of Geosciences, University Park, PA, USA

Previous paleoecological research of the late Pleistocene has largely focused on the dynamics between the arrival of modern humans, climate change, and megafauna extinction. While the interactions between large charismatic animals and humans is interesting, recent investigations into how entire ecosystems may have changed during the Pleistocene-Holocene transition tell a story that is equally dramatic. The study of smaller animals provides a more complete picture of how climate change affected late Pleistocene ecosystems. To examine large scale patterns in small mammal community structure, 203 fossil faunas from 183 locations east of the Rocky Mountains in North America were compared using non-metric multidimensional scaling. These faunas ranged in age from the last Full Glacial to the last Holocene. Late Glacial faunas were much more diverse than late Holocene faunas. Glacial sites were also more taxonomically similar along an East-West gradient. This finding suggests that this gradient steepened during the transition into the Holocene. Heterogeneous environments during the last glacial could produce such patterns, and are also consistent with the presence of late Pleistocene non-analog faunas and novel habitats. These results indicate that North America not only experienced extinctions of organisms at the end of the last glacial, but that some late Pleistocene habitats were removed from the modern landscape. These findings provide relevant details about how future climate change may affect patterns in terrestrial biodiversity.
species of mammals, 12 genera of birds, and 18 genera of amphibians and reptiles. The fauna is dominated by fossils of the Columbian mammoth, Mammutthus columbi, and the giant bison, Bison latifrons. Although North American mammoths have been studied extensively from other localities in the United States, limited in situ material has been described from Georgia. However, the type specimen of Mammuthus columbi was described by Falconer in 1857 based on a partial 3rd upper molar from coastal Georgia. He received the tooth from Charles Lyell who obtained it from Hamilton Couper in 1846. Couper recovered the tooth during excavations of the Brunswick Altamaha Canal in 1838-39. Clark Quarry borders the abandoned Brunswick Altamaha Canal and its location presents the possibility that this new mammoth material is from the same locality as the type specimen. Correlation of Couper’s description, the original canal survey maps, and modern Georgia Department of Transportation maps strongly support this conclusion. Mammoth material identified thus far indicates a minimum of two individuals and includes a juvenile palate and dentary with cheek teeth, adult tooth fragments, complete and partial long-bones, carpals, tarsals, ribs, sternal elements, and cervical, thoracic and caudal vertebrae.

**NEW TYRANNOSAURID REMAINS FROM THE LATE CRETACEOUS ‘EL GALLO’ FORMATION OF BAJA DE CALIFORNIA, MEXICO**

**Poster Session III, (Tuesday)**

**PEECOOK, Brandon, University of Michigan, Ann Arbor, MI, USA; WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA; WILSON, Gregory, University of Washington, Seattle, WA, USA; HERNÁNDEZ, Rene, Universidad Nacional Autónoma de México, Coyoacán, Mexico; MONTELLANO-BALLESTEROS, Marisol, Universidad Nacional Autónoma de México, Coyoacán, Mexico**

North American tyrannosaurids are best known from southern Canada and north-central US, predominantly from paleolowlands along the Western Interior Seaway. The record of tyrannosaurids from southwestern North America has improved with the recent description of Bistahieversor zelei of New Mexico, and here we add new remains from Baja de Califormia, Mexico. We report on a left fourth metatarsal collected from sediments of the Upper Cretaceous (Campanian) ‘El Gallo’ Formation exposed near El Rosario, Baja de California, Mexico. The metatarsal was found associated with a nearly complete pedal phalanx and fragments of other phalanges, but no other remains were recovered. The ‘El Gallo’ metatarsal IV was a part of a strongly arctometatarsal metatarsus, as evidenced by a deep medial notch proximally and tight articulation for metatarsal III that extends most of the length of the shaft. This condition, along with overall size and proportions of the bone, supports its identification as a tyrannosaurid. Compared to other tyrannosaurids, the ‘El Gallo’ metatarsal IV is relatively short and slender. It is 2/3 the length and 3/4 the robusticity (midshaft circumference/total length) of metatarsal IV of Tyrannosaurus rex, but closely resembles the proportions of the gracile Appalrichiosaurus montgomeriensis and Albertosaurus sarcophagus. Due to the fragmentary nature of the ‘El Gallo’ material, no diagnosis can be made beyond Tyrannosauridae. Before the discovery of this material, the only non-dental evidence of tyrannosaurids in Mexico was Labocanita anomalida, which consists of a few massive skull bones and fragmentary postcranial remains that include an ischium. An undescribed partial metatarsal, likely metatarsal III, referred to Labocanita is slightly larger and more robust than the ‘El Gallo’ metatarsal, but it is too fragmentary to be retained for more detailed comparisons. Continued sampling in the southwestern US and Baja de California will provide insight into paleobiogeographic provincialism in North America during the Cretaceous.

**EFECT OF DIAGENESIS ON SRCA AND BA/CA RATIOS OF TOOTH ENAMEL**

**PEEK, Stephanie, University of Wyoming, Laramie, WY, USA; CLEMENTZ, Mark, University of Wyoming, Laramie, WY, USA**

Elemental concentrations of barium and strontium relative to calcium (Sr/ Ca and Ba/ Ca) in bioapatite are commonly used to characterize an organism’s diet. These ratios decrease with bioapatite also occurs across the placenta and mammary glands. Unlike bone, which has its Sr/Ca and Ba/Ca values continuously adjusted as it undergoes biological remodeling, the Sr/Ca and Ba/Ca values of enamel are fixed at the time of mineralization. Thus, physiologically speaking, tooth enamel that is forming in utero or during nursing should have significantly lower Sr/Ca and Ba/Ca ratios than tooth enamel or bone that forms post-weaning. To assess these differences, we will look at bone and tooth enamel from mandibles of four steer (Bos taurus) fed a controlled diet and five wild deer (Odocoileus virginianus). To address the question of diagenesis, three mandibles each from archaeological and fossil deer remains will be analyzed for bone and enamel Sr/Ca and Ba/Ca.

**Assessing Morphological Rates of Change: An Example Using Coelurosaurian Dinosaurs**

**Technical Session XVII, Wednesday 2-45**

**PEI, Rui, Columbia University, New York, NY, USA**

Several recent studies have examined the tempo of the evolution of discrete morphological characters of fossil species. Here we propose a method combining the maximum likelihood phylogenetic reconstruction and relaxed clock models to estimate the divergence time and morphological evolutionary rate of extinct taxa. We used the data matrix of the Theropod Working Group (TWG) as an example, which contains only morphological characters of more than 80 coelurosaurian dinosaurs (including fossil birds). Phylogeny was reconstructed with GARLI 0.96, implemented with Mkv Model (Markov Model for discrete characters), which is designed for morphological dataset analyses under the maximum likelihood criterion. The advantage of this approach is that the phylogenetic reconstruction is based on the entire dataset, including missing data, and 2) it yields branch lengths proportional to the time across which characters changed, both of which are important for divergence time estimation. The resulting topology is similar to that from the maximum parsimony reconstruction, with the monophyly and relationships of major coelurosaurian families unchanged, but the ingroup relationships of some clades are modified. We analyzed the phylogeny with the software r8s, to estimate the divergence time and evolutionary rate for each branch. All terminal taxa were temporally calibrated by the age of their first fossil. The dating analyses were implemented with relaxed clock models such as the local clocks model and the rate smoothing model, both allowing variable evolutionary rates for different branches. Results indicate an early radiation of coelurosaurian dinosaurs, with most of the major coelurosaurian cladest established before the Jurassic-Cretaceous transition. The early radiation of coelurosaurians happened at about the same time as the increase of oxygen concentration in Middle and Late Jurassic, but whether there is a causal relationship between these events is unclear. Aves show the highest average evolutionary rate compared with other coelurosaurian lineages, which may either reflect the early radiation of birds or reflect the bias of the dataset.

**Evolution of the Modern Afican Fauna, Wednesday 10:15**

**A REVIEW OF THE FOSSIL RECORD OF CARNIVORA (MAMMALIA) IN AFRICA**

**PEIGNÉ, Stéphane, Muséum national d’Histoire naturelle, Paris, France; WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden**

The order Carnivora has a shorter history in Africa than on any other continent except Australia and South America. The definite record of the order on the African continent extends back to the late Oligocene. We present a review of the fossil record of the order, based on direct study of the majority of the known fossil carnivorn material by at least one of us. Our review encompasses nearly 120 genera and about twice that many species, to be compared with estimates, made in 1978, of 58 genera and 118 species. Known carnivoran species-locality occurrences have also greatly increased since 1978, to more than 1000, demonstrating that the fossil record of Carnivora in Africa has expanded enormously in the past 30 years, despite biases in its geographical and stratigraphical distribution. Thus, the Neogene fossil record of carnivora is extremely poor in western, central and west-central Africa, and in some southern countries. In contrast, some regions have yielded extremely rich faunas for certain times and/or have a good and continuous long-term fossil record (typically eastern Africa). With the increasing amount and intensity of field research in Africa, some regions or countries (e.g., Mio-Pliocene of Chad) are showing their scientific potential, indicating that eastern African dominance may not only be due to its unique geographic and tectonic position, which created exceptional conditions for fossilization, but also to the near absence of a fossil record in most other African regions. The arrival of Carnivora in Africa is correlated with a migration event, either from Europe, or Asia, or both. The paleobiogeographical history of the order results from a series of such events, both into and out of Africa. Although the fossil record biases the data, most of these events are distinct and broadly associated with glacial-intersticial and, partly, with tectonic events. The earliest events show no sorting, but gradually middle- to large-sized taxa predominate. During the Pliocene, migrations are mainly out of Africa, correlate with regional climates, and involve middle- to large-sized taxa.
tive measures. While preferable, preventive measures are largely inadequate in cases where the reaction is well underway, and in many cases the reaction has already begun before fossil discovery and excavation. The New Jersey State Museum has conducted research and long-term experiments to evaluate the use of Beeswax (and synthetic alternatives) as consolidants in pyrite-diseased fossils for over two decades. Beeswax is readily available and inexpensive. The treatment requires only simple apparatus and a heat source. Fossils and wax are gradually heated to 80-120°C during treatment. Heating has the added benefit of removing bound water, thus dehydrating sulfate minerals produced by sulfide oxidation and decreasing the likelihood of further reactions. Results indicate that despite its limitations, the Beeswax remedial treatment is a cost-effective and efficient means to halt ongoing pyritic decay.

Poster Session II, (Monday)

AN UNUSUAL CERATOPSID QUARRY FROM THE HELL CREEK FORMATION OF MONTANA

PENKALSKI, Paul, Geology Museum, UW-Madison, Madison, WI, USA; SKULAN, Joseph, UW-Madison Geology Museum, Madison, WI, USA

Two partial ceratopsids were recovered from a small quarry in Carter County, southeastern Montana. The material includes skull elements, a lower jaw, a predentary, a poorly preserved saccynerval, dorsal vertebrae, ribs, pubes, ischia, two humeri, an ulna, and numerous fragments. Two right postorbitals indicate the presence of at least two animals. Both horncores are unusually straight but otherwise show a similar, subadult morphology. Of the four large frill pieces, one is Torosaurine while another shows Triceratops characters including a prominent sagittal crest. The latter partial section also exhibits an unusual break that appears to be a pseudosutural division. The elongate, torosaurine squamosal has distinct, poorly fused, sausage-like epiprossamosals, confirming that this individual was not fully mature when it died. However, it lacks the rolled parietal bar and longitudinal depression characteristic of mature Torosaurus latus squamosals. Dorsal vertebrae from the quarry are subtly different than known vertebrae of Triceratops. The humerus is adult-sized but intermediate in morphology between Torosaurus (FMNH VP6441) and Triceratops (FMNH 12005). The apparent presence of Triceratops and Torosaurus together in the same quarry has potential implications for taxonomy and sexual dimorphism. Three interpretations of the quarry material were explored: (1) that it represents a new taxon; (2) that the material represents sexual dimorphs of Triceratops; and (3) that one specimen each of Triceratops and Torosaurus were simply deposited together.

Poster Session I, (Sunday)

TURTLE DIVERSITY FROM THE UPPER JURASSIC AND LOWER CRETACEOUS OF GALVE (TEREUL, SPAIN)

PÉREZ GARCÍA, Adán, Universidad Complutense, Madrid, Spain; XABIER, Murelagar, Universidad del País Vasco, Bilbao, Spain; ORTEGA, Francisco, Facultad de Ciencias UNED, Madrid, Spain

The Upper Jurassic to Lower Cretaceous Galve fossil sites (Tereul, Spain) are located in a sedimentary succession with marginal marine and continental deposits of the Maestrazgo Basin. At present, more than fifty vertebrate taxa have been identified, including fishes, mammals, lissamphibians and many reptiles. Among them, turtles are very abundant but yet poorly known. Herein, four panceptydridan taxa are recognized. The oldest record comes from the Villar del Arzobispado Formation (Tithonian-Berriasian), and corresponds to an inhabitant of marine environments that can be interpreted as a member of the euctypidian group Plesiochelyidae due to several characters, such as the presence of three cervical scutes on the mchial plate. This group has been previously recognized in the Jurassic of other Iberian locations, but its diversity is not well known. In the Lower Cretaceous, turtles come from two formations: Castellar (upper Hauterivian–lower Barremian) and Camarillas (lower Barremian). One of the recognized turtles is ornamented by small pits, and with fine stria tions parallel to the margins of the plates, as that of some members of Pleurosternidae (Paracryptodira). It differs from the European Pleurosternon in the morphology and contact between some of its plates, being more similar to some Portuguese Jurassic pleurosternids undescribed yet. The ornamentation of a second taxon is composed of isolated granulations, attributed to Solemydidae (basal Pacychelydra), being similar to those identified in the Cameros Basin (NW of the Iberian Range) or in the Morella sub-basin (Maestrazgo Basin), which have been related to the British taxon Helochelydra. In addition, a third taxon is recognized as a new euctypidid turtle, also represented in other Spanish localities. The knowledge of the turtles of the Upper Jurassic-Lower Cretaceous transition is very limited in Europe, and particularly in the Iberian Peninsula. In this sense, the chelonian fauna of Galve increases the systematic and paleobieographic knowledge on this group, represented here by taxa shared with other European regions as well as exclusive Iberian taxa.

Poster Session III, (Tuesday)

ANATOMY OF A SPEED DEMON: THE CAUSAL MUSCULATURE OF CARNOTaurus AND THE IMPLICATIONS FOR ABELISAUROID Locomotion AND EVOLUTIONARY TRAJECTORY

PERSONS, Walter, University of Alberta, Edmonton, AB, Canada

The South American genus Carnotaurus is the largest and most derived member of the Abelisauridae, a clade of carnivorous dinosaurs best known for the small horns and other cranial ornamentations common to its members. However, the most bizarre and unique skeletal adaptations of Carnotaurus and its close relatives occur not in the skull, but in the tail. The anterior caudal vertebrae of Carnotaurus have transverse processes that are posteriorly inclined and dorsally angled to the point of exceeding the neural spines in absolute height. The epiphyses of the transverse processes are flattened and expanded, with rounded posterior tips and projecting half-crescent-shaped anterior tips that interlocked with those directly adjacent. These vertebral structures must have increased the mediolateral rigidity of the tail and, therefore, diminished the capacity to move sinuously and to make tight turns. This study interprets the unique caudal morphology of Carnotaurus as a possible adaptation for high-speed sprinting.

The ventral surfaces of the transverse processes of the exceptionally well preserved tail of Aucasaurus show a narrow anteroposteriorly directed scar that marks the most dorsal insertion boundary of the M. ilio-ischiocaudalis/M. caudofemoralis region. The septum of the M. caudofemoralis onto the lateral surfaces of the transverse processes (unknown in other theropods) and the extreme dorsal tilt of the transverse processes are interpreted as adaptations that permit the dorsal expansion of the M. caudofemoralis. In most non-avian dinosaurs, the M. caudofemoralis was the primary retractor muscle of the hind limb. Digital muscle models indicate that, relative to its overall body size, Carnotaurus had a substantially larger M. caudofemoralis than any other theropod yet studied, which suggests the potential for greater curvilinear abilities. Consideration of these vertebral adaptations in an evolutionary context reveals a progressive sequence of increasing caudofemoral mass and tail rigidity among the Abelisauridae of South America.

Technical Session XI, Tuesday 2:15

MICRORNAS AND VERTEBRATE PHYLOGENETICS

PETERSON, Kevin, Dartmouth College, Hanover, NH, USA; LYSON, Tyler, Yale University, New Haven, CT, USA; SPERLING, Erik, Yale University, New Haven, CT, USA; ALYSHA, Heimburg, Dartmouth College, Hanover, NH, USA; DONOGHUE, Philip, Bristol University, Bristol, United Kingdom

Understanding the evolution of a clade, either from a morphologic or genomic perspective requires a correct topology, allowing for the polarization of traits and the ability to distinguish homologies from homoplases. Although great advances have been made in unraveling the vertebrate tree of life, primarily based on the incorporation of molecular data, some areas remain incalculant. Two areas in particular are the interrelationships of the jawless fishes (hagfish and lamprey) with respect to the jawed fishes, and the interrelationships among the amphibians. Here, we propose that microRNAs, small non-coding regulatory genes, may be a new dataset that can resolve many relationships as they show three properties that make them excellent phylogenetic markers: 1) new microRNA families are continually being identified within metazoan genomes through time; 2) they show very high degrees of evolutionary conservancy, with only rare instances of secondary loss, and only rare instances of substitutions occurring in the mature gene sequence; and 3) they are almost impossible to evolve convergently. Sequencing small RNA libraries coupled with genomic searches supports the monophyly of the cyclostomes, as hagfish and lamprey share several novel microRNA families not found in gnathostomes or in any other metazoan taxa, and the possession of several novel microRNA families supports a sister group relationship between testudines and lepidosaurs. Because of these three properties, we propose that miRNAs are a novel type of data that can be applied to virtually any area of the metazoan tree, including the vertebrate tree, to test among competing hypotheses or to forge new ones.

Poster Session I, (Sunday)

FIRST PALYNOLOGICAL DATA AND INTERPRETATION OF “LO HUECO” VERTEBRATE SITE (UPPER CRETACEOUS, CUENCA, SPAIN)

PEYROT, Dani, Universidad Complutense de Madrid, Madrid, Spain; BARROSO-BARCENILLA, Fernando, Universidad de Alcalá de Henares, Alcalá de Henares, Spain; MERTEOAGA, Ana, Universidad de Alcalá de Henares, Alcalá de Henares, Spain; CAMBRA-MOO, Oscar, Universidad Nacional de Educación a Distancia, Madrid, Spain

The “Lo Hueco” fossil site includes an interval in “Garumn” facies (informal term for shallow marine, coastal or continental sediments of south-western Europe deposited during Latest Cretaceous and Early Palaeogene) that contain an exceptional richness and diversity of fossil vertebrates from the Early Palaeogene). Among the terrestrial vertebrates, the most abundant are mammals, lissamphibians and many reptiles. Among them, turtles are very abundant but yet poorly known. Herein, four panceptydridan taxa are recognized. The oldest record comes from the Villar del Arzobispado Formation (Tithonian-Berriasian), and corresponds to an inhabitant of marine environments that can be interpreted as a member of the euctypidian group Plesiochelyidae due to several characters, such as the presence of three cervical scutes on the mchial plate. This group has been previously recognized in the Jurassic of other Iberian locations, but its diversity is not well known. In the Lower Cretaceous, turtles come from two formations: Castellar (upper Hauterivian–lower Barremian) and Camarillas (lower Barremian). One of the recognized turtles is ornamented by small pits, and with fine stria tions parallel to the margins of the plates, as that of some members of Pleurosternidae (Paracryptodira). It differs from the European Pleurosternon in the morphology and contact between some of its plates, being more similar to some Portuguese Jurassic pleurosternids undescribed yet. The ornamentation of a second taxon is composed of isolated granulations, attributed to Solemydidae (basal Pacychelydra), being similar to those identified in the Cameros Basin (NW of the Iberian Range) or in the Morella sub-basin (Maestrazgo Basin), which have been related to the British taxon Helochelydra. In addition, a third taxon is recognized as a new euctypidid turtle, also represented in other Spanish localities. The knowledge of the turtles of the Upper Jurassic-Lower Cretaceous transition is very limited in Europe, and particularly in the Iberian Peninsula. In this sense, the chelonian fauna of Galve increases the systematic and paleobieographic knowledge on this group, represented here by taxa shared with other European regions as well as exclusive Iberian taxa.
Polypodiceopsitories. As a whole, the studied samples suggest a tropical palaeovegetation dominated by the angiosperms. The sporadic presence of Normapolles indicates that Fagales constituted a minor component of the palaeoenvironment. The comparison with the assemblages described in other Spanish sites in “Garumn” facies supports a late Campanian–early Maastrichtian age for “Lo Hueco”.

Making Connections: The Evolution and Function of Joints in Vertebrates, Tuesday 10:30

REGIONAL VARIATION OF INTERVERTEbral JOINT STIFFNESS IN EXTANT AND EXTINCT TETRAPODS AND ITS IMPORTANCE FOR THE WATER-LAND TRANSITION

PIerce, Stephanie; Museum of Zoology, University of Cambridge, Cambridge, United Kingdom; MOLnAR, Julia; Structure and Motion Lab, Royal Veterinary College, London, United Kingdom; HUTCHINson, John, Structure and Motion Lab, Royal Veterinary College, London, United Kingdom; CLack, Jennifer; Museum of Zoology, University of Cambridge, Cambridge, United Kingdom

For decades, the iconic genus Ichthyostega has been viewed as an archetypal primitive tetra-
pod from the late Devonian. However, recent work has suggested that its locomotor mode was more like that of a seal than a salamander – the intervertebral joints of its trunk flexing in a dorsoventral plane rather than laterally as would be predicted for a basil tetrapod. Its backbone exhibits regionalisation in a manner more like a mammal than a Palaeozoic tetra-
pod implying the presence of specialised musculature with parts of the column adapted for different functions. Our current study aims to test this idea, by examining a broad selection of phylogenetically disparate aquatic and semi-aquatic animals with very distinct modes of locomotion (e.g., salamanders, crocodiles, otters and seals) in order to tease out morpho-
functional differences between the vertebral column. We have chosen these taxa for having aspects of vertebral form and function, especially joints and the structures that guide their motion, which might be partly analogous with those of Ichthyostega. Fifteen biomechanical indices of axial joint mobility have been measured on each vertebral unit along the spinal column and anatomical and geometrical indices for all representative species so far constructed. Our results identify clear regional variation within the axial skeleton which is intimately linked with locomotor style. These data are then compared to experimental measurements of static and dynamic mechanical properties of intervertebral joints in fresh, excised vertebral columns in order to identify how the intervertebral joint stiffness of the axial skeleton varies regionally with morphometric correlates of stiffness. The ultimate goal of this research is to gain a bet-
ner understanding of the relationship between the morphology and function of the vertebrae and to provide a comparative database for exploring the locomotor behaviour and evolution of Ichthyostega and other early tetrapods.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

COMPARISON OF EARLY EOCENE SAN JUAN BASIN, NM PHENACOLEMUR JEPSENI WITH PHENACOLEMUR CITATUS AND PHENACOLEMUR PRaeCOX FROM BIGHORN BASIN, WY - STUDY OF THE VARIATION AND VALIDITY OF THESE PHENACOLEMUR SPECIES

PilbRo, Clayton; University of New Mexico Anthropology Dept., Albuquerque, NM, USA

Phenacolemur was a late Paleocene-early Eocene paromomyid plesiadapiform from the Wyoming and North America. As many as seven species are recognized in North America, and several are distinguished primarily by differences in size and subtle differ-
ences in tooth morphology. However, there are questions regarding the validity of at least one species, P. Jepseni, a taxon originally named from the early Eocene of the San Juan Basin, New Mexico. Some workers have suggested that P. Jepseni is a junior subjective synonym of P. Citatus or P. Praecox from the early Eocene of the Bighorn Basin Wyoming, where specimens are purported to show a continuum in size and morphology that overlap with smaller samples of P. Jepseni from New Mexico. Unfortunately there is only one holotype skull and a limited number of isolated teeth associated with P. Jepseni collected in New Mexico (15 teeth). The low number of comparable fossils makes a meaningful statisti-
cal comparison difficult. However, by looking at the larger Phenacolemur collections of P. Citatus (1,047 teeth) and P. Praecox (955 teeth) from the Bighorn Basin, I have compared trends, using metric data and statistical tools coupled with physical morphology, between the larger Wyoming sample and the smaller New Mexico sample showing patterns and possible variations between the three closely related species. The result of the statistical analyses show P. Jepseni, P. Citatus, and P. Praecox to be distinct, yet highly variable species with characteristics that show intermediate stages between the three species. Morphologically P. Jepseni specimens from New Mexico are smaller, lack a paraconid on M2 (present on P. Citatus, and P. Praecox), and may have a double-rooted upper canine or P1 not seen in either of the other two species of Phenacolemur. With these results, it seems logical to consider the New Mexico P. Jepseni a valid species of Phenacolemur.

Technical Session XIV, Wednesday 8:45

THE EVOLUTION OF TAIL VARIATION IN SAUROPOD DINOSAURS

Pittman, Michael, UCL, London, United Kingdom; Upchurch, Paul, UCL, London, United Kingdom; Hutchinson, John, RVC, London, United Kingdom

Sauropod tails are interesting because of differences in length and articular geometry that underlie their purported ‘whip-lash’ and tail club specializations. To quantify the form, function, and evolution of sauropod tails, we examined factors associated with dorsoventral and mediolateral joint flexibility in 17 taxa. We compiled a dataset of approxi-
mately 6500 size-normalized vertebral measurements, and employed principal components analyses to determine parameters responsible for most data variation. Ancestral states were reconstructed using parsimony-based phylogenetic mapping to determine changes along the most-parsimonious tree. For each transitional vertebra, we calculated its dorsoventral and mediolateral flexibility, particularly transverse process, centrum and chevron height, indicates that dorso-
stiffness decreased across Sauropoda for the proximal tail. The vertebral width, associated with mediolateral stiffness, decreased across Sauropoda for the proximal and mid-tail. This is in line with our prediction that orthochoelose and prococelous tails had higher dorsoventral and mediolateral flexibility. We also expected high dorsoventral and mediolateral flexibility in ‘whip-lash’ tails. However, we observed high proximal neural spine height, low mid-tail neural spine transverse process and centrum height and relatively narrow vertebral width. This instead suggests that the Diplodocoidea used a stiffer proximal tail to support a long but quite flexible mid- and distal tail. This is consistent however with a variety of behaviour interpretations. The Diplodocoidea condition is thus specialized in comparison to the Neo-
sauropoda condition. We also predicted high stiffness distally in clubbed tails to support the club but lower proximal stiffness to increase range of movement. Higher distal neural spines supported distal tail stiffness. In contrast, we actually found high proximal and mid-tail neural spine transverse processes and chevrons and wide vertebral width suggesting higher proximal stiffness and a relatively restricted range of club movement. High dorsoventral and mediolateral stiffness appears to be the plesiomorphic condition which clubbed sauropods later exapted.

Physical Drivers and Marine Tetrapod Evolution, Monday 9:00

SENSory ADAPTATIONS IN MOSAUSAR

PolCyN, Michael, Southern Methodist University, Dallas, TX, USA

The shift from a terrestrial to a marine habit in mosasaurs should be reflected in their sense organs. Well preserved snouts of Turonian fossils reveal a neuroarchael palatine. The small size of the copula Jacobsoni, housing the vomeronasal organ, indicates diminished olfactory abilities, consistent with reduction of the olfactory lobe of brain. The facial nerve exits form periodic linear arrays laterally, increasing in density on the anterior portion of the snout. This arrangement is an adaptation for acoustic beamforming with bimodal frequency and spatial sensitivity. The extracollumellar cartilage in mosasaurs is calcified and greatly expanded, suspended within and occupying most of the lateral aperture of the quadrate, forming a stiff, yet functional tympanum. The internal process is robust and passes through the meatus, inserting in the medial wall of the quadrate and medially the contacting the stapes. These modified structures are present in Turonian forms; however, in later forms, the cavity between the extracollumellar cartilage and the quadrate increases in volume and its structure is modified, acting as a tuned cavity backing a tympanic membrane. Optimization of acoustic capabilities is accompanied by increased relative head width in plioplatecarines, displac-
ing the quadrates laterally and providing enhanced spatial sensitivity. Taken together, the changes in the vomeronasal, facial, and auditory sensory organs, suggest an early shift from chemical to acoustic mode of prey detection and acquisition. Progressive reduction of the vestibular organ, and thus its sensitivity, is positively correlated with derived tail and limb morphology, consistent with increasingly agile swimming. Early modifications of the quad-
rate, tympanum, and extracollumellar cartilage for submarine hearing is augmented in later forms by modification of the facial nerves for acoustic beamforming, suggested increased role in feeding. Diminished preaural and extracollumellar structures, lessened verte-
basa organ and development of novel systems to deal with submarine acoustics are similar to the pattern seen in the evolution of the whales.

Technical Session XIII, Tuesday 2:45

COMPARATIVE EVOLUTIONARY ECOLOGICAL MORPHOLOGY OF LOCOMOTION IN TERRESTRIAL VERTEBRATE CARNIVORES

Polly, P. David, Indiana University, Bloomington, IN, USA; Lawing, A. Michelle, Indiana University, Bloomington, IN, USA; Head, Jason, University of Toronto at Mississauga, Toronto, ON, Canada

We studied the evolution in locomotor traits in two North American carnivore guilds, the Mustelinae Carnivora and the Viperidae Serpentes, examining their evolution in functional, phylogenetic, community and environmental contexts to better understand how the coevolu-
tion of morphology, environments, and members of the same guild have interacted over long temporal and large spatial scales. We collected locomotor osteological measurements: metatarsal/ femur, anterior/posterior calcaneum, and sustentacular facet/calcaneal length in carnivores and body/tail length, vertebral length/width, and vertebral shape scores in snakes. For both carnivors and snakes, we categorized morphology relative to dominant substrate: arboreal, scansorial, natatorial, fossorial, and generalized terrestrial (snakes do not have fossorial specialists). The osteological indices were correlated with these categories in both carnivors (N=132; R² = 0.24, 0.11, and 0.35 respectively) and snakes (N=271; R²=0.52, 0.44, and 0.42 respectively). We used these continuously varying proportions as geometric indices because they more precisely measure the form-function interaction than do the broad locomotor categories. Using phylogenetic regression, we traced the morphological evolution on a tree whose branch-lengths were calibrated against the fossil record. Crown carnivors originated with a five-toed terrestrial morphology when global temperatures were falling and the dominant tropical forest habitat was fragmenting, rapidly diversifying into arboreal, scansorial, and natatorial morphologies as global habitats opened. Pit vipers originated 47 mya with generalized terrestrial morphology and radiated into
different ecomorphological categories later than carnivorans during the Miocene and Plio-Pleistocene. Community sorting was assessed by sampling all species in each group on a 50 km grid across the continent. Mean locomotor morphology in a community was strongly correlated with ecoregion (R² = 0.70) and macrovegetation (R² = 0.49). In snakes, community-level locomotor ecomorphology was most strongly correlated with mean annual temperature (R² = 0.16).

Poster Session I, (Sunday)

THE UNUSUAL PELVIC CONSTRUCTION OF THE INSULAR SHREW NESIOTTES HIDALGO (SORICIDAE, MAMMALIA) FROM MALORCA (BALEARIC ISLANDS, SPAIN)

PONS-MONJO, Guillem, Institut Català de Paleontologia, Cerdanyola del Valles; SPAIN; FURIO, Marc, Institut Català de Paleontologia, Cerdanyola del Valles; SPAIN; MOYÀ-SOLA, Salvador, ICREA, Institut Català de Paleontologia, Cerdanyola del Valles; SPAIN

The genus Nesiotites includes several species of endemic shrews from some Mediterranean islands. The insular shrew Nesiotites hidalg no, from the isolation of the Mediterranean islands, is described, along with additional material and recently collected specimens (totally about 100 specimens). The presence of British Cretaceous and Cenozoic of the USA. During second half of the XIX century a number of HF chimaeroid specimens were collected and studied. The holocephalian assemblage from the Hornerstown Formation (HF) (latest Maastrichthyan – earliest Paleocene) in New Jersey was the first studied, and most diverse, of the Mesozoic-HF chimaeroid assemblage consisted of 3 genera and 9 species (Morat, 1991). In 2009, a number of museum collections were re-examined. The inspection of the postcranial elements of Nesiotites resulted in the discovery that the sacro-pelvic complex of N. hidalg no was completely fused. This is, to our knowledge, the first case of a soricid in which the two halves of the pelvis and the sacrum constitute an undividable skeletal element. The lack of a similar construction in any living shrew makes it difficult to elucidate the mechanical advantage that this fused pelvic girdle could have provided. Extreme modifications like this in the postcranial skeleton of the shrews are rather infrequent, and only the recent species Scutorex someneri (the ‘hero shrew’) from Congo is comparable in its overdeveloped resistant spine for which there is no satisfactory mechanical explanation.

Poster Session I, (Sunday)

THE DIVERSITY AND NOMENCLATURAL REVISION OF THE HOLOCEPHALIAN FISHES (CHIMAERIFORMES) FROM THE HORNERTOWN FORMATION (K/T TRANSITION) OF NEW JERSEY, USA

POPOV, Evgeny, Saratov State University, Saratov, Russia

The holocephalian assemblage from the Hornertown Formation (HF) (latest Maastrichtian – earliest Paleocene) in New Jersey was the first studied, and most diverse, of the Mesozoic–Cenozoic of the USA. During second half of the XIX century a number of HF chimaeroid taxa (7 genera and 20 nominal species) based mainly on isolated tooth plates and some fine spines were published. Most of them were later revised by L. Hussakof. Prior to the current study, the HF assemblage consisted of 3 genera and 9 species (Edaphodon mirificus, E. laterigerus, E. stenobryus, E. agassizi (= E. smockii), E. sedgwicki (= E. tripartitus), Leptomylus densus, L. cooki; L. forfex; Isotæmiæ neocausariænsis). In 2009, a number of museum collections with type specimens (in New York, Philadelphia, Trenton and New Haven) were studied, along with additional material and recently collected specimens (totally about 100 specimens).

A revision of the numerous HF chimaeroid species confirms the validity of 3 genera (Morat, 1991). The presence of British Cretaceous and Cenozoic of the USA. During second half of the XIX century a number of HF chimaeroid specimens were collected and studied. The holocephalian assemblage from the Hornerstown Formation (HF) (latest Maastrichthyan – earliest Paleocene) in New Jersey was the first studied, and most diverse, of the Mesozoic–Cenozoic of the USA. During second half of the XIX century a number of HF chimaeroid taxa (7 genera and 20 nominal species) based mainly on isolated tooth plates and some fine spines were published. Most of them were later revised by L. Hussakof. Prior to the current study, the HF assemblage consisted of 3 genera and 9 species (Edaphodon mirificus, E. laterigerus, E. stenobryus, E. agassizi (= E. smockii), E. sedgwicki (= E. tripartitus), Leptomylus densus, L. cooki; L. forfex; Isotæmiæ neocausariænsis). In 2009, a number of museum collections with type specimens (in New York, Philadelphia, Trenton and New Haven) were studied, along with additional material and recently collected specimens (totally about 100 specimens).

Preparators’ Session, Monday 8:00

FROM THE BONEBED TO THE BASEMENT: COLLECTION PROCEDURES AT THE MAMMOTH SITE OF HOT SPRINGS, SOUTH DAKOTA

POATAPOVA, Olga, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, USA; AGENBROAD, Larry, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, USA; WILKINS, William, Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, USA

The Mammoth Site (MS) is a 26,000 year-old natural, geologic-hydrologic natural trap with entombed remains of Columbian mammoths and other 83 species of vertebrates, invertebrates and plants. Since the site was discovered in 1974, over 2500 specimens from 58 mammoths, and over 2,000 specimens from invertebrates have been recovered. Due to on-going excavations part of the in situ collection (5-8% of over 1,200 uncovered bones) is removed from the bonebed for treatment and shelf storage, and at the same time 5-8% of bones are added (newly excavated) annually to the bonebed, mapped and treated. In order to maintain good and reliable records of each bone that is excavated and curated, the collections procedures were developed (following Institute of Museum and Library Services (IMLS) Conservation Assessment Program and IMLS Museum Assessment Program recommendations in 2005), specimens forms redefined, and changes were made in using some of the consolidants. The MS has been carefully mapped for 36 years, predominantly through use of string grids and Cartesian mapping coordinates. With a grant from the IMLS, the MS was able to purchase a Trimble® 5600 robotic transit and completely re-map the bonebed in 2006-2009. This machine, in conjunction with ArcGIS® 9.3.3, is used to produce photo-accurate maps of the specimens, both those in situ and those that have been removed during

Mammoth function has been investigated using a range of techniques, from simple beam modeling to complex finite element analysis, with numerous studies focusing on extant and extinct archosaurs. However, it is unclear how well results from different modeling methods reflect reality, or how specific performance variables (e.g., reaction forces, model damage, and stress distribution) vary between techniques. These uncertainties must be considered when comparing results from different techniques. Furthermore, it is important to understand how estimated input parameters (e.g., material properties and muscle forces) and the loss of scale-smooth features such as sutures in fossil taxa affect model results. We modeled the Alligator mandible during biting at five different locations using both 2D and 3D beam models, as well as a series of increasingly complex finite element (FE) models accounting for sutures, bone anisotropy, variable constraints, and muscle activity. Our results demonstrate that the FE models exhibited higher peak stresses and greater variability in stress distribution than the beam models; furthermore, reaction force magnitudes and distribution were different in the beam and FE models. These findings suggest that the Alligator mandible is not optimized to reduce stress during biting (compared to a simple beam) and that beam modeling does not accurately represent the mechanical behavior of the Alligator mandible. Incorporating anisotropic bone material properties and sutures into the FE model reduced sagittal stresses within the mandible, but led to increased transverse and torsional stresses, and reduced bite force magnitude. Our results also suggest that the elongate pterygoid flange of crocodilians mitigates mediolateral and torsional stresses generated during bites on the posterior teeth. These findings demonstrate that model complexity determines which questions regarding mandibular function can be addressed, and highlight the limits imposed by taphonomy when modeling fossil archosaurs.
excavations. For several years the Mammoth Site has been looking into Light Detection and Ranging (LiDAR) mapping, a laser based technique that yields a 3D point cloud, showing the topology of the bonebed in a way that 2D mapping cannot. Lamentably, LiDAR is an expensive technology beyond the MS’s means at this time. By feeding multiple views of a single area of the bonebed into photogrammetric software, a 3D map can be generated. There are several bonebed applications for this new technology. First, by distributing this data to other researchers, they will be able to take measurements of the relationships between bones, and measure their morphology. Second, using archival images, it will be possible to make accurate 3D meshes of the conditions at the site during past excavations.

Poster Session I, (Sunday)

NEW CHORDICHTHYAN MICOREMAINS FROM NEW YORK, USA: INSIGHTS INTO MIDDLE- LATE DEVONIAN CHORDICHTHYAN GLOBAL DISPERSION

POTVIN-LEDUC, Daniel, Université du Québec à Rimouski, Rimouski, QB, Canada; CLOUTIER, Richard, Université du Québec à Rimouski, Rimouski, QB, Canada; LANDING, Ed, New York State Museum, Albany, NY, USA; VANALLER HERRICK, Linda, New York State Museum, Albany, NY, USA; MANNOLINI, Frank, New York State Museum, Albany, NY, USA

Chondrichthians represent a diverse component of the Devonian fish assemblages from eastern North America. Although most Early and Middle Devonian chondrichthians are thought to be endemic to Laurussia, some of the shark genera displayed a cosmopolitan distribution by the Late Devonian. Fossil fish remains from New York state, including the Antarctilamnidae Wellerodura, suggest an earlier presence of some shark species on both Gondwana and Laurussia. A new Givetian fish assemblage from the Catskill, NY, area composed of ca. 15 species includes two shark genera (Portaldodus, Wellerodura) earlier thought to characterize Gondwanan assemblages. Abundant teeth of a new species of Portaldodus reveal a monomor- nathic heterodonty and two possible morphotypes, one of them interpreted as juvenile. Rare small teeth are referable to Portaldodus. In addition, two groups of chondrich- thyan scales have been identified: (1) compound scales of ctenacanth type and (2) body and head scales characterized by a single median rhomboid crown and an anteriorly protruding base. Elasmobranch scales similar to both groups have been described from the Givetian of east Gondwana (Antarctica). However, the first group shows even stronger affinity to scales from the Givetian of west Gondwana (Spain). Remains of Portaldodus and antarctilamnids are known from Australia, Antarctica, South Africa, South America (Bolivia, Brazil, Colomb- bia and Venezuela); Iran and Saudi Arabia, and also from the USA and Europe (Spain, Po- land and Russia); this distribution could suggest a dispersal path from north to south, along the west coast of Gondwana. Thus, the New York fossils reinforce the hypothesis of a global dispersal of sharks by the Middle Devonian rather than by the Late Devonian.

Physical Drivers and Marine Tetrapod Evolution, Monday 12:00

WHAT HAPPENED TO GRAY WHALES DURING THE PLEISTOCENE? RECONSTRUCTING THE ECOLOGICAL IMPACT OF SEA-LEVEL CHANGE ON CRITICAL BENTHIC FEEDING HABITATS IN THE NORTH PACIFIC OCEAN

PVENSON, Nicholas, Smithsonian Institution, Washington, DC, USA; LINDBERG, David, University of California, Berkeley, Berkeley, CA, USA

Gray whales (Eschrichtius robustus) undertake long migrations, from Baja California to Alaska, to feed on the seasonally productive benthos of the Bering Sea. The invertebrates that form their primary prey are restricted to shallow water environments, but global sea-lev- el changes during the Pleistocene eliminated or reduced this critical habitat multiple times. Because the Eschrichtius fossil record is coincident with the onset of Northern Hemisphere glaciation, gray whales survived these massive changes to their feeding habitats, but it is unclear how. We reconstructed the ecological history of gray whales during the past 120,000 years by quantifying gray whale feeding habitat availability using bathymetric data for the North Pacific Ocean, constrained by their maximum diving depth. We used two different es- timates of pre-whaling population size (census and molecular estimates) as initial values, and plotted changes in estimated population size based on correlated changes in both eastern and western North Pacific benthic habitats during the last glacial-interglacial cycle. Results using census estimates show that the elimination of key benthic feeding habitats during glacial maxima would have caused multiple genetic bottlenecks, but such genetic patterns are absent in mitochondrial haplotype data. Results using molecular estimates show that gray whales survived glacial maxima in sufficient numbers to maintain genetic diversity, providing inde- pendent support for molecular estimates of pre-whaling population size. Given the lack of benthic feeding habitat during glacial maxima, we propose that gray whales survived the Pleistocene by employing generalist filter-feeding modes, similar to those by non-migrating sub-populations off the coast of British Columbia today.

Technical Session XV, Wednesday 8:00

A URNALOPHUS-LIKE LUNGFISH FROM THE PRAGIAN (EARLY DEVONIAN) OF YUNNAN, SOUTH CHINA

QIAO, Tao, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ZHU, Min, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Urnalophus from the Pragian (Early Devonian) of Wyoming, USA, is among the earliest known undisputed lungfish. However, some morphological features of Urnulophus such as the shape of the parasphenoid, as well as its phylogenetic relationship, have been debated. Here we report a new Urnulophus-like lungfish from the late Pragian of Yunnan, China. The new form exhibits many primitive lungfish features, such as the supraorbital canal not in contact with the infraorbital canal, 1 bones meeting behind the B bone, the skull broad- est posteriorly, the long supra-temporal series, and a short pretemporal region. It shares with Urnulophus aspects of the morphology of the palate: the surface of the palate covered predominantly by small, conical denticles, a continuous strip of teeth along the lateral margin, and a smooth undetuberculated area along the posterior margin. The new form differs from Urnulophus in the presence of the pinial foramen, the fusion of bones in the anterior part of the skull roof, the relatively long nasal capsule, and a pair of anteriorly positioned vomers. A high-resolution CT scan of the material shows that the new form has a slim triangular paras- phenoid which separates the major part of the pterygoid. This may suggest that the parasphenoid condition in Urnulophus is more likely as suggested in the original description. The ante- riorly elongated parasphenoid is also present in Diapholops, Youngolepis and porolepiforms, indicating that this might be a plesiomorphy of the Dipnomorpha. Phylogenetic analysis places the new form as the sister taxon to Urnulophus. The close relationship between these two forms may indicate some close paleogeographic connections between the South China and Eurasia blocks during the Pragian.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

PHYLOGENETICS OF FOSSIL AND EXTANT DELPHINOIDEA (CETACEA: DELPHINOIDEA) USING BAYESIAN INFERENCE

RACICOT, Rachel, Yale University, New Haven, CT, USA

Delphinoids (Cetacea: Delphinoidea) are a diverse group of charismatic cetaceans, including Phocoenidae (true porpoises), Delphinidae (oceanic dolphins), and Monodontidae (narwhals and belugas), the phylogenetic relationships of which have recently been examined exten- sively using molecular data and modern phylogenetic methods. Little emphasis has been placed on the use of morphological characters in this group, let alone scientifically rigorous morphological analysis to complement recent molecular studies. This talk will focus on two morphologically distinct lineages of delphinoid whales such as the Kentriodontidae. The uncertainty of fossil and extant delphinid affinities underscores the lack of justification for using certain fossils to calibrate molecular clocks in cetacean phylogeny. Among extant delphinoids, further complications arise as no proposed subspecies or species limits are recognized at the formal taxonomic level, despite compelling evidence for distinct lineages, nor have they been used or recognized in morphological phylogenetic analyses. To reconcile these issues within a cohesive phylogenetic framework, I analyzed morphological and molecular data using Bayesian Inference. I explored methods of partition- ing the morphological data based on character type (e.g., binary, multistate) and functional region (e.g., cranium, pectoral region) applying the Mk1 model (currently the only model of evolution available for morphology) to each. I explored the impact of excluding certain taxa, and compared results from molecular-only, morphology-only, and combined data. Monophyly of crown Delphinoidea, as well as Phocoenidae, Monodontidae, and Delphin- idae, was strongly supported. No fossils were supported as belonging within the crown taxa. Fossil taxa referable to Phocoenidae were inferred as stem delphinoids. Additionally, results confirm that the Kentriodontidae are a paraphyletic grade with some taxa sister to crown delphinids and others more closely related to other kentriodontids. These results emphasize the importance of direct taxon sampling for phylogenetic inference, and taxonomic revision of the group is imperative for conservation initiatives and any study of character evolution.

Poster Session III, (Tuesday)

DENTAL MICROWEAR ANALYSIS REVEALS SPATIAL AND TEMPORAL VARIABILITY IN THE DIET OF TWO EOCENE PRIMATES FROM FRANCE

RAMDARSHAN, Anusha, Institut des Sciences de l’Evolution de Montpellier (UMR-CNRS 5554) , Montpellier, France; MARIVAUX, Laurent, Institut des Sciences de l’Evolution de Montpellier (UMR-CNRS 5554), Montpellier, France; MERCERON, Gildas, UMR 5125 Paléoenvironnement & Paléobiosphère, Lyon, France

Diet is important in a primate’s life, correlating to parameters as diverse as foraging strate- gies, body size, ranging, or even social group. It is also highly variable, as potential food sources vary in spatial distribution and availability over time. The fossil record offers few possibilities to assess the spatial range of a given primate over its spatial and temporal distri- bution. Because of the fragmentary nature of fossils, dietary estimations for extinct primates merely represent either an overall approximation or a snapshot in time. The European pri- mate fossil record of the Eocene has been built up over decades of fieldwork and now offers the possibility of an extensive dietary study in a spatial and temporal framework. Here we focus on two taxa, Leptadapis magnus (Adapidae, Adapiformes; 32 specimens sampled) and Necrolemur antiquus (Microchoeridae, Ommatomyinae; 71 specimens sampled). These two taxa occur in different localities of the late Eocene of France ranging from MP16 (Robiac), MP17a (La Bouffie, Euzet, Fons 6) to MP17b (Perrière). Fossil diet was assessed by dental microwear analysis using a comparative database of 11 species of living strepsirhines. On the whole, leaves were a preferred food for the large bodied Leptadapis (4-5kg). However, this taxon varied from a mixed leaf/fruit diet at La Bouffie, a closed tropical rain forest envi- ronment, to a strictly folivorous one in the more open environment of Perrière. The small lemur Necrolemur (<200-300g), on the other hand, basically had a diet consisting of fruit and would have supplemented its diet with insects. Similarly to that of Leptadapis, mi- crowear patterns show variations in Necrolemur’s diet between coeval localities, most likely shifting from a soft fruit based diet at La Bouffie to a mixed fruit/insect diet in the tropical wooded savannas of Euzet and Fons, i.e. going from a soft based diet to a more abrasive one.
When comparing localities from similar tropical rainforest environments but of different ages (Robles vs La Bouffie), *Necrolemur* varies from a mixed fruit/insect diet (Robles) to a mainly fruit-based diet (La Bouffie).

**Poster Session I, (Sunday)**

**A PRELIMINARY REPORT ON A BLANCAN MICRO MAMMAL ASSEMBLAGE FROM THE OTAY RANCH VILLAGE 2 NORTH HOUSING DEVELOPMENT PROJECT, SAN DIEGO, FORMATION, CHULA VISTA, CALIFORNIA**

RANDALL, Kesler, San Diego Natural History Museum, San Diego, CA, USA; GENSBLER, Philip, Hagerman Fossil Beds National Monument, Hagerman, ID, USA

Construction activities associated with the development of the Otay Ranch Village 2 North Housing Development Project, Chula Vista, California, exposed approximately 67 feet of marine and non-marine deposits from the lower portion of the Pliocene-age San Diego Formation. Approximately 4000 lbs of micro-fossil-rich matrix was collected from informal member 1C, which at this site was a light orange brown, fine-grained sandstone as part of a 10 foot thick paleosol deposit. This unit is below and older than the terrestrial-deposited fluvial member 2C of the San Diego Formation, which previously has produced Blanccan micro vertebrate faunas from other areas of southwestern San Diego County. These faunal assemblages from member 2C have been dated to approximately 3.6 million years through biochronological and paleomagnetic techniques. After heavy liquid separation and picking, the 4000 lb sample from Otay Ranch Village 2 North produced a wide array of terrestrial vertebrates which has been catalogued into the paleontological collections of the San Diego Natural History Museum. The small mammal portion of the collection includes the leporid *Hypolagus*, soricids, the sciurids *Spermophilus* and *Tamias*, the heteromyids *Perognathus* and *Dipodomys*, and cricetid rodents *Peromyscus*, *Reithrodonotus*, *Calomys*, and *Neotoma*. A single lower carnassial tooth of the mephitid *Spilogale* was also discovered. This assemblage of micro mammals represents a Blanccan-aged fauna older than previously documented terrestrial Pliocene faunas from the San Diego Formation. This older fauna is compared to other Blanccan faunas from the Southwestern United States including San Timoteo Badlands and Vallecito-Fish Creek Badlands in Southern California; and the Verde Valley and Stafford and Duncan Basins in Arizona. Initial comparisons reveal the lack of some desert small mammals including arvicoline and geomyid rodents. The recovery of this new fauna is significant owing to the general paucity of Pliocene terrestrial deposits in California.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

**LATE MIDDLE TIFFANIAN (LATE PALEOCENE) MAMMALS FROM SOUTHEASTERN SASKATCHEWAN, CANADA**

RANKIN, Brian, University of Calgary, Calgary, AB, Canada

The late Paleocene Roche Percée mammalian local fauna is based on over 5000 specimens (principally isolated teeth and jaw fragments with teeth) collected in the early 1970s by field parties from the University of Alberta led by D. W. Krause. The fossils come from the Ravesveng Formation exposed in abandoned pits in the coalfields near Estevan, southeastern Saskatchewan, Canada. Descriptions of the Roche Percée multituberculates and plesiadapids were provided in the late 1970s, but the vast majority of the other members of the local fauna had remained unstudied until the present project. My research shows that the Roche Percée local fauna includes over 30 mammalian species, exclusive of multituberculates and plesiadapids. Significant discoveries include several new species of viverravid carnivorns, a new species of the phanocadodontid condylarth *Ectocion*, a probable new species pertaining to the semi-aquatic pantolestid *Ectocion*. During the present study, and rare teeth suggesting only the second known North American occurrence of the European lipotyphlan *Adapisorex*. More conventionally, a late middle Tiffanian Land Mammal Age (T4 lineage zone) has been assigned to the Roche Percée local fauna based mostly on the plesiadapids, including the occurrence of *Pleistiaspis chatchillii*. My correlations from the remainder of the local fauna are in general agreement with this age estimate. My comparisons suggest a close similarity of the Roche Percée assemblage to the near contemporaneous Divide Quarry local fauna in the Bighorn Basin, northern Wyoming, which occurs in geomagnetic polarity chron 26R, at approximately 59 Ma, but also reveal some similarities to slightly older early middle Tiffanian local faunas at localities further west, in the Pakkapoo Formation of central Alberta. The specimens from the Roche Percée local fauna represent the largest and most taxonomically diverse assemblage of late middle Tiffanian mammals yet known, offering a unique perspective on mammalian evolution and diversity in North America during this time interval.

**Poster Session II, (Monday)**

**OLDEST BAT (CHIROPTERA, EOCOCHIROPTERA) FROM AFRICA: EARLY EOCENE FROM EL KOHOL (ALGERIA)**

RAVEL, Anthony, Institute des Sciences de l’Evolution (UMR-CNRS 5554), MONTPELLIER, France; MARIVAUX, Laurent, Institut des Sciences de l’Evolution (UMR-CNRS 5554), Montpellier, France; TABUCE, Rodolphe, Institut des Sciences de l’Evolution (UMR-CNRS 5554), Montpellier, France; MAHBOUBI, Mohammed, Laboratoire de paléontologie, stratigraphie et paléoenvironnement, Oran, Algeria

The Afro-Arabian Paleogene fossil record of Chiroptera is very poor. In North Africa and Arabia, this record is limited, thus far, to a few localities mainly in Tunisia (Chambi, late early Eocene, Egypt (Fayum, late Eocene to early Oligocene), and the Soutanat of Oman (Taqah, early Oligocene). It consists essentially of isolated teeth or mandible fragments. Interestingly, these African fossil bat remains document two modern groups (Vespertilionoidea and Rhinolophoidea) as early as the late early Eocene, while the bat fossil record of North America, Eurasia and Antarctica principally includes members of the Eochiroptera during the early Eocene. In Algeria, the region of Blida, in the earliest Eocene El Kohol Formation, which yielded one of the earliest mammalian faunas of the continent. A very primitive and endemic fauna including the early protobatoid *Nu-midotherium kholense* was discovered in a marl level at the base of this rock unit. Recent fieldwork in the same level has led to the discovery of a new vertebrate locality, including isolated teeth of Chiroptera. These fossils represent the first occurrence of Chiroptera in Africa, thus extending back to the earliest Eocene the record of the group on that continent. The material consists of an upper molar and two fragments of lower molars. The upper molar shows a rectangular outline, which is twisted mesio-distally. Its lingual part displays a strong and central protocone that is surrounded lingually by a complete cingulum, which extends distally forming a hypsognathic lobe. A metaconule is faintly visible. On the lower molars, the trigonid is higher than the talonid. The large talonid basin bears a small hypoconulid, which is dinto-lingular in position, and relatively close but labial to the entocnium. This condition of the hypoconulid-hypocnulid-entocnium complex corresponds to a typical subyotodont structure. Such a dental character association occurs primarily in Eochiroptera. This first occurrence of Eochiroptera in Algeria, and by extension in Africa, shows that this basal group of Chiroptera had a worldwide distribution during the early Paleogene.

**STASIS IN LATE PLEISTOCENE BISON FROM LA BREA TAR PITS OVER THE LAST GLACIAL-INTERGLACIAL CYCLE**

RAYMOND, Kristina, East Tennessee State University, Johnson City, TN, USA; PROTHERO, Donald, Occidental College, Los Angeles, CA, USA

Conventional evolutionary biology often portrays organisms as infinitely responsive to environmental change in size and morphology, but many decades of research on large Pleistocene mammals has shown that they don’t change much during the climatic changes of multiple glacial-interglacial cycles. To evaluate this hypothesis, we studied one of the most common large Pleistocene herbivores, *Bison antiquus*, from the Rancho La Brea tar pits in the Page Museum in Los Angeles. We measured large samples (more than 100 of each element) of several dimensions of the most common bones (typically leg or foot bones) from all the pigs with good radiocarbon dates. We evaluated these measurements for variation through time using standard ANOVA and t-tests. Despite that all the available climatic indicators (isotopes, plants, pollen, land snails) provide evidence of major climatic and vegetation change from the previous interglacial (40 ka-20 ka) to the peak glacial (20 ka-15 ka) to the glacial-interglacial transition (15 ka-10 ka) to the Holocene, none of these bones show any statistically significant differences in size or shape from one level to the next. Such stasis is prevalent among all the common mammals and birds over the late Pleistocene-Holocene, despite dramatic climatic changes. This suggests that birds and mammals are less responsive to environmental variables than conventional evolutionary biology has assumed.
NEW PERMO-CARBONIFEROUS CASEID SYNAPSIDS FROM NORTH AMERICA AND EUROPE, AND THEIR EVOLUTIONARY SIGNIFICANCE
REISZ, Robert, University of Toronto Mississauga, Mississauga, ON, Canada; FROBISCH, Jörg, Field Museum of Natural History, Chicago, IL, USA; BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA, USA; HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, PA, USA
Two new basal members of Caseidae provide valuable insights into the early evolution of this clade of Paleozoic synapsids. The preparation and study of a very small, immature synapsid skeleton from the Upper Pennsylvanian Hamilton Quarry in Kansas reveals that it represents the oldest known caseid. The skeleton includes phylogenetically informative parts of the skull, including a very large supratemporal that overhangs the skull table, large triradiate postorbital with a significant contribution to the skull table, reduced squamosal, small temporal fenestra, and a large subtemporal bar. Phylogenetic analysis places this new taxon at the base of Caseidae, more closely related to members of that clade than to its sister taxon, the Eothyrididae. The presence of this basal caseid at the Hamilton Quarry greatly extends the fossil record of this clade of stem synapsids, significantly shortening the ghost lineage of this taxon. Despite its caseid affinity, it lacks any osteological evidence for high fiber herbivory, a characteristic of all other known caseids. Similarly, preparation of caseid specimens collected from the famous Lower Permian Bromacker Quarry near Gotha, Germany has resulted in the discovery of a partial skull. This discovery also has major implications for our understanding of caseid evolution because this is one of the oldest known caseids, being only slightly younger than the small caseid from Kansas. Several articulated postcranial skeletons of this undescribed caseid have been collected previously and prepared, and they reveal the typical features that denote high fiber herbivory, such as a barrel-shaped body. However, the skull lacks the typical leaf-shaped dentition seen in younger caseids. These new caseids not only extend the fossil record of the clade significantly, but they also indicate that the primitive condition for the clade is a combination of relatively small size and a carnivorous or omnivorous diet. Thus, high fiber herbivory and large body size likely evolved within Casei- dae, an evolutionary trend that seems to have paralleled the history of another clade of stem synapsids, the Edaphosauroidae.

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considerably stouter in proportion than the North American genus Scutelloaurus, suggesting that the new taxon is an obligate quadraped with a body length of approximately two meters. The subtriangular crowns, none of which show wear facets, have symmetrical enamel, a rounded cingulum, and five to six denticles along each edge. The dentition thus appears similar to that of Scutelloaurus, the most basal thyreophoran known at present. Portions of both girdles have been recovered showing features more advanced than in comparable bones in Scutelloaurus. The scapular blade has a very unusual subtriangular, rather than subrectangular, shape. The ilium has a moderate supracetabular crest over an acetabulum that is largely open. The preacetabular process twists into a horizontal plane and expands towards its distal end. The pubis has a short prepubic process that is dorsoventrally, rather than transversely, compressed, and a postpubic process that is reduced to a slender rod about one-half the length of the ischium. Dermal armor ranges from small, keeled ossicles to considerably larger hollow-based scutes half as long as the ilium. Although comparisons are limited at present, the new basal thyreophoran appears to be more advanced than Scutelloaurus but to lie outside Eurypoda (Stegosaurus + Ankylosaurus). It represents the first basal thyreophoran from a southern continent.

Physical Drivers and Marine Tetrapod Evolution, Monday 8:30

THE DIVERSIFICATION AND DECLINE OF SAUROPTERYGIA IN THE TRIASSIC WESTERN TETHYS
REEPEL, Olivier, The Field Museum, Chicago, IL, USA

During the Triassic, sauropterygian diversification occurred along coastlines, in lagoonal settings, or shallow epicontinental seas. Only the plesiosaurs ventured into deeper waters, eventually giving rise to the pelagic plesiosaurs at the Triassic-Jurassic boundary. The correlation of sauropterygian diversification with geophysical events is particularly well documented for the Western Tethyan faunal province. A marine transgression beginning in the late Early Triassic, and proceeding from East to West, led to the colonization of the central European Muschelkalk basin by sauropterygians. The opening of a southern gateway allowed sauropterygians to disperse into intraplatform basins along the northern shore of the Western Tethys, providing for further diversification. Rifting between the African and Eurasian plates opened the Neoetethys, which was followed by a divergence of southern (middle Eastern) and northern (European) nothosaurian taxa. The last stem sauropterygians to go extinct in the Late Triassic were the cymadonodont placodonts, which in virtue of their dental armor were tolerant of varied environmental conditions that resulted in a sea-level drop and an increasingly warmer climate.

Poster Session IV, (Wednesday)

EVIDENCE OF A PREDATION ATTEMPT ON A GIANT BEAVER BY A TERRESTRIAL CARNIVORE
RINALDI, Caroline, UMKC School of Medicine, Kansas City, MO, USA; MARTIN, Larty, University of Kansas Natural History Museum and Biodiversity Research Center, Lawrence, KS, USA; TIMM, Robert, University of Kansas Natural History Museum and Biodiversity Research Center, Lawrence, KS, USA; COLE III, Theodore, UMKC School of Medicine, Kansas City, MO, USA; KUMAR, Vandana, UMKC School of Dentistry, Kansas City, MO, USA

The skull of an adult Late Pleistocene giant beaver (currently referred to as Castoroides leiseyorum from the Cooper River of Charleston Co., South Carolina) shows evidence of a partially-healed bite wound on the left maxilla. A puncture wound in the left infraorbital from the Cooper River of Charleston Co., South Carolina) shows evidence of Aguscalantia leiseyorum. Here we report the first known mammals from the underlying Late Oligocene/early Miocene Las Cascadas Formation (Centenario Fauna). We here report the first known mammals from the underlying Late Oligocene/early Miocene Las Cascadas Formation, a volcanoclastic and tuffaceous sequence cropping in the southern part of the Panama Canal. The fauna assemblage includes the oldest records of carnivores, rodents, peccaries, equids, anthracotheres, proto cetoids, and camels from the Panama Canal. The new camels, represented by two partial dentaries and isolated lower teeth, can be attributed to Floridatragulus based on the following characteristics: 1) a complete lower dental formula, 2) brachyodont lower molars, 3) an unusual elongated jaw with 2 caniniform teeth (C1-P1) well separated by a diastema; 4) a long and narrow mandibular symphysis; 5) reduced lower premolars; 6) small intercolumna lar pillars present in the molars; and 7) an M3 hypochmolid divided by lingual and labial selenes. This new Central American floridatragulid lacks the presumably more derived P2-P3 diastema present in Hemingfordian-Barstovian North American Floridatragulus (F. dolichanchantherus, F. helouxus, F. namus and F. texanus) suggesting a primitive morphological state similar to the potentially younger floridatragulid Aguscalantia wilsonti from the Hemingfordian of Mexico and possibly Aguscalantia sp. from the Arikareean of the Texas Big Bend area. Preliminary geochronological and stratigraphical data indicate that the Las Cascadas local fauna may constitute a distinctive Arikareean faunal province characterized by the arrival of early Miocene northern immigrants into a small continental basin clearly connected with North American continental terrains. The inferred appearances of Agus calantia in the Hemingfordian of Mexico and the late Arikareean of Texas and Panama are consistent with the idea that ungulates appearing in the early Miocene of North America may have had their origins in Central America.

Poster Session IV, (Wednesday)

NEW MAMMAL RECORDS FROM THE EARLY MIocene CASTILLO formation of VENEZUELA
RINCON, Ascanio, Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela; SOLOZANO, Andrés, Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela; MCDONALD, H., National Park Service, Fort Collins, CO, USA

We report four mammals: Lipotinia, Astropatherinae, Pamphiderini and Orophodontini. The first two genera are new records from the late Early Triassic, and proceeding from East to West, led to the colonialization of the Western Tethys, providing for further diversification. Rifting between the African and Eurasian plates opened the Neoetethys, which was followed by a divergence of southern (middle Eastern) and northern (European) nothosaurian taxa. The last stem sauropterygians to go extinct in the Late Triassic were the cymadonodont placodonts, which in virtue of their dental armor were tolerant of varied environmental conditions that resulted in a sea-level drop and an increasingly warmer climate.

Poster Session III, (Tuesday)

ADVANCES IN UNGULATE DENTAL WEAR TECHNIQUES REVEAL NEW PATTERNS OF NICHE BREADTH AND EXPANSION THROUGHOUT THE CENOZOIC
RIVALS, Florent, ICREA and Institut Català de Paleobiologia Humana i Evolució Social, Taragona, Spain; SEMPLIBERGON, Gina, Bay Path College, Longmeadow, MA, USA; SOLOUNIÁS, Nikos, New York College of Osteopathic Medicine, Old Westbury, NY, USA

In the last few decades, dietary ecological reconstructions have been used as powerful tools in gaining insight into local and global environmental trends. Ungulate mesowear and microwear studies in particular serve as useful proxies for demonstrating the existence of geographical and/or temporal variability in diet and vegetation structure. Improvements in these techniques reveal patterns involving Cenozoic vegetation and climatic structure as well as aspects of mammalian niche utilization. Results here indicate a congruity of responses to climate and aridity shifts among different ungulates and a much greater plasticity in dietary behavior among forms with similar tooth crown heights and morphology than previously supposed. Different diets are observed by the same taxon from different localities and brachy-
dentine is well documented that a priori exclusion of taxa can have a major impact on the outcome of analyses. The last decade saw a boost in our knowledge of pterosaur phylogeny, both by the discovery of new taxa and by the publication and improvement of several works on the topic. The relationship between basal pterosaurs is, however, still a hot debate. Even though it has been noticed that the pruned taxa were not necessarily the most incomplete ones. Also, we would like to draw attention to the differences obtained between a priory and a posteriori deletion of taxa. When eight taxa were a priori excluded, Austriadactylus and Cacibupteryx were recovered as the basalmost pterosaurs, while the Anurognathidae was found in a sister-group relationship to the Pterodactyloidea, whose topology remained unchanged. It is important to notice that the pruned taxa were not necessarily the most incomplete ones. Also, we would like to draw attention to the differences obtained between a priori and a posteriori deletion of taxa. When eight taxa were a priori excluded, Austriadactylus and Cacibupteryx were recovered as the basalmost pterosaurs, while the Anurognathidae was found in a sister-group relationship to the Pterodactyloidea, thus making the ‘Ubeidiya specimens can be assigned to G. jumae based on biochronology. Contrary to previous studies only three sites in the Levant provide evidence for the presence of Giraffa. This confirms an African dispersal beginning in the Late Pliocene and at least two dispersal events. A previously unnoted dispersal event dated to the Epivillafranchian is suggested by the giraffe present at Latamne, which differs from the earlier species in the Levant. The dispersal of Giraffa, a browser taxon, can be correlated with more humid conditions observed in the Sahara and Negev deserts at these times which would have allowed dispersing populations to cross from East Africa to the Southern Levant. This study provides insights into pathways of dispersal of large mammals during the Plio-Pleistocene and its relationship to climate change.

Technical Session VI, Monday 3:45

RODGERS, Jeri, The University of Texas at Austin, Austin, TX, USA; RODGERS, Michael, Hughes Network Systems, LLC, San Diego, CA, USA

Neurologic experiments on humans and domestic animal models provide tools for understanding relative vestibular sensory experiences across extant and extinct mammal species. Researchers have established some relationships between the dimensions of the inner ear, semicircular canal arc, radius of curvature and locomotor agility. These previous studies worked from classic models of semicircular canal orthogonality and parallelism for the semicircular canal system contained within the thoracic skull. Other studies investigating the orientation of semicircular canals in a head-centered reference system found significant deviations of canal orientations and angular relationships from this classic model for humans and common experimental species. These canal variations result in misalignment with the orientations of eye muscles whose eye motor tracking stimulation are influenced by excitatory and inhibitory signals from specific canals. Separate recent neurologic studies have found that semicircular canal dimensions and orientations influence not only balance and eye tracking movements but also navigational abilities processed in higher-order neural computations.

Those results came from study of humans and other animals with terrestrial lifestyles. We now report results from a study of 31 extant and recently extinct thier mammal species that combined semicircular canal dimensions and orientations to determine the animals’ preferred vestibular sensitivity directions in 3D environments. The study utilized HRXCT scans of skulls, 3D imaging, and vector analysis of the inner ear semicircular canal bony labyrinth endocasts. This work extends methods previously utilized for very limited sets of domestic terrestrial species to a wide range of species that exhibit different locomotor specializations and it provides an understanding of locomotor specialization and sensory sensitivity in extinct mammals.

Poster Session I, (Sunday)

REAPPRaisal OF BASAL PTEROSAUR RELATIONSHIPS THROUGH THE REDUCED CONSENSUS METHOD

RODRIGUEZ, Taios, Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; KELLNER, Alexander, Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

The last decade saw a boost in our knowledge of pterosaur phylogeny, both by the discovery of new taxa and by the publication and improvement of several works on the topic. The relationship between basal pterosaurs is, however, still a hot debate. Even though it has been noticed that the pruned taxa were not necessarily the most incomplete ones. Also, we would like to draw attention to the differences obtained between a priori and a posteriori deletion of taxa. When eight taxa were a priori excluded, Austriadactylus and Cacibupteryx were recovered as the basalmost pterosaurs, while the Anurognathidae was found in a sister-group relationship to the Pterodactyloidea, thus making the ‘Ubeidiya specimens can be assigned to G. jumae based on biochronology. Contrary to previous studies only three sites in the Levant provide evidence for the presence of Giraffa. This confirms an African dispersal beginning in the Late Pliocene and at least two dispersal events. A previously unnoted dispersal event dated to the Epivillafranchian is suggested by the giraffe present at Latamne, which differs from the earlier species in the Levant. The dispersal of Giraffa, a browser taxon, can be correlated with more humid conditions observed in the Sahara and Negev deserts at these times which would have allowed dispersing populations to cross from East Africa to the Southern Levant. This study provides insights into pathways of dispersal of large mammals during the Plio-Pleistocene and its relationship to climate change.

Poster Session I, (Monday)

STABLE CARBON ISOTOPE VALUES IN MOSASAUR TOOTH ENAMEL: REFLECT NICHE DIFFERENTIATION

ROBBINS, John, Southern Methodist University, Dallas, TX, USA; POLCYN, Michael, Southern Methodist University, Dallas, TX, USA; FERGUSON, Kurt, Southern Methodist University, Dallas, TX, USA; JACOBS, Louis, Southern Methodist University, Dallas, TX, USA

This study presents stable carbon isotope data from tooth enamel for mosasaurine, tylosaurine and plioplatecarpine mosasaurs. Tylosaurine mosasaurs are represented by species and individuals of varying ontogenetic stages and differing geological ages. 13C values range from ~7%o for a small basal tylosaurine from the Turonian of Texas, between ~8.0 and ~10.5%o for the moderately-sized Campanian T. tonosits, and between ~10.5 and ~13.2%o for large individuals of a Campanian T. proriger. Because carbon isotope values of primary producers decrease with increasing distance from the shore, the values from tylosaurine mosasaurs indicate increasing foraging range correlated with increasing average body size over time. A large-bodied Mosasaurus presents a value far lower (~14.4%o) than ~13%o values previously reported for this genus (~7 to ~10%o). Durophagous mosasaurs such as Globidens present values of ~10.5 to ~14.5%o. Tooth enamel ~13C values should reflect the isotopic values of their prey, in this case indicating the lighter values of fish. Additionally, samples from two individuals of Prognathodon are among the most depleted isotope values found in mosasaurs (~11.3 to ~16.2%o). The depleted values for Prognathodon likely reper- sent the respiratory effect of long dive times without expelling CO2, which has been argued as a cause of lower ~13C values in the tissues of deep-diving species compared to their shallow- and non-diving counterparts. This study reinforces the conclusion that niche differentiation in mosasaurs is reflected in stable carbon isotope values of tooth enamel.

Poster Session I, (Wednesday)

THE TAXONOMY AND BIOGEOGRAPHY OF GIRAFFA SPP., IN THE PLIO-PLEISTOCENE: EVIDENCE FOR MULTIPLE DISPERsALS OUT OF AFRICA

ROBINSON, Chris, Department of Biology, Bronx Community College, CUNY, Bronx, NY, USA; BELMAKER, Miriam, Department of Anthropology, Harvard University, Cambridge, MA, USA

The taxonomy and biogeography of the African and Eurasian Giraffidae is debated, particularly with regard to their importance for understanding the tempo and mode of faunal dispersals from Africa to Eurasia. It has been suggested that the presence of giraffids in Europe and Levant is evidence for dispersals of African fauna and that there were probably no new dispersals of these taxa during the Pleistocene. This study analyzes evidence for the presence of the genus Giraffa in Europe and the Levant and tests the hypotheses that: 1) All European giraffid Fossilene species are Asian rather than African, 2) the presence of Giraffa in the Levant indicates an African dispersal start-
NEW INSIGHTS INTO THE GEOLOGICAL CONTEXT OF THE LATE CRETACEOUS VERTEBRATE ASSEMBLAGE FROM THE MAEVARANO FORMATION, MAHAJANGA BASIN, MADAGASCAR

ROGERS, Raymond, Macalester College, Saint Paul, MN, USA; KRAUSE, David, Stony Brook University, Stony Brook, NY, USA

The Maevarano Formation of the Mahajanga Basin, northwestern Madagascar has yielded a spectacular assemblage of Late Cretaceous vertebrates, including ray-finned fishes, amphibians, turtles, snakes, non-ophidian squamates ("lizards"), crocodyliforms, non-avian dinosaurs, birds, and mammals. Analyses of this assemblage have revealed significant new insights into its diversity, phylogenetic relationships, biogeography, and paleoecology. Geological studies of the formation and associated units have advanced in pace with the many paleontological discoveries and analyses, and at present there is a very good understanding of the stratigraphy, taphonomy, and paleoenvironment of the Upper Cretaceous section in the Mahajanga Basin. In the northern Study Area (the focal area of field studies for almost two decades), the Maevarano Formation consists of terrestrial facies that represent a dynamic dryland ecosystem laid down in a highly seasonal, semi-arid climate when this region lay within the subtropical desert belt. Various lines of evidence indicate that the formation is Maastrichtian in age. There are no data whatsoever that support previous contentions that the Maevarano Formation is Campanian or older. It is also likely that the beds that yield the vast majority of fossils in the Berviorva area, which are included within the Anemalambela Member, represent an extremely short interval of time. Indeed, sedimentological and taphonomic datasets indicate that most fossils recovered from the member were deposited in recurrent debris flows that collectively represent a few particularly stressful years during the Maastrichtian. Lastly, recent reconnaissance on the western side of the Betsiboka delta along the shores of Lake Kinkony, located ~90 km to the west of the Berviorva Study Area, has led to the identification of a new member in the Maevarano Formation. The distinctive light gray to white calcareous sandstones and marlstones of this new, soon-to-be-formalized unit yield an abundance of aquatic and semi-aquatic vertebrates, and represent a heretofore unsampled paleoenvironment of the Maevarano Formation, which is otherwise comprised of more terrestrial members.

POSTCRANIA OF SMALL MAMMALS FROM THE LATE PALEOCENE OF WALBECK, GERMANY

ROSE, Kenneth, Johns Hopkins University, School of Medicine, Baltimore, MD, USA; STORCH, Gerhard, Forschungsinstitut Senckenberg, D-60325 Frankfurt, Germany

The Walbeck site (late Paleocene of Sachsen-Anhalt, Germany), one of only a few Paleocene mammal localities in Europe and the only one in Germany, has produced a moderately diverse assemblage of mammals including 14 species in at least 5 orders. Although the fossils were collected 70 years ago, significant parts of the collection remain unstudied. The fossils come from Oligocene fissure fills in the Muschelkalk, interpreted to represent a single deposition of reworked Thanetian sediments. Here we summarize for the first time an extraordinary collection of micro-mammal postcrania from the Walbeck fissures. More than 300 individual bones were examined and sorted into morphs for each element. Based on comparative anatomy, size, and relative abundance, we have attempted to associate those elements most likely to represent the same taxon, and to assign them to the most likely dental taxon from Walbeck. The supposed erinaceomorphs Adunator (n=600) are the most common small taxa in the fauna, accounting for the most advanced analysis. The veterinary term for the associated linear sclerosis is "puppy line," attributed to plastic deformation that resolves as the canine ages. Absence of peri-lesional disorganized bone reaction rules out infectious disease, the only major differential diagnostic consideration. Stress fractures result from repetitive stress or single traumatic events. Intraspecific conflict-related horn injuries would be expected to cause bone scoring, not linear periosteal reaction. Actualistic analysis eliminates even that remote possibility. Attributing linear alterations to effects of conspecific horn might have credibility, if damage was a gouge rather than peristomal reaction and if a reasonable behavior were presented that would explain the direction of the linear damage. It is unclear how a horn attack would cause such vertical damage, unless the victim was already lying on its side, a position offering a much more vulnerable target. It is hypothesized that the observed linear fracture in Triceratops skull elements may represent part (although exaggerated) of normal growth or at least that the process of repair could not keep up with the stress-induced changes of remodeling. This is parsimonious with the variation in the Cincinnati frill morphology that characterizes ceratopsian ontogeny.

A NEW SPECIES OF MOROPUS IN THE BATESLAND FORMATION AND A REVIEW OF CHALICOthere CERATOPSID FROM THE RUNNINGWATER FORMATION, GREAT PLAINS MIOCENE OF NORTH AMERICA

ROUND, Carolyn, University of Massachusetts, Amherst, MA, USA; COOMBS, Margery, University of Massachusetts, Amherst, MA, USA

The chalicotherium Moropus was a rare perissodactyl present in the Great Plains region of North America during the Miocene. On the Great Plains, there is a temporal gap in named species of Moropus through much of the Hemingfordian North American Land Mamm Age. Within this space in time are specimens currently referred to as Moropus sp. from the Batesland Formation in southwest South Dakota and the Runningwater Formation in northwestern Nebraska. A comparison of these fossils with those of previously described species of North American chalicotheres, such as Moropus elatus, Moropus hollandi, Tylocephalonyx skinneri, Moropus merriani, and Moropus matthiwi has shown that there are notable differences between equivalent skeletal elements, especially the teeth and bones of the manus and pes. Further examination of fossils belonging to Moropus sp. from the Batesland and Runningwater Formations has revealed that specimens from these two formations possess some substantial differences in morphology. This result is intriguing, as the Batesland and Runningwater Formations share some of the faunal elements and are considered to be approximate temporal equivalents. Based on these findings, it is proposed that the specimens of Moropus sp. from the Batesland Formation belong to a new species of Moropus, which may include some Runningwater specimens, and that the other specimens from the Runningwater Formation may belong to Moropus hollandi, or a different new species of Moropus.
claws in the manus, the wide-gauge trackway, and a step angle between 100° and 120°, are features found in the ichnogenus Brontopodus. Isolated tridactyl footprints, of variable size, were assigned to Theropoda. Interestingly, some beds showed notable bioturbation, caused by hundreds of sauropod footprints, in the same horizon. This is the first dinosaur track site recorded for this Jurassic unit. Nevertheless, this site is placed approximately 100 km from the well known Chacarilla Formation, where only indistincts from Cretaceous levels are present. Also, this is the second Jurassic sauropod record in Chile, together with the southern Parabrontopodus record from the Baños del Flaco Formation, being the first Brontopodus-like record of the Gondwana occidental margin. Future study of this site will broaden our understanding about the faunistic representation of dinosaur assemblages in this part of South America and Gondwana.

Technical Session II, Sunday 10:15
CT SCANNING ANALYSIS OF THE BASICRANIUM AND THE INNER EAR OF HALDANODON EXSPECTATUS (DOCODONTA, MAMMALIA)

RUF, Irika, Universität Bonn, Bonn, Germany; LUO, Zhe-Xi, Carnegie Museum of Natural History, Pittsburgh, PA, USA; MARTIN, Thomas, Universität Bonn, Bonn, Germany
The docodont Haldanodon exspectatus, a mammaliform from the Upper Jurassic of Portugal, is a major taxon for studying higher level relationships of mammaliforms and their morphological evolution. Based on high-resolution computed tomography scanning of four basioccipital specimens of Haldanodon, we developed a new reconstruction of the petrosal, including the inner ear. Our new study confirms that the main characteristics of Haldanodon in the ears cochleae, the lateral trough and the lateral flange of the petrosal are similar to their homologues in other mammaliforms, such as Morganucodon and Sinoconodon. However, Haldanodon is unique among Mesozoic mammaliforms in having a hypertrophied and spongy paroccipital region. The paroccipital process is massive and excavated by a large epitympanic recess and a deep stapedial muscle fossa much larger than in other mammaliforms. The large size of these external structures is accompanied by extensive development of the internal structures of the petrosal and the exoccipital. The inferior petrosal sinuses in the pars cochlearis is well developed, with multiple external foramina, in correlation with the porous interior of the basioccipital and basisphenoid bones. One specimen has preserved the stapled footplate and parts of the crurae, which were attached in the center and at the posterior border of the footplate. The vestibular part of the inner ear endoast of Haldanodon resembles the condition seen in Morganucodon and Sinoconodon. The anterior semicircular canal is the largest and the posterior semicircular canal is almost triangular in shape. However, the cochlear canal of Haldanodon has a curvature to almost 180°, with an expanded apex, comparable to the apex of the cochlear canal in monotremes, which corresponds to the lagenan macula in the bent membranous duct. The internal acoustic meatus appears to have a separate channel continuing anteriorly with a shallow sulcus on the interior surface of the cochlear canal. We interpreted that these bony structures correspond to the lagenal innervation in Haldanodon, which likely had a cochlear lagenan macula as in monotremes.

Poster Session I, (Sunday)
MAXIMUM PARSIMONY AND BAYESIAN INFERENCE ANALYSES OF PALEOZOIC TEMNOSPONDYLYS: SUPPORT FOR A CLADE OF HETEROCHRONIC TAXA AND RAPID Character EXHAUSTION IN EARLY DIVERGING BRANCHES

RUTA, Marcello, University of Bristol, Bristol, United Kingdom; BOLT, John, Field Museum of Natural History, Chicago, IL, USA
A revised and expanded data matrix of (mostly) Paleozoic temnospondyl amphibians (80 taxa including selected Devonian and Carboniferous outgroups; 270 binary and multistate characters) is used to reconstruct major branching events in this group, and to examine rates of character change and models of character extinction. Both parsimony and Bayesian inference recover major clades (edapsoids; euryapsids-based archeosauromorphs; diapsids; dissorophoids), with a sister group relationship between diapsids and dissorophoids even in the absence of putative heterochronic traits. Statistical support is moderate to good only for a few branches within each clade, and invariably poor for internal branches joining major clades. For increasing number of states, edapsoids and diapsids tend to exhaust ("use up") available characters more rapidly than other clades, suggesting novel traits in less plesiomorphic branches of the Paleozoic radiation, such as dissorophoids. The interrelationships of the latter remain highly controversial, but a few nodes appear increasingly stable (e.g. olsionoids). Amphibamids are consistently paraphyletic relative to either branchiosaurids or a branchiosaurid-microclepotheridan clade.

Technical Session I, Sunday 11:45
PALEOBIOGEOGRAPHIC RANGE OF CENTROSAURUS APERTUS (ORNITHISCHIA/CEERATOPSIDA), WITH IMPLICATIONS FOR LATE CRETACEOUS DINOSAUR PROVINCIALLY AND EVOLUTION

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; SCOTT, Evan, Cleveland Museum of Natural History, Cleveland, OH, USA; CHIBA, Kentaro, Hokkaido University, Hokkaido, Japan
Centrosaurine ceratopsids are well represented in the Late Cretaceous of North America

Poster Session I, (Sunday)
NEW LOCALITY WITH DINOSAUR TRACKS FROM THE LATE JURASSIC OF THE ATACAMA DESERT, NORTHERN CHILE

RUBILAR-ROGERS, David, Museo Nacional de Historia Natural, Santiago, Chile
Dinosaur tracks (as isolated footprints and trackways) are known from five localities in Chile, mostly in the northern part of the country. These records extend from the Upper Jurassic of the Quebrada Huayñan, in correlation with the porous interior of the basioccipital and basisphenoid bones. One specimen has preserved the stapled footplate and parts of the crurae, which were attached in the center and at the posterior border of the footplate. The vestibular part of the inner ear endoast of Haldanodon resembles the condition seen in Morganucodon and Sinoconodon. The anterior semicircular canal is the largest and the posterior semicircular canal is almost triangular in shape. However, the cochlear canal of Haldanodon has a curvature to almost 180°, with an expanded apex, comparable to the apex of the cochlear canal in monotremes, which corresponds to the lagenan macula in the bent membranous duct. The internal acoustic meatus appears to have a separate channel continuing anteriorly with a shallow sulcus on the interior surface of the cochlear canal. We interpreted that these bony structures correspond to the lagenal innervation in Haldanodon, which likely had a cochlear lagenan macula as in monotremes.

Poster Session I, (Sunday)
AGE PROFILE OF COLUMBIAN MAMMOTHS FROM THE TULE SPRINGS FOSSIL BEDS, UPPER LAS VEGAS WASH, NEVADA

ROWLAND, Stephen, Department of Geosciences, University of Nevada, Las Vegas, NV, USA
The Tule Springs Fossil Beds in Las Vegas Valley contain a diverse Rancholabrean assemblage of mammals. Columbian mammoth(Mammuthus columbi)are especially abundant. Excavations in Unit E1 of the Las Vegas Formation at the Gilcrease spring mound site have produced more than one hundred whole and partial mammoth cheek teeth, but very little bone and tooth material. Teeth of Bison, Camelops, and Equus are also present, but are much less abundant than those of Mammuthus.

For the purpose of constructing an age profile, I used thirty whole cheek teeth and determined the age (in African elephant years) of each animal at death. Twenty-seven percent of the teeth represent animals aged 0-12; forty-three percent represent animals aged 13-24; 20 percent represent animals aged 25-36; seven percent represent animals aged 37-48; and three percent represent animals aged 49-60. Radiocarbon dates of six of the teeth range from about 18 thousand radiocarbon years to about 13 thousand radiocarbon years; so the assembled age of teeth appears to represent an artribal assemblage extending over at least five thousand years, beginning near the Last Glacial Maximum.

Compared to healthy herds of African elephants, the juvenile cohort (age 0-12) of the Tule Springs population is depressed. This may be a product of preservation bias; i.e., for some reason the remains of young animals did not end up in the Gilcrease spring-mound deposit in proportion to their abundance in the population. Or it may reflect environmental stress on the population, resulting in a depressed birthrate and/or depressed juvenile survival rate.
and are known from localities from Mexico to Alaska. Their fossil record from the Belo
River Group (Campanian; ‘4 Ma) of Alberta records a succession of at least seven genera
displaying high turnover rates (~25 to .50 Ma). Previous studies have advocated that
the group represents an unbroken sequence of anagenesis, or a series of disjointed sequential
replacements of taxa tracking preferred habitats along the margin of the fluctuating Western
Interior Seaway (WIS). Previous work at the continental scale has noted narrow geographic
ranges for large-bodied Late Cretaceous ornithischians west of the WIS, and suggested a
high degree of habitat specificity and provinciality in these animals; however, there is little
data on the paleobiogeographic distribution of individual large-bodied ornithischian species
beyond their relatively restricted occurrences at single localities or within particular host
formations. An intense field sampling program in southern Alberta has revealed the first
Centrosaurus apertus specimens from the Oldman Formation, including an articulated skull,
isolated parietals, and a dense bonedense. These localities occur in relatively xeric strata that
are time equivalent to the lower part of the putatively more mesic Dinosaur Park Formation
180 km to the north. These new localities, plus a previously undocumented bonedone from Saskatchewan, show that C. apertus had a geographic range of at least 250,000 km², much
larger than previously estimated. This also provides evidence that some centrosaurine spe-
cies could tolerate a wider range of environmental conditions than previously supposed, and
could cross the putative upland-lowland transition in depositional environments adjacent to
the WIS, perhaps on an annual basis, possibly following seasonal resources or migrating to
and from nesting sites. This has implications for hypotheses of dinosaur provinciality, and
must be considered carefully when invoking habitat fragmentation and divergence models in
the evolutionary diversification of centrosaurines.

Romer Prize Session, Monday 10:30
SEASONALITY AS A POTENTIAL SOURCE OF VARIATION IN ALLIGATOR CRANIAL EVOLUTION
SADLEIR, Rudyard, University of Chicago & Field Museum, Chicago, IL, USA
Unable to internally regulate their body temperature, the global distribution of crocodylians
has been principally influenced by climate. During their 80 million year evolution, the coin-
cidence of sharp declines in taxonomic diversity with drops in global temperature during the
Eocene-Oligocene and Phocene suggests that elevated global temperature is a mechanism
 generating morphological diversity in crocodylian evolution. Natural selection operates
upon variation and developmental processes can generate phenotypic variation. Life his-
tory and environmentally induced changes during development can be a strong influence
on phenotype. The ability of an organism to change its phenotype in response to changes in
its environment can be broadly referred to as phenotypic plasticity. Alligator mississippiensis
ranching provides a unique opportunity to investigate whether the absence of seasonality
during ontogeny can induce cranial shape variability, and whether the magnitude and direc-
tion of environmentally induced shape plasticity corresponds with fossil Alligator evolution.
I use 3D geometric morphometrics to analyze extant and fossil Alligator cranial shape us-
ing coordinate data. This quantitative approach affords the ability to make comparisons of
ontogenetic shape change and can statistically test the degree to which two samples share
an ontogenetic shape trajectory for insight on evolutionary processes. In addition, geometric
morphometrics provides a framework for evaluating patterns of phenotypic evolution and
testing for phylogenetic signal in a distribution of shape data. For this analysis I developed
a new software application to visualize and explore 3D morphometric data output. My work
using 3D geometric morphometric analysis shows the removal of seasonality for continual
growth in A. mississippiensis significantly alters the cranial shape and ontogenetic shape
change from the wild population. Comparison of this phenotypic plasticity in A. mississippi-
ensis with the climate record and evolution of fossil Alligator cranial shape variation is
suggestive of a causal link between climate change, ontogenetic change, and the evolution of
Alligator cranial shape.

Poster Session II, (Monday)
PHYLOGENETICALLY STRUCTURED VARIANCE IN FELID BITE FORCE: THE ROLE OF PHYLOGENY IN THE EVOLUTION OF BITING PERFORMANCE
Sakamoto, Manabu, University of Bristol, Bristol, United Kingdom; Lloyd, Graeme, Natural History Museum, London, United Kingdom; Benton, Michael, University of
Bristol, Bristol, United Kingdom
A key question in evolution is the degree to which morphofunctional complexes are con- 
strained by phylogeny. We investigated the role of phylogeny in the evolution of biting
performance, quantified as bite forces, using phylogenetic eigenvector regression. Results
indicate that there are strong phylogenetic signals in both absolute and size-adjusted bite
forces, although it is weaker in the latter. This indicates that elimination of size influences
reduces the level of phylogenetic inertia and that the majority of the phylogenetic constraint
is a result of size. Tracing the evolution of bite force through phylogeny by character opti-
mization also supports this notion, in that relative bite force is randomly distributed across
phylogeny whereas absolute bite force diverges according to clade. The nonphylogeneti-
cally structured variance in bite force could not be sufficiently explained by species-unique
morphology or by ecology. This study demonstrates the difficulties in identifying causes of
nonphylogenetically structured variance in morphofunctional character complexes.

Technical Session XII, Tuesday 3:15
NEW MATERIAL OF MEKOSUCHUS INEXPECTATUS (CROCODYLIA: MEKOSUCHINAE) FROM THE LATE QUATERNARY OF NEW CALEDONIA, AND THE PHYLOGENETIC RELATIONSHIPS OF AUSTRALASIAN CENOZOIC CROCODYLIANS
SALISBURY, Steven, University of Queensland, Brisbane, Australia; Holt, Timothy, University of Queensland, Brisbane, Australia; Worth, Trevor, University of New South
Wales, Sydney, Australia; Sand, Christophe, Institute of Archaeology of New Caledonia and the Pacific, Noumea, New Caledonia; Andersson, Atholl, Australian National University, Canberra, Australia
New material of the small, pug-nosed eusuchian crocodyloform Mekosuchus inexpectatus
is described from late Quaternary deposits in the Pindai Caves of New Caledonia, South
West Pacific. This material permits the first detailed investigation of the cranial osteology of
this previously enigmatic crocodyliform, other species of which are known from the late Oli-
gocene (Volia) of Riversleigh, Australia, the early and late Pliocene of New Caledonia
(Trilophosuchus, Zenkerella, and Volia), and the late Miocene of Vanuatu (M. kalpakasi).
The Australian and New Caledonian species of Mekosuchus can be differentially diagnosed based on characteristics of the maxillary rostrum and interorbital region. Although poorly known, M. kalpakasi is regarded as a valid species. The morphology of Mekosuchus spp. indicates that their behav-
ior and ecology was comparable to that of extant dwarf crocodylians such as Paleosuchus
spp. and Osteolaema tetrapus. The absence of any large, permanent freshwater rivers or
lakes on New Caledonia during the Quaternary suggests that M. inexpectatus was salt toler-
ant, which may help explain the distribution of Mekosuchus spp. in the South West Pacific.
Phylogenetic analysis of 110 eusuchian taxa using 185 discrete morphological characters
places Mekosuchus in a clade with Trilophosuchus, Quinkana and Vilia, close to the base of
Crocodyloidea. Other Australasian Cenozoic crocodylians (Kambara, Bara, Australosuchus,
Palimnarchus and Harpocachampa) are most parsimoniously considered non-crocodyline
crocodylians, but character support for a clade uniting these taxa isweak. The evolution and
paleobiogeographic history of Australasian Cenozoic crocodylians is consequently more
complex than previous thought, involving likely a endemic radiation of archaic Gondwana
crocodylians (Mekosuchinae), and multiple immigrations of more derived crocodyliids from
South East Asia as New Caledonia moved into increasingly lower latitudes during the Cenozoic.

Technical Session III, Sunday 2:15
POSTCRANIAL MORPHOLOGY OF AN ANOMALUROID RODENT FROM THE LATE EOCENE EGYPT
Saleh, Hesham Mohamed, University of Oxford, Oxford, United Kingdom; Seiffert, Erik, Stony Brook University, Stony Brook, NY, USA; Bouer, Doug, Stony Brook University, Stony Brook, NY, USA; Simons, Elwyn, Division of Fossil Primates, Duke
Lemur Center, Durham, NC, USA
Anomalurid rodents are today restricted to equatorial Africa, and are represented by three
extant genera. Anomalurus and Idiurus bear a patagium and are known to be gliders; this
structure is absent in Zenkerella, but all extant genera are arboreal. Anomaluridae (Anoma-
 lurus + Pedetidae) is likely to be an endemic African group, possibly derived from the early-middle Eocene zygolimyids. Paleogene anomalurids are rare, being known from only
three sites, all about ~37 Ma, in Algeria, Egypt, and Myannar. Dental remains of anom-
-alurids have recently been recovered from the earliest late Eocene Birkit Quram Locality 2
(BQ-2) in the Fayum Depression of northern Egypt. Two species are represented -- one small
and highly derived species similar to Miocene Paranomalurus from east Africa, and a larger
and more primitive stem anomalurid that is similar in size to extant Anomalurus. BQ-2 has
also yielded the first known postcranial bones of Paleogene anomalurids, most of which are
attributable to the large-bodied species. The forelimb of this large anomalurid lacks features
present in living anomalurids that are related to increased capacity for pronation/supination
(such as enlarged and globular capitula) and support for the patagium (such as a greatly
expanded olecranon process). The humerus is very short relative to predicted body mass,
and unlike the relatively elongate humerus of living species. The femoral head is not large
and expanded as in living anomalurids, but meets the femoral shaft at a high angle, suggesting
the potential for increased abduction at the hip. Unlike extant anomalurids, the astragalus has
a short neck and no articulation for an elongate medial tarsal bone; the distal segment of the
calcaneus is relatively short, and the sustentacular shelf is relatively broad, as in sciurids and
early fossil rodents such as paramyids. Overall, the postcranial morphology of this primitive
fossil anomalurid is highly generalized, and bears many primitive features that were likely
present in the ancestral crown rodent. There is no evidence from the forelimb that this primi-
tive species had a patagium or engaged in gliding behavior.

Technical Session XV, Wednesday 10:45
FUNCTIONAL MORPHOLOGY AND MODULAR LAGS IN THE EARLY DIVERSIFICATION OF RAY-FINNED FISHES (ACTINOPTERYGI) 
Sallan, Lauren, University of Chicago, Chicago, IL, USA
Living ray-finned fishes (Actinopterygii) are ecophysiologically disparate, ranging in shape
from sunfish and angelfish to eels and seaorses. In contrast, the dozen named Devonian taxa
were homogeneous in both form and presumably function. Actinopterygian morphologi-
cal and functional diversification has been considered a major event within the Mesozoic
Marine Revolution, one occurring primarily within the teleost clade and linked to genome
duplication. However, a new impetus for examining earlier, non-teleost taxa was recently

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provided by recognition of the proximity of the Paleozoic Hangenberg extinction with both actinopterygian diversity increases and deep phylogenetic branching events. The first study of Paleozoic ray-fin morphospace reveals two surprising phenomena: 1) the diversification of early actinopterygians occurred along functional lines recognizable from extinct teleosts; 2) expansion in cranial morphospace occurred in the immediate aftermath of the end-Devonian Hangenberg extinction, while post-cranial diversification lagged by one stage. The functional signal suggests hydrodynamic limits on aquatic vertebrate form were hit early in actinopterygian evolution. The lag between head and body morphospace expansion indicates a changed relationship between functional modules falling under different selective pressures. Actinopterygian diversification was likely first driven by occupation of feeding niches, while locomotory specialization occurred only later, as competition increased. This pattern was suggested to occur among living species (e.g. cichlids) at a microevolutionary scale, but had not been observed at larger temporal or taxonomic levels. Such modular lags – gaps between the diversification of otherwise related functional structures such as heads and bodies - might be a common feature of adaptive radiations.

Poster Session III, (Tuesday)

ECOLOGICAL STRUCTURE AND HABITAT OF TWO MIDDLE MIocene SOUTH AMERICAN MAMMAL PALEOCOMMUNITIES
SAMEH, Melissa, CWRU, Cleveland, OH, USA; CROFT, Darin, CWRU, Cleveland, OH, USA
Middle Miocene South American land mammal communities include many species with few or no close living relatives. This can hamper inferences of habitat and community structure or, in some cases, result in erroneous conclusions. One way to deal with such challenges is taxon-free analysis, which focuses on attributes of species rather than their taxonomical affinities. When used with a sufficiently broad comparative data set of modern taxa, taxon-free analysis can provide robust insights into extinct communities. We performed a taxon-free analysis on 120 modern-day mammal communities representing diverse habitats, spread throughout the globe, and found small Miocene localities: La Venta, Colombia and Quebrada Honda, Bolivia. Our goal was to: (1) test whether the vegetational structure of these localities could be inferred using modern communities; and (2) determine which modern communities were most appropriate models. The fact that the vegetational structure of La Venta has been studied extensively provided a baseline to judge the accuracy of the results. We coded each nonvolant land mammal species for size, locomotor range, and diet. The size six size categories were based on an exponential scale. The locomotor categories included arboreal, semiarboreal, terrestrial, semisessorial, fossorial, semiaquatic, and cursorial. Dietary categories included fruit, grasses, insects, invertebrates, seeds, barks, and vertebrates. There was also a true omnivore category, for species that had many categories make up their primary diet. These data were used to calculate the percentage of species in each fauna in each category. We then arcsin transformed the data, and used the statistical and graphing program, JMP, to perform a cluster analysis and principal components analysis (PCA). The cluster analysis matched previous findings, that in La Venta clustered with many forested areas. Quebrada Honda grouped with open habitats and temperate broadleaf forests. Additionally, La Venta grouped with South American, North American, and African faunas, while Quebrada Honda grouped with Australian ones.

Technical Session V, Sunday 1:45

IMPACTS OF CENOZOIC CLIMATE AND HABITAT CHANGES ON RODENT COMMUNITIES
SAMUELS, Joshua, John Day Fossil Beds National Monument, Kimberly, OR, USA; JANIS, Christine, Brown University, Providence, RI, USA
A well-documented paleoclimatic record shows a general trend of later Cenozoic global cooling and increased aridity, corresponding with large scale environmental changes from predominantly forest to more open habitats. Previous studies of large mammalian herbivores show ecomorphological and community structure changes corresponding with environmental changes. Here we use the fossil record of rodents from the Cenozoic of North America to improve our understanding of the history of the herbivore component of terrestrial communities. Rodent adaptations for jumping and burrowing should reflect more open environments, and either crown tooth should reflect increased aridity and the presence of grasses. Morphological data were gathered for nearly 150 extant rodent genera, including: tooth crown height, incisor shape, relative grading area, overall limb proportions, and the size of muscular attachments. Discriminant function analysis, analysis of variance, and linear regressions were used to build an ecomorphological framework to infer the dietary and locomotory habits of extinct rodents. 51 extinct species were measured and supplemented by data from literature sources. Broad scale patterns within the North American rodent communities were analyzed, as well as finer scale changes within the fossil records of Oregon and Nebraska. Jumping adaptations first appear in rodents around the early Miocene, similar timing to ungulate cursoriality. Burrowing adaptations are seen in multiple lineages as early as the mid Oligocene (30 Ma), and highly fossorial beavers are seen by the late Oligocene (26 Ma). Multiple rodent lineages display parallel increases in herbivorous adaptations over time, such as increased crown height, enlarged grinding area, and broad incisors. The proportion of rodents within communities displaying these adaptations increased dramatically between 30 – 20 Ma. The origin and subsequent radiation of rodents with these ecomorphological adaptations corresponds with environmental changes. This suggests that, in contrast to larger mammals, rodents responded very quickly to mid Tertiary environmental changes, possibly as a result of their shorter generation times.

Poster Session IV, (Wednesday)

MORPHOLOGICAL DIVERSITY OF THE EARLY MIocene TRAGULIDAE (CETARIDACTYLA, RUMINANTIA)
SANCHEZ, Israel, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; QUIRALTE, Victoria, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; MORALES, Jorge, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; PICKFORD, Martin, Museum National d’Histoire Naturelle-CNRS, Paris, France
Tragulids comprise small and primitive ruminants that survive as relics in the Old World today. The genus Hypsiprymnops is known from Africa. A well-documented paleoclimatic record shows a general trend of later Cenozoic global cooling and increased aridity, while the mammalian fossil record displays an increase in the diversity of tragulids. The Tragulidae belong to an ancient radiation of basal non-pecoran ruminants that were very common during the Paleogene. The genus Archaeotragulus, from the late Eocene of Thailand, is the oldest known tragulid so far. However, with the exception of Archaeotragulus, the Tragulidae are unknown from Paleogene deposits. Tragulids suddenly reappear in the basal Miocene, revealing a surprisingly high diversity. These very first Miocene forms are related to modern species from Africa (ca. 19-20 Ma) and Asia. The origin of this radiation and its early Miocene relatives are still enigmatic. The talk will present a comparative anatomical analysis of the early Miocene tragulid Dorcatherium, Dorcafurus, Dorcachrome and Siamotragulus, focusing on published data and new unpublished material from Kenyan and Ugandan localities. We discuss their dental features and their biogeographical distribution. Our results show that, while tragulids are first recorded in the early Miocene of Africa and Asia, two advanced selected forms (Afrotragulus in Africa and Siamotragulus in Asia) existed along with two more primitive bunselenodont genera (Dorcabune in Asia and Dorcatheiran in Africa). The lower cheek teeth of the selenodont tragulids show a characteristic array of features including flat cusps with expanded cristids, which easily set them apart from the bunselenodont genera. These features are highly developed in Afrotragulus, which also shows elongated molaris with very reduced M3 -structure and an interrupted contact between the anterior and posterior lobes. In fact, afrotragulus will help to clarify the taxonomy and systematics of the group, hitherto obscured by the excessive use of body size as the main criterion used by specialists to diagnose extinct tragulid species. Finally, this early Miocene diversity of tragulids suggests that the family underwent a yet-unknown and important radiation event previous to their first Miocene record.

Poster Session III, (Tuesday)

THE PULMONARY ANATOMY OF ALLIGATOR MISSISSIPPIENSIS: A UNIDIRECTIONAL AIR FLOW SYSTEM THAT FORESHADOWS THE AVIAN RESPIRATORY SYSTEM
SANDERS, Richard, University of Utah SOM, Salt Lake City, UT, USA; FARMER, Colleen, University of Utah Dept Biology, Salt Lake City, UT, USA
Recently we suggested that unidirectional airflow was present in the common ancestor of birds and crocodilians based on our observations of a bird-like pattern of airflow in the lungs of alligators. Furthermore we hypothesize that there are key features of the lung that give rise to this pattern of airflow that are shared by birds and crocodilians. Here we re-examine the anatomy of the alligator lung with the aim of gaining insight into the mechanisms by which this pattern of flow is generated and of elucidating pulmonary features that may be homologous with the avian lung-air sac respiratory system. Like previous workers we find a similar structural plan is present in the crocodilian and avian lung. Using computed tomography and gross dissections, we revisit the anatomy of the crocodilian lung. The topography of the lung of juvenile American alligators is highly similar to the embryologic topography of the avian bronchial network and air sac system. We describe in greater detail the macroscopic anatomy of the alligator lung, homologize avian similarities, and identify the various morphological characters associated with the unidirectional flow-through system including a Hazelhoff loop-like aerodynamic valve that separates inhaled and exhaled airflow, dorsally located hypervascular gas exchange zones, nested spiral inhalational intrapulmonary conductive bronchi, ventral exhalational intrapulmonary bronchi, and hypovascular ventrally located rudimentary intrapulmonary air sacs.

Evolution of the Modern African Fauna, Wednesday 8:45

AFRO-ARABIA AS THE CRUCIBLE OF PROBOSCIDEAN EVOLUTION
SANDERS, William, University of Michigan, Ann Arbor, MI, USA
Since the last major review of African proboscideans three decades ago, new fossil discoveries and chronostratigraphic, systematic, and paleoecological advancements have established Afrotropical as the locus of most proboscidean evolution and the record of the order >20 million years older to the late Paleocene, and have more comprehensively documented its phylogeny and temporal, geographic, faunal, and paleobiological contexts. Proboscideans, and constituent taxa including phosphatheres, numidotheres, barytheres, moeritheres, palaeomastodonts, deinotheres, mammutids, gomphotheres, and elaphants are now known to have originated in Afro-Arabia, with greatest taxonomic diversity in the Miocene. Comparative study of features such as lophid number, accessory conule/crescentoid distribution, half-loph(id) configuration, and task shape and construction, indicates that mammutid-gomphothere divergence occurred earlier than previously recognized, possibly within early Oligocene Palaeomastodontidae. It has also helped identify basal members of initial early Miocene gomphothere radiations of gomphotheres, amebelodontines, and cheirolophodontines. As well, this work facilitated development of phylogenetic schema outlining progressive morphometric transformations in these subfamilies and mammutids
that have utility for biochronological correlation of site-horizons. Morphometric analysis also shows that the radiation of early elephants was more complex than previously understood, and isotopic studies indicate that they were among the first Afro-Arabian mammals to specialize in the consumption of C4 plants. Their activity may have opened local habitats in a manner critical to the connection between grazing and early Pleistocene grass diets of other mammalian groups, such as bovids, equids, rhinos, hippos, and suids. Subsequent competition among these groups and climate change appear to have contributed to taxonomic decline among proboscideans, leaving only savanna and forest loxodont elephants on the continent today, and forced an adaptive shift to greater incorporation of C3 resources in their diets.

Poster Session IV, (Wednesday)

HEAD SHAPE EVOLUTION IN RHINOCEROTIDAE (PERISSODACTyla): AN OVERVIEW OF ITS ECOLOGICAL IMPLICATIONS SANJIDHOO, Oscar, Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain; ALBERDI, Maria Teresa, Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain; MORALES, Jorge, Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain

Rhinoceroses are one of the best examples of possible underestimation of morphologic diversity when considering extant species only. The aim of the study is to assess an introductory analysis concerning head morphology and several paleoecological traits as locomotion (Mc III gracility index) and hypsodonty in Rhinocerotidae. Although cranial morphology in rhinoceroses has been extensively studied in the last decade, the present study represents a wide sampled approach for evaluating the evolution of cranial variability in the family Rhinocerotidae and its ecological implications. A geometric morphometric analysis of the shape of the skull in 93 specimens from 38 rhinoceros genera has been performed. Trends in skull evolution were evaluated by using relative warp analysis. Relationships between morphological variation in head shape and both locomotion and diet were examined through two simple regression analyses. Shape changes along individual evolutionary lineages have been observed. More derived forms in both Rhinocerotini and Elasmotherini show a certain degree of convergence towards a relatively elongated rostrum and a backwards-slanted skull occiput. They have slender metapodials and more hypsodont dentitions. On the other hand, Aceratheriini and Teloceratina Rhinocerotini exhibit an enlarged palate, shorter rostrum, shorter metapodials and brachydont dentition.

Poster Session I, (Sunday)

NUMEROUS SHARKS FROM LATEST CRETACEOUS UPPERMOST HELl CREEK FORMATION, NORTH DAKOTA: SEA LEVEL RISE DUE TO THE LATE MAASTRICHTIAN GREENHOUSE EVENT? SANKEY, Jula, California State University, Stanislaus, Turlock, CA, USA

Did climatic fluctuations during the latest Cretaceous effect vertebrate communities leading up to the K/P (Cretaceous-Paleocene) boundary? Microvertebrate sites were wet-screened from the Hell Creek Formation of North Dakota. Two sites include: 1) PTRM (Pioneer Trails Regional Museum) 86002, a channel deposit 29.9 m below the K/P and ~65.9 Ma; and 2) PTRM 89003, a crevasse splay 8.4 m below the K/P and ~65.6 Ma. Fish were the most numerous specimens. From the remaining 1432 identifiable specimens, there are sharks and rays (79%), amphitri, lizards (2%), snakes (0.2%), crocodilians/champsosaurus (7%), hadrosaurs/ceratopsians (2%), theropods/birds (2%), and mammals (3%). Previous estimates of vertebrate diversity from these sites were based on surface collections and excavations. This yielded vastly different results, with sharks and rays rare or absent and dinosaurs and other larger specimens more numerous. This new study has several implications. First, screening and surface collection, in combination, should be used to produce vertebrate diversity estimates. Second, the discovery of numerous sharks and rays alters the paleoenvironmental picture for the latest Cretaceous in this area, indicating the proximity of a seaway just prior to the K/P. Third, both sites were deposited during or close to the late Maastrichtian greenhouse event (~66.1-65.7 Ma) when a sharp increase in CO2 and temperatures (~2-4° C) occurred. This event may have triggered a rise in sea level. This and other severe fluctuations in climate and sea levels would have stressed and altered terrestrial ecosystems, contributing to the background extinctions leading up to the K/P.

Poster Session III, (Tuesday)

TAPHONOMY OF PIPESTONE SPRINGS MAIN POCKET, A MIDDLE CHADRONIAN MICROVERTEBRATE ASSEMBLAGE FROM SOUTHWEST MONTANA SANTANA, GRACE, Dakota, The Webb Schools, Claremont, CA, USA; LOGFREN, Don, Raymond Alf Museum of Paleontology, Claremont, CA, USA; GLUCKSTEIN, Lisa, The Webb Schools, Claremont, CA, USA; UGOLICK, Danny, The Webb Schools , Claremont, CA, USA

Pipestone Springs Main Pocket (Renova Formation, Jefferson County, Montana) is an unusually rich concentration of well preserved small-bodied (~34kg) Chadronian mammals. First discovered in 1899, the fauna includes over 40 mammalian species including numerous holotypes. Renewed fieldwork yielded more than 2000 specimens from the outcrop surface, of which 70% have been identified to element and about 25% to taxon. Dentigerous elements include 493 specimens from over 20 genera. Most common are small artiodactyls (~66.1-65.7 Ma) when a sharp increase in CO2 and temperatures (~2-4° C) occurred. This event may have triggered a rise in sea level. This and other severe fluctuations in climate and sea levels would have stressed and altered terrestrial ecosystems, contributing to the background extinctions leading up to the K/P. Newly discovered in 1899, the fauna includes over 40 mammalian species including numerous holotypes. Renewed fieldwork yielded more than 2000 specimens from the outcrop surface, of which 70% have been identified to element and about 25% to taxon. Dentigerous elements include 493 specimens from over 20 genera. Most common are small artiodactyls (~66.1-65.7 Ma) when a sharp increase in CO2 and temperatures (~2-4° C) occurred. This event may have triggered a rise in sea level. This and other severe fluctuations in climate and sea levels would have stressed and altered terrestrial ecosystems, contributing to the background extinctions leading up to the K/P.

Poster Session IV, (Wednesday)

NEW REMAINS OF TITANOSAUR (DINOSAURIA: SAUROPODA) FROM THE EARLY CRETACEOUS OF SPAIN SANTOS-CUBIDO, Andréu, Grup Guix, Vila-real, Spain; POZA, Bego, Consorci Ruta Minera, Cercs, Spain; SUÑER, Maite, Universitat Valenciana, Burjassot, Spain; DE SANTISTEBAN, Carlos, Universitat Valenciana, Burjassot, 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 seven hundred fossils have been collected, including vertebrate and invertebrate species. Dinosaur bones (Theropoda and Ornithopoda) are abundant in this assemblage and in the fifth field season bones determined as Sauropoda were found. Taxonomically, the Ana site is dominated by disarticulated remains of ornithopods, which are usually fragmentary and abraded. We identified teeth of Theropoda indet. and Baryonychinae indet., and bones of Iguanodon sp. and Iguanodontia indet.

Herein, we report new finds from the Ana site. The specimen 5ANA08125 corresponds to a right and nearly complete femur and it is housed at the Coleccion Museografica de Cincocorres, Spain. It is complete except for a part of the fibular condyle and a fragment of the lateral condyle. The preserved dorsoventral length is 114 centimeters (medium-sized femur). It is a well-preserved fossil, showing only some small fractures apparently due to diagenetic processes.

The specimen number 5ANA08125 shares with Titanosauriforms a prominent lateral bulge, the lateromedial flattening of the articular head and the lateromedial flattening of the diaphysis, quantified in terms of eccentricity (Titanosauriforms yield values below 0.50). The specimen also bears several features characteristic of titanosaurs, including an outwardly angled femora with a markedly elliptical cross-section; the presence of a medial deflection of the head of the femur along a low, laterally oriented flange; the head of the femur situated dorsal to the level of the greater trochanter and faced dorsally; the prominent development of a lateral bulge and eccentricity of 0.33. These characteristics allow us to determine 5ANA08125 as belonging to Titanosauria indet.

Poster Session II, (Monday)

INVENTORY AND MONITORING OF VERTEBRATE PALEONTOLOGICAL RESOURCES FROM NATIONAL PARK SERVICE AREAS SANTUCCI, Vincent, National Park Service, McLean, VA, USA; KENWORTHY, Jason, National Park Service, Denver, CO, USA; TWEET, Justin, National Park Service, Cottage Grove, MN, USA; WOODS, James, National Park Service, Denver, CO, USA

During the past decade baseline paleontological resource inventories were undertaken throughout the National Park Service in order to identify the scope, significance, distribution and condition of fossils. This initial phase of inventories identified at least 224 units of the National Park Service that preserve fossils. Nearly half of the total park areas identified with fossils contain vertebrate paleontological resources, of which 33 parks were identified with vertebrate ichnofossils. The National Park Service supports scientific research and collection of fossil vertebrates through a permit system. The agency manages and monitors thousands of documented paleontological localities. The National Park Service first developed science policy and technical guidance for the management of paleontological resources during the 1980s. As new laws, policies and scientific methodologies emerge, the National Park Service has demonstrated leadership in paleontological resource management, stewardship and science. In 2009, Glen Canyon National Recreation Area (GLCA) was established as a prototype paleontological resource monitoring park with a focus on the development of long term monitoring strategies for in situ fossil vertebrate tracksites. Fluctuating water levels at Lake Powell result in intermittent periods of submergence and exposure impacting many dozens of vertebrate tracksites within GLCA. Long term monitoring of in situ vertebrate paleontological resources will provide information to support management decision-making regarding stabilization and recovery of threatened vertebrate fossils. Through the work of professional paleontologists within the National Park Service, along with partnerships with vertebrate paleontologists employed by museums and academic institutions, new vertebrate paleontological discoveries continue to be made within parks and monuments across the
BRAINCASE OF A POLYCOTYLID PLEOSAUR (REPTILIA: SAUROPTERYGIA) FROM THE UPPER CRETACEOUS OF MANITOBA, CANADA
SATO, Tamaki, Tokyo Gakugei University, Tokyo, Japan; WU, Xiao-chun, Canadian Museum of Nature, Ottawa, ON, Canada
Polycotylid pleosaurs are common components of the Cretaceous marine fauna of the Western Interior Seaway of North America, and represented by a number of skeletons including the skull. Nevertheless, postmortem deformation usually collapses the wide parietal table onto the braincase and displaces the neighboring bones even in well-preserved skull, and their braincase anatomy is hardly obtainable except for the palatal side and occasional isolated elements. A partial skeleton of the polycotylid Dolichorhynchops osborni from the Niobrara Formation (Santonian, Upper Cretaceous) in Manitoba, Canada, retains a well-preserved braincase that provides unprecedented details of a polycotylid braincase, such as the dorsal view of the braincase floor and the morphology of individual elements of the otic capsule. A virtual reconstruction of the braincase was created by a three-dimensional scanning technique that produces an accurate reconstruction of missing or damaged braincase elements, and it demonstrates the three-dimensional relationships among the elements in a polycotylid skull for the first time. Revised information on the braincase anatomy of D. osborni includes the peculiar morphology of the parasphenoid within the interpterygoid vacuity, long paroccipital process with expanded distal end, notched anterior process of prootic, and the presence and nearly horizontal orientation of the fenestra ovalis. Comparison with other pleosaurian taxa revealed a considerable variation of the braincase anatomy within the Polycotylidae and Plesiostosaurs.

ROMER PRIZE SESSION, MONDAY 10:45
TRICERATOPS: A MODEL ORGANISM FOR DECIPHERING DINOSAUR HETEROCHRONY
SCANNELLA, John, Museum of the Rockies, Montana State University, Bozeman, MT, USA
A combination of small sample sizes and a lack of high-resolution stratigraphy obscures ontogenetic and stratigraphic trends within the majority of non-avian dinosaur taxa. The latest Cretaceous ceratopsid Triceratops provides a rare opportunity to track shifts in both of these dimensions of variation within a taxon. Triceratops is the most commonly recovered dinosaur in the Hell Creek Formation of Montana and equivalent age strata of adjacent states and provinces. Comparative morphological studies supplemented by histological analyses indicate that this taxon underwent radical changes in cranial morphology throughout ontogeny, providing indicators of relative maturity between specimens. When placed in a new temporal framework for the Hell Creek Formation, specimens of Triceratops bridge gaps in stratigraphically resolved ontogenetic sequences. The two species of Triceratops, T. horridus and T. prorsus, are stratigraphically separated and their distinctive features represent a mosaic of heterochronous shifts. The parietal-squamosal frill is paedomorphic such that broad T. prorsus.

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ACORNSHIMMID-LIKE BASAL COELUROSAUR FROM THE EARLY CRETACEOUS (APTIAN) CEDAR MOUNTAIN FORMATION OF UTAH
SCHUEETZ, Ashley, Brigham Young University, Provo, UT, USA; BRITT, Brooks, Brigham Young University, Provo, UT, USA; SCHEETZ, Rodney, Brigham Young University, Provo, UT, USA; RAUHUT, Oliver, Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany; CHURE, Daniel, Dinosaur National Monument, Jensen, UT, USA
A horizon near the base of the Yellow Cat Member of the Cedar Mountain Formation of eastern Utah is yielding a number of fossils including fish, hybodontid shark coprolites, turtles, sphenodontids, ornithopods, ankylosaurs, and a theropod consisting of partial associated skeleton of a single individual with an estimated length of ~4m. The few recovered cranial bones of the theropod are indicative of a lightly built skull. The frontal suggests a large orbit, the occipital condyle is diminutive (12 mm diameter), and the dentary is delicate with super-pernumery, minute alveolus ~2.5 mm long anteroposteriorly. No tooth crowns are preserved in the dentary but a 4 mm tall crown associated with the skull has a bulbous base. Cervicals are highly pneumatic with camellate internal structure, slightly amphicoelous centra, and anteroposteriorly elongate, low neural spines. The three known cervicals are elongate, with centra up to 2.3 times as long as high, and cervical 13 in small diameter, suggesting a long, tapersing neck. No dorsals or sacra are known. Proximal caudals bear thin spines and strongly backswept transverse processes. Distal caudals have prezygapophyses nearly 50% of centrum length, centra wider than tall, and skid-like chevrons. All caudals have a robust ventrolateral prezygapophysial ridge. The scapular blade is broad and the humerus is relatively straight, moderately built, and 33% longer than the lightly built radius. The ilium has a large acetabular shelf, the tubia & fibulae are long and gracile, and distally the fibula articulates with the calcaneum and a sheath on the astragalus. The astragalar ascending process is moderately high, straight-sided, and narrower than the astragalus body. The metatarsus is not arctometatarsalian but is long (metatarsal III 60% of tibial length). A preliminary cladistic analysis suggests the taxon is a basal coelurosaur and the elongate neck and greatly reduced dentition housed in a light skull are congruent with ornithomimids.

EVOLUTION OF THE DINOSAURIFORM RESPIRATORY SYSTEM: NEW EVIDENCE FROM THE POSTCRANIAL AXIAL SKELETON
SCHACHNER, Emma, University of Pennsylvania, Philadelphia, PA, USA
In all extant archosaurs, there is a strong relationship between the postcranial axial skeleton and both pulmonary anatomy and respiratory mechanics. Based on comparisons with extant archosaurs and squamates, the patterns observed in the rib and vertebral morphology of extant taxa allow for predictions of the gross morphology of their lungs and ventilation mechanics. Lung ventilation in extant crocodilians is achieved by a hepatic-piston pump and costal rotation; this mechanism is associated with a smooth internal thoracic ceiling, facilitating the expansion of the lungs and movement of the internal organs. The rigid lungs and air sacs of the avian respiratory system are coupled with strongly bicipitate ribs that, when articulated, generate a corrugated thoracic ceiling that locks the lungs in place. The dorsal vertebral series and adjacent ribs of 36 well-preserved fossil specimens were examined and compared with phylogenetically relevant extant taxa, permitting the reconstruction of the pulmonary anatomy for Dinosauriformes. When the results are mapped onto a phylogeny for Archosauromorpha, clear trends become apparent indicating that the highly derived avian and crocodilian pulmonary anatomies are a function of very different evolutionary pressures, and that neither likely represents the plesiomorphic pulmonary condition for Archosaurus. These data indicate a transition from a cranially rigid, heterogeneously partitioned, multi-chambered flow-through lungs in basal dinosauriforms, towards the small rigid avian-style lungs that were likely present in saurischian dinosaurs. There is no skeletal evidence for a crocodilian-style hepatic-piston pump in any of the taxa reviewed, supporting the hypothesis that it was a novel respiratory mechanism acquired by crocodyliforms when they adopted a more aquatic lifestyle.

A LARGE, TALL-SPINED IGNUANODONTID DINOSAUR FROM THE EARLY CRETACEOUS (EARLY ALBIAN) BASAL CEDAR MOUNTAIN FORMATION OF UTAH
SCHUEETZ, Ashley, Brigham Young University, Provo, UT, USA; BRITT, Brooks, Brigham Young University, Provo, UT, USA; HIGGIERSON, Jeff, Brigham Young University, Provo, UT, USA
Among 5000+ bones recovered from Dalton Wells near Moab, Utah nearly 100 bones pertaining to at least four individuals of a large iguanodontid have been recovered. All are preserved in lobes of several stacked debris flows at the base of the Cedar Mountain Formation that rest on sandstone and consist almost entirely of, reworked Morrison Formation that entombs the reserved bones. Bones from the large adult iguanodont indicate this animal was ~8 meters long, as large as the European Iguanodon bernissartensis, with dorsal neural spines 5.5 times as high as the centrum, almost 2/3 that of Ouranosaurus. Although many skeletal elements are known, most lack phylogenetically useful characters. The lower jaw is represented by an elongate (50 cm long) but incomplete dentary and gradually sloping surangular which is plesiomorphic for the grade. The thick postorbital and large basioccipital suggests a type of Iguanodon ottingeri, are similar to the large European iguanodonts but were later shown to be non-diagnostic at the generic level. The femur possesses a deep, wide anterior intercondylar groove with a robust distal lateral condyle, and a fourth trochanter just above midshaft. The adult femur would have been over one meter long. Although iguanodonts are common worldwide in the Early Cretaceous, phylogenetic resolution is hampered by their incompleteness. Though the Dalton Wells iguanodont is likewise fragmentary, several elements are useful in plugging the taxonomy into the general scheme of ornithopod phylogeny. The teeth, lower jaws, tall-spined dorsal vertebrae, and femur fits within a transformational series more derived than camptosaurid-grade ornithopods, but less derived than most of the large European iguanodontians.
ANALYSIS OF THE BONE CRUSHING BEHAVIOR OF CANIS DIRUS USING DENTAL MICROWEAR TEXTURE ANALYSIS

SCHMITZ, Elizabeth, East Tennessee State University, Johnson City, TN, USA; SCHUBERT, Blaine, East Tennessee State University, Johnson City, TN, USA; UNCAR, Peter, University of Arkansas, Fayetteville, AR, USA; SCOTT, Jessica, University of Arkansas, Fayetteville, AR, USA

Dental microwear analysis is an important method for reconstructing the diet of past peoples and extinct animal species. It utilizes new dental microwear technique that combines confocal microscopy and scale sensitive fractal analysis (dental microwear texture analysis) has proved to be an objective way of looking at dietary preferences in living and fossil mammals. While the application of this technique has focused mostly on primates and various ungulate species, its application has only recently been applied to carnivores. It has been hypothesized by other researchers that the extinct Pleistocene dire wolf (Canis dirus) ate more bone than the modern gray wolf (C. lupus) does today. This behavioral disparity has been proposed due to differences in skull morphology and dentition between these two canids, as well as the high incidence of tooth fracture and breakage in the dire wolf. It is possible that the predator competition during the Pleistocene influenced the dire wolf’s diet by increasing carcass utilization through bone consumption. Unlike hyaenids and felids, which lack postcarnassials, canids tend to perform most bone crushing with the posterior molars. This makes inferences of diet differences based on comparisons of homologous tooth surfaces between canid and other carnivore families unreliable, and therefore any results of this study will be useful only for comparisons between canids. In the project described here the microwear texture analysis of Canis dirus is compared with that of the extant gray wolf, coyote (C. latrans), and African wild dog (Lycaon pictus) to assess degree of bone consumption in dire wolves.

Technical Session VI, Monday 3:30
INFLUENCE OF BODY MASS ON THE EVOLUTION OF DIETACTIVITY PATTERN IN HERBIVOROUS MAMMALS AND IMPLICATIONS FOR PALEOBIOLOGY

SCHMITZ, Lars, UC Davis, Department of Evolution and Ecology, Davis, CA, USA; PRICE, Samantha, UC Davis, Department of Evolution and Ecology, Davis, CA, USA

Extinct synapsid herbivores feature a large range of body sizes. Since body size influences many ecological traits, comparative analyses of the link between body size and ecology in extant species will yield important information for paleobiological inferences. One ecologi­cal trait of mammalian herbivores thought to be controlled by body size is diel activity pattern (DAP), i.e., the timing of activity during the 24h cycle. Specifically, it has been suggested that an increase in body mass correlates with the evolution of catheremality, the activity during both day and night. We tested this hypothesis with a dataset on body mass and DAP of 459 species of extant mammalian herbivores. First, we assigned species to bins of body mass and calculated proportions of DAP for each bin. We recognized that for species of 1kg and above, the proportion of catheremal DAP increases, whereas the proportions of both diurnal (day-active) DAP and nocturnal (night-active) DAP decrease. Higher proportions of catheremal species in bins of larger body mass are consistent with the hypothesis, yet may be biased by phylogeny. Thus, we analyzed the dataset in a phylogenetic framework using a time-calibrated tree. First, we tested whether evolutionary shifts in DAP are linked with absolutely large changes of body mass. Indeed, phylogenetically independent contrasts of body mass at nodes with a shift of DAP are larger than contrasts at nodes with no shifts DAP (p=0.01). Next, we tested whether shifts from diurnal or nocturnal to catheremal DAP are more likely to be due to nocturnal/diurnal shifts. This pattern is expected if increases of body mass cause transitions in DAP. Maximum likelihood transition rates based on a symmetric rate model support this prediction. Our results confirm the influence of body mass on the evolution of DAP in herbivorous mammals. Possible mechanisms explaining this phenomenon include foraging and thermoregulatory requirements. Our results further open the possibility that many large-sized extinct synapsid herbivores were active day and night, which is consonant with the recent finding of catheremality in herbivorous dinosaurs.

Technical Session I, Sunday 10:45
CRANIAL ONTOGENY IN STEGOCERAS AND THE EVOLUTION OF CRANIAL DOMING AND ORNAMENTATION IN PACHYCEPHALOSAURUS (DINOSAURA: ORNITHISCHIA)

SCHOTT, Ryan, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; GOODWIN, Mark, University of California Museum of Paleontology, Berkeley, CA, USA; BROWN, Caleb, University of Toronto, Toronto, ON, Canada; LONGRICH, Nicholas, Yale University; NEW HAVEN, CT, USA

Historically, studies of pachycephalosaurs have recognized plesiomorphic flat-headed taxa and apomorphy domed taxa. More recently, it has been suggested that the expression of the frontoparietal dome in Stegoceras validum develops ontogenetically, and that the flat-headed taxon Ornatotholus browni may represent a juvenile of this species, but evidence to support these hypotheses was previously limited. Here we test these hypotheses with the first ontogenetic growth series of a pachycephalosaur supported by multiple, independent lines of evidence, including preserved morphology, allometric growth curves, histology, and constrained stratigraphic occurrence. This series demonstrates that cranial growth in S. validum proceeded from a flat-headed to a domed state. Dome growth is positively allometric and

the frontoparietal grows faster in width than length, resulting in a more triangular dome in adults. While slightly variable between individuals, the morphology of the parietosquamosal bar, and associated ornamentation, is ontogenetically conserved. Flat-headed juveniles display three characters (open interfrontal and frontoparietal sutures, tuberculate dorsal surface texture, and open supratemporal crest) that are reduced or eliminated through ontogeny. Historical examination of this growth series confirms that juveniles have highly vascular skulls and this vasculature is reduced with increasing ontogenetic age. These results have implications for the delineation of species. They suggest that patterns of ornamentation are ontogenetically conserved and thus are of higher taxonomic and phylogenetic value than previously realized, whereas the shape of the dome can change considerably through ontogeny and, therefore, is less reliable. The cranial characters we identify in juvenile Stegoceras are also present in flat-headed pachycephalosaurs, which suggests they may also represent juveniles, possibly of domed taxa. However, it remains possible that these characters would be expressed in an ontogenetically mature flat-headed taxon. Multiple lines of evidence, as shown here, will be needed to further resolve the validity of flat-headed taxa.

Technical Session II, Monday 12:00
3D ISOTOPE ANALYSIS OF THE TYPE MAASTRICHTIAN MOSASAURUS

SCHULZ, Julia, Universität Bonn, Bonn, Germany; MARTIN, Thomas, Universität Bonn, Bonn, Germany

Mosasaur fauna from the type Maastrichtian marine ecosystem would not necessarily place a large mosasaur such as P. saturator at a much higher trophic level than the small C. belgicus.

High-resolution serial sampling along the teeth of M. hoffmanni and P. saturator showed changes in δ13C values during ontogeny to be within the accuracy/measurement error range of the method, and seasonality effects – if any – on the δ13C values can be considered very limited at most.

Technical Session II, Sunday 12:00
3D ANALYSIS OF FUNCTIONAL SURFACES IN THE PRE-TRIBOSPHENIC DENTITION

SCHULZ, Julia, Universität Bonn, Bonn, Germany; MARTIN, Thomas, Universität Bonn, Bonn, Germany

Molars of the so-called “tribosphenic” dentition are characterized by embrasure shearing evident from the mesio-distally compressed and linguo-buccally widened “trigon” and trigonid. The reversed triangular pattern of “trigonid” and trigon, shared with the more plesiomorphic symmetrodontans, is crucial for the embrasure shearing process, as the lower molars fit into the embrasures between the upper molars during occlusion. The three main cusps of the trigonid and the sharp leading edges have mainly puncture-crushing function for opening hard exoskeletons of insects. Dryolestid diastemal tusks evolved additional shearing surfaces for further processing of softer food items. The lower molars show a unicuspid talonid (hypocono­crista) disto-lingual to the trigonid, the upper molars a parastyle mesial to the “trigon”. The buccally oriented guiding groove of the unicuspid talonid is homologous to the hypoconid of the tribosphenic molar. However, in tribosphenic molars the hypoconid is more steeply inclined and less involved in occlusal contacts. Striation analysis and virtual simulation of the relative movements of the molars using the newly developed “Occlusal Fingerprint Analysis”-software demonstrate a functional difference of the dryolestid and the tribosphenic hypoconid. In the dryolestid hypoconid, shearing is the important function during the chewing cycle, while the paracone slides buccally along the guiding groove. The average angle of the striations related to the occlusal plane is steeper than the inclination of the guiding groove in the hypoconid. 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 occlusal contact. A typical tribosphenic grinding phase after centric oc­
clussion does not occur in dryolestids. During the evolution of the talonid basin, the shearing area of the hypoflexid 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.

Technical Session XV, Wednesday 11:00
THE EARLY APPEARANCE OF ADVANCED EUTELEOSTS AND THE CONTROVERSY BETWEEN MOLECULAR CLOCK AND GEOLOGICAL APPEARANCE OF ACTINOPTERYGIDS
SCHULTZE, Hans-Peter, The University of Kansas, Natural History Museum and Biodiversity Institute, Lawrence, KS, USA; ARRATIA, Glória, The University of Kansas, Natural History Museum and Biodiversity Institute, Lawrence, KS, USA; GONZÁLEZ RODRÍGUEZ, Katia, Área Académica de Biología, Universidad Autónoma del Estado de Hidalgo, Pachuca, Mexico.

The occurrence of an advanced percomorph (Cottiformes, Acanthomorpha) in the Albian Cenomanian of Mexico places the appearance of higher euteleosts, or neoteleosts, between the Late Jurassic and the end of the Early Cretaceous. This indicates an accelerated diversification of advanced teleosts in the Early Cretaceous. The first “true” teleosts (Leptolepidae) with cycloid scales, ossified autogenous vertebrae, diural caudal skeleton, etc. occur in the Early Jurassic. Even though there is a dense fossil record, no “true” teleost has been found in deposits earlier than upper Lower Jurassic. The accepted basal teleosts, Pholidophoriformes (Ph. becheri) (occurring in the Late Triassic and Early Jurassic, respectively) have rhombic scales, surangular bone, no ossified vertebrae, etc., and look like other sister groups of “true” teleosts. This contradicts molecular clock data that postulate that teleosts go back to the Paleozoic. In the Middle-late Early Jurassic, teleost taxa (Crossoagnathiformes, Ichthyodectiformes, and others) restricted only to the Jurassic and/or Cretaceous appear. Only at the end of the Late Jurassic do modern teleosts (Teleocephala) such as elopiforms, osteiophyans and protactinopterygians appear. Consequently, it has to be expected that osteoglossomorphs and euteleosts appeared after the fossils found in Upper Jurassic deposits based on their relationship to elopiforms and osteiophyans. The stepwise occurrence of higher teleostean taxa indicates a discontinuous kind of evolution with an acceleration from early teleosts in the Early Jurassic to fossil higher taxa in the Middle Jurassic, to basal Teleocephala in the Late Jurassic and to neoteleosts in the late Early Cretaceous. The two last appearances of high numbers of higher taxa are connected with the two modern highest radiations within teleosts (in cypriniforms and perciforms). In contrast to molecular analyses, the appearance of higher teleostean lineages from the most basal taxa to most advanced modern taxa is condensed to a time span of 100 Million years.

Poster Session II, (Monday)
A ‘WOOLLGARI-ZONE MOSASAUR’ (SQUAMATA: MOSASAURIDAE) FROM THE CARLILE SHALE (LOWER MIDDLE TURONIAN) OF CENTRAL KANSAS AND STRATIGRAPHIC OVERLAP OF EARLY MOSASAURS AND PLIOSAURID PLESIOSAURS
SCHUMACHER, Bruce, Sternberg Museum of Natural History, Hays, KS, USA; A new specimen of russellosaurine mosasaur (FHSM [Sternberg Museum, Hays, Kansas] VP-17564) from the middle Fairport Chalk Member (Collignoniceras woolgari zone, early Middle Turonian), Carlile Shale of central Kansas is among the earliest records of a derived mosasaur known from the North American Western Interior Seaway (WIS). Unequivocally the oldest recorded occurrence of a russellosaurine mosasaur from Kansas, and one of only four Kansas occurrences consisting of more than just isolated elements, the specimen includes sevensuccessive caudal vertebrae bearing articulating hemal facets. No demonstrable characters ally the specimen to a more refined taxonomic subgroup. Size of the vertebrae indicates a relatively large animal roughly 3.5 m in total body length. A large pliosaurid plesiosaur skull (FHSM VP-321) is known from similar geographic and stratigraphic positions, and the record of plesiosaurs continues (FHSM VP-17469) into the younger Blue Hill Shale (Prionocyclus hyatti zone, middle Middle Turonian), demonstrating with certainty that plesiosaurs and early mosasaurs shared the seaway for minimally one million years. Holding both the earliest evidence of relatively large russellosaurine mosasaurs, and the latest occurrence of old-guard pliosaurs, the Late Cretaceous shallow marine carbonate shelf that was theWIS served as both harbor for evolutionary advancement and a refuge for top predators of a bygone era. Although speculative at the time, the scene of a large pliosaur attacking an early tyllosaurinae as first depicted by paleo-life artist Daniel W. Varneris entirely plausible. Upper Turonian rocks record the interval when pliosaurs, long-reigning monarchs of the earth’s oceans for some 65 million years, disappear and in their place there is scant but tangible evidence of large tyllosaurinae mosasaurs appearing. This was a time and environment in which mosasaurs began to diversify and increase in size. Thus, it seems logical to speculate that ever larger and increasingly successful mosasaurs may have played a competitive role in pushing pliosaurs toward extinction.

Poster Session III, (Tuesday)
THE SEDIMENTOLOGY AND STRATIGRAPHY OF BULLOCK CREEK, AUSTRALIA - AN IMPORTANT BIOCHRONOLGIC MARKER FOR AUSTRALIA’S MID-CENOZOIC
SCHWARTZ, Leah, Monash University, Melbourne, Australia.

Bullock Creek, a site in the Northern Territory of Australia, is an important calibration point for Australia’s Tertiary fossil record. As a middle Miocene site, it forms a bridge between the diverse late Oligocene-early Miocene sites of South Australia’s Etadunna and Nambro sites, and more securely dated, and older mid Miocene sites. A diverse fauna including dromornithid birds, crocodiles, turtles and fish is found here. Bullock Creek is the type locality for a number of mammalian species including the diprolodontid Neohelen stirtoni; the macropods Balbaro camfieldensis and Namboro balbaro; the thylacoleonid Wakeko vanderlauyeri; the thylacinids Nimbacinus richi and Mutupurucinus archibaldi; the palorchestid Propalorchestes novaculiceps; and the mirinilds Bargur kyrowi and Bargur maru. This study represents the first detailed geological survey of Bullock Creek. The outcrops of the Camfield beds, a freshwater carbonate deposit, in which the Bullock Creek Local Fauna is found, was mapped in detail. A stratigraphic sequence was demonstrated in which the quarry sites X and Y occur within the same unit, which underlies the unit containing the Dromornithid Mountain and Far Site quarries. This implies that the assemblage represented at Bullock Creek may in fact be diachronous, but collection records are not as yet sufficient to determine if any time differences are significant. The sedimentological evidence suggests a depositional model wherein the Camfield beds were deposited in a low-energy environment that included oxbow lakes. Diagenesis appears to be the primary factor in determining the preservation of fossils within the Camfield beds, comparable to that of the Uita Limestone, another local fossil-bearing deposit in which the Kangaroo Well Fauna is preserved.

Poster Session IV, (Wednesday)
MICRO-CT ANALYSIS OF THE EAR REGION IN HETEROXERUS COSTATUS (RODENTIA, MAMMALIA)
SCHWARZ, Catrin, Universität Bonn, Bonn, Germany; RUF, Irina, Universität Bonn, Bonn, Germany.

The well preserved skull of Heterocephalus costatus, a fossil ground squirrel from the Upper Oligocene of Gaimersheim (MN 28), Southern Germany, was investigated by high-resolution computed tomography (Micro-CT). Based on the CT data, the bony labyrinth housing the inner ear as well as the middle ear ossicles, were reconstructed for testing the proposed phylodynamic position and elucidating the type of locomotion. Further fossil and extant sciuromorph rodents representing different locomotion types (arboreal, gliding, fossorial, generalist) were included in the study for comparison. Tupaia sp. represents the outgroup. The middle ear ossicles of Heterocephalus resembles the general morphology observed in our investigated sciurids, for example Sciurs vulgaris and Spermophilus citellus. In proportion to the malleus and incuds, the stapes of Heterocephalus is smaller than in the other sciurids. In all investigated taxa, a secondary crus commune is observed, which exhibits a groundplan character and is regarded as plesiomorphic. The cochlea of Heterocephalus has 2.5 turns, and thus differs from the extinct fossorial sciurid species, which have almost 3.5 cochlea turns. Adaptations to locomotion and posture can be deduced from the morphology of the semicircular canals of the bony labyrinth, by studying allometric correlations, e.g. the width, height and length of the canals. For the spatial orientation, the lateral semicircular canal is significantly important. In the first results of this study, regression analyses of the height of this canal show a similarity in Heterocephalus and Spermophilus citellus, whereas in a fossil specimen of Spermophilus undulatus it is considerably larger. Hence, the locomotory behaviour of Heterocephalus can be assumed as fossorial, a specialization for living on the ground.

Technical Session XI, Tuesday 3:00
MOLECULAR MECHANISMS FOR THE PRESERVATION OF SOFT TISSUES AND ORIGINAL BIOMOLECULES IN FOSSILS
SCHWITZER, Mary, North Carolina State University, Raleigh, NC, USA; CLELAND, Timothy, North Carolina State University, Raleigh, NC, USA; ZHENG, Wenxi, North Carolina State University, Raleigh, NC, USA; SAN ANTONIO, James, Orthovita INC, Malvern, PA, USA.

No chemical models account for the preservation of original biomaterials in ancient (>1Ma) fossils, so the identification of apparent bone matrix, blood vessels with contents, cells, and peptides derived from original proteins is controversial. However, the persistence of these components after demineralization of skeletal elements has been documented in multiple specimens derived from different ages, taxa, and depositional settings. No obvious biochemical or geochemical commonalities unite these specimens, other than that they are all vertebrates. Except for some fish, vertebrate bone consists of the same components (e.g. collagen, mineral, bone forming cells, vascular components), although these differ in ratio, abundance and protein sequence among taxa. We hypothesize that preservation of these components over geological time must rely on conditions inherent in bone in general, and that mechanisms preservingapparentblood vessels and cells differ from those preserving bone matrix. Experiments provide preliminary evidence that hemoglobin-derived iron may play a role in preservation of vessels and associated osteocytes, and we propose a chemical pathway that may result in preservation. Alternatively, the molecular structure of the collagen fibril, including the physical nature of its triple helical sequences, their modes of intermolecular
interaction, and potentially, the fibril’s association with mineral, may contribute to the preservation of fossil collagen in bone. We show molecular interactions that may play a role in early diagenetic processes resulting in long term preservation, despite proposed theoretical limitations the survival potential of organic components over geological time.

Poster Session III, (Tuesday)
ONE OR TWO SPECIES OF THE GIANT CROCODYLIAN DEINOSUCHUS? SCHWIMMER, David, Columbus State University, Columbus, GA, USA

The largest crocodylomorphs known from North America and Mexico comprise the Late Cretaceous species Deinosuchus. Originally named from teeth and osteoderms in North Carolina, post-cranial remains in Montana, and skull fragments and a few post-cranial bones from southwest Texas, the huge crocodylian remains were respectively placed in “Polyptictodon” (a pre-occupied genus) rugosus, Deinosuchus hatcheri, and Phosphosuchus riograndensis. Most recent studies recognize a single genus Deinosuchus, but there is no consensus about the number of species. The question of species is due in part to the existence of two distinct temporal sub-populations on either side of the sedimentological boundary in Seaway (WIS) bisecting the northern American landmass during the later Cretaceous. The eastern Deinosuchus morph tends to have smaller individuals (maximum estimated overall lengths under 9.0 m) whereas the western population tends toward much larger individuals (maximum lengths to ~12.0 m). Other differential characters include subtleties of the teeth (more rugose external surface in the eastern form) and osteoderms (thick and irregular in the western form). These variations are significant because teeth and osteoderms are among the principle synapomorphies of the genus. It has been debated whether these are size related characters, which, if so, would mean size is the main difference between populations and would imply a single species. New specimens from both sides of the WIS indicate that the eastern-western population differences are not just size-related, and thus justify specific separation. A few very large teeth recently collected in the Southeastern USA indicate ~10 m individuals, yet they are similar to the common, smaller regional specimens with strong surface enamel infolding, and notably different from western teeth. Additionally, osteoderms from smaller western individuals are clearly thicker and less regular than size-equivalent eastern osteoderm specimens. Although the gross skull morphology and known post-cranials are very similar, it is here proposed that the separate species be recognized and formalized as (western) Deinosuchus riograndensis and (eastern) Deinosuchus rugosus.

Poster Session I, (Sunday)
MORPHOLOGY AND ASPECT RATIO OF THE TAIL OF THE LOWER DEVONIAN OSTEOSTRACAN SUPERCILIASPIS GABRIELSEI

SCOTT, T., Bradley, University of Alberta, Edmonton, AB, Canada; WENDRUFF, Andrew, University of Alberta, Edmonton, AB, Canada

Among the jawless vertebrates the Osteostraci are the only group to possess epicercal tails, a synapomorphy they share with the gnathostomes. This makes the tail of osteostracans significant to the evolution of epicerial tails in jawed vertebrates. Unfortunately, few well-preserved caudal fins and trunks are known for osteostracans. Several specimens of Super- ciliaspis gabrielsei from smaller western individuals are clearly thicker and less regular than size-equivalent eastern osteoderm specimens. Although the gross skull morphology and known post-cranials are very similar, it is here proposed that the separate species be recognized and formalized as (western) Deinosuchus riograndensis and (eastern) Deinosuchus rugosus.

Poster Session I, (Sunday)
PLACEMENT OF THE PERMO-CARBONIFEROUS BOUNDARY IN THE HALGAITO FORMATION, CUTLER GROUP, SOUTHEASTERN UTAH

SCOTT, Kim, California State University San Bernardino, San Bernardino, CA, USA; SUMIDA, Stuart, California State University San Bernardino, San Bernardino, CA, USA

Carboniferous-Pennsylvanian strata of southeastern Utah lack volcanism, significant local reversals in the magnetostratigraphic record, or any large extinction or speciation events, thus barring most avenues of radiometric and relative dating. Marine biostratigraphy has recently redefined the Carboniferous-Pennsylvanian boundary to the Global Stratotype Section and Point (GSSP) for the late occurrence of the conodont Streptognathodus violaceus, but if a terrestrial deposit lacks a marine influx then it cannot be dated by these means. The Halgaito Formation in the Valley of the Gods area of southeastern Utah has produced fossils at a point where synaporphs and lineages leading to modern saurophid groups diverged. Thus, the Halgaito Formation provides data bearing on both important geological and biological transitions during this time period. Fossils and stratigraphic data collected from 2002 to 2007 allow for biostratigraphic analysis in this region. Taxa present near the Carboniferous-Pennsylvanian boundary include Aviculopecten sp., Hystriculina wauhathanus, Orthacanthus texensis, Sagenodus sp., Lohmannia utahensis, Diplocaulusp, Eryops sp., Pliatysphrinx cf. P. rugosa, Diadectes sp., Limnoscelidae, Edaphosaurus sp., Ophiacocon cf. O. navajovenis, and Sphenacodon sp. with possibly Varan-nosaurus sp. Marine and terrestrial fossils from the Halgaito Formation indicate that the boundary is within 50 meters of the base of the formation, near the McKim Limestone.

Advances in Paleogeography: Geochronometry, Microwear and Beyond, Sunday 10:45
DENTAL MICROWEAR TEXTURE ANALYSIS, DENTAL MESOWEAR AND DISTAL LIMB ECMOPHYLOGENESIS OF THE KALFA (MOLDOVA) HIPPARIONINE HORSES: A MULTI-PHONY PALEOCOLOGICAL RECONSTRUCTION

SCOTT, Robert, Rutgers, The State Univ. of New Jersey, New Brunswick, NJ, USA; MERCERON, Gildas, Université Claude Bernard Lyon 1, Campus de la Doua, Villeurbanne, France; TANJU, Kaya, Ege Üniversitesi, Bornova, Turkey, KOSTOPOULOS, Dimitrios, University of Thessaloniki, Thessaloniki, Greece; SERBAN, Maya, Ege Üniversitesi, Bornova, Turkey

Following migration from the New World, hipparionine horses are recorded from a wide variety of late Miocene Old World sites. Very early Old World hipparionine horses have been interpreted as either preferring more wooded habitats or somewhat open intermediate habitats. Browsing or mixed feeding have been offered as possible dietary modes. The hominid-bearing site of Kalfa in Moldova includes a large fossil mammal collection of middle Sar-matian age according to the local biochronological scale (or MN 9 in the Mammal Neogene succession). The fauna of Kalfa shows a mix of Eurasian, local (i.e. Paratethyan) and West Asian elements, with a predominance of equids and cervids. The Kalfa collection of hipparionines is likely the most representative of early Old World hipparions from Eastern Europe. Here we present a multi-proxy analysis of the paleoecology of the Kalfa hipparions. Cover and substrate preference are inferred from habitat scores generated on third metapodials. Probable “last suckers” are inferred using dental microwear texture analysis. Diets over a longer time scale are reconstructed based on dental mesowear.Habitat scores for the Kalfa hipparions based on the elongation and slenderness of third metapodials relative to body size are comparable to those for Hoxnegg hipparions previously interpreted as indicative of forested conditions. The Kalfa hipparion third metapodials are neither relatively elongate nor slender. Dental microwear textures compare to published values for extant grazing bovids for mean and variance. Land mammal ages can appear in different geographic regions at different times, depending upon dispersal patterns of the species in question. Land mammal ages can thus be considered time-transgressive rather than synchronous. In the case of the Rancholabrean, time-transgressive nature may be quantifiable due to the abundance of Pleistocene localities and the accuracy of radiometric dating techniques. Vertebrate fossils assigned to the Tule Springs local fauna, recovered from ground water discharge deposits of the informally designated “Las Vegas Formation” in the Upper Las Vegas Wash, Clark County, Nevada, include the oldest and youngest reliably dated occurrences of Bison in the Mojave Desert and the southern Great Basin. Fossils of a long-horned form similar to Bison latifrons, as well as a smaller form in the size range of B. antiquus, are interpreted to derive from unit B2 of the formation, which ranges in age between 144 Ka and 89 Ka based upon thermoluminescence dating. Fossils assigned to B. antiquus are also known from unit E of the Las Vegas Formation, directly associated with a radiocarbon date of 14,780 +/- 40 ybp. These records effectively delimit the Rancholabrean NALMA in this biotic region of the American southwest. Many published “Rancholabrean” faunas from southern California and Nevada entirely lack Bison, which is the index taxon for this time period; published accounts considered land mammal ages to be temporally rather than faunally delimited. Other southwestern “Rancholabrean” assemblages reported to contain remains of Bison actually lack any such fossils. The records of Bison from the Tule Springs local fauna are therefore significant in documenting the oldest and youngest occurrences of the genus from the region, as well as providing robust new data on the temporal and geographicospatial and evolution of these animals through the latest Pleistocene.
ever, the sample was extensively coated with preservatives and, despite exhaustive cleaning, it is possible preservative still adhered to wear facets. Kal′ha hipparion mesowear was com-
pared with a set of extant species. Among perisodactyly, the Kal′ha hipparion sample dif-
fered significantly from grazing zebras and the browsing black rhino. It appears more similar to Eparus australis, a mixed feeder. The mesowear, microwear, and ecomorphological results taken together suggest a mixed-feeding, forest-dwelling habitus for the Kal′ha hipparions.

Technical Session XVI, Wednesday 2:45
DEVELOPMENTAL MECHANISMS UNDERLYING TRENDS IN ARTIODACTYL LIMB REDUCTION: A CASE STUDY IN THE DOMESTICATED PIG, SUS SCROFA
SEARS, Karen, University of Illinois, Urbana, IL, USA; BORMET, Allison, University of Illinois, Urbana, IL, USA; ROCKWELL, Alexander, University of Illinois, Urbana, IL, USA; POWERS, Lisa, University of Illinois, Urbana, IL, USA; GROBIS, Matt, University of Illinois, Urbana, IL, USA

Over half of modern mammalian orders experienced digit reduction during their evolution-
ary history. This includes the artiodactyls, which have likely independently lost some com-
Fig. 1. A cranium of the Early Miocene tenrec Erythrozootes from Napak, Northeastern Uganda. SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, USA; MACLATCHY, Laura, University of Michigan, Ann Arbor, MI, USA; COTE, Susanne, Alberta Biodiversity Monitoring Institute, University of Alberta, Alberta, AB, Canada

Three tenrec genera are known from early Miocene sites in Kenya and Uganda – Erythrozoo-
etes, Paragorgeole, and Protenrec. The phylogenetic affinities of these taxa, and particularly those of Paragorgeole, a form that shares a series of derived morphological features with Malagasy Geogale, are currently controversial, and have important implications for tenrec biogeography. It has long been known that collections from the early Miocene (~20 Ma) Na-
pak localities in northeastern Uganda, now housed in the Uganda National Museum, include fragmentary remains of Erythrozootes and Protenrec, but remarkably a largely complete cranium of Erythrozootes was recently identified in the old Napak collections. Only three remains are preserved on the cranium, but the rostrum is badly abraded unilaterally, and the specimen is broken through the mesosceanum, but otherwise most morphological details are observable either externally or through inspection of micro-CT scans. The specimen exhibits a number of features that are likely preserved within Tenureocidea. Unlike extant tenrecs aside from Potamogale, the relatively unworn m1-2 have distinct metacines and comparatively large protocones, providing additional evidence for the hypothesis that metacine loss and protocine reduction occurred convergently within Afroserica. With regard to cranial mor-
phology, the infraorbital canal is relatively small in diameter and more elongate than those of other tenrecs aside from Geogale; a suboptic foramen is present; the postglenoid process is tall and not recurved; the piforin fenestra is small and enclosed anteriorly by a broad alisphenoid contribution; there is no pith tubal canal; a well-developed sinus canal courses along the sidewall of the braincase; and the caudal tympamic process of the petrosal was relatively small. Interestingly, the cranial bones of Erythrozootes are much thicker than those of extant tenrecs. The Napak specimen exhibits morphology that is very similar to that of a braincase from Koru, Kenya, that was initially attributed to Erythrozootes but later consid-
ered to belong to the erinaceid Ambiuchina; the original attribution was evidently correct.

Poster Session III, (Tuesday)
THREE NEW THEROPODS FROM THE CEDAR MOUNTAIN FORMATION (LOWER CRETACEOUS) OF UTAH
SENTER, Phil, Fayetteville State University, Fayetteville, NC, USA; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; DEBILLEUX, Donald, Utah Geological Survey, Salt Lake City, UT, USA; MADSEN, Scott, Utah Geological Survey, Salt Lake City, UT, USA

Here we report the discovery of three new theropods from the Cedar Mountain Formation (Lower Cretaceous) of Utah. Phylogenetic analysis indicates that one is a troodontid, one is a dromaeosaurid, and one is a basal therizinosaurid. The troodontid specimen consists of a partial left maxilla with nine small, closely spaced alveoli separated by septa. A prominent fenestra is large and a maxillary fenestrae are present. The maxilla is remarkable for its extreme inflation by a large, pneumatic chamber. The dromaeosaurid specimen is a partial skeleton that includes a lacrimal, radius, pubis, ilium, and several vertebrae from the neck, back, and tail. The lacrimal is unusual in that it lacks an anterodorsal process. The pubis is unusual in that it exhibits a pronounced tuber on the cranial edge of the proximal end. The posterior caudal vertebrae have elongated prezygapophyses, as in most dromaeosaurids. The basal therizinosaurid specimen includes a cervical neural arch, a dorsal centrum, and fragments of several limb and girdle bones. Several manual uanalgs are almost completely pre-
served; all are strongly curved and lack a proximal “lip.” As in other therizinosaurids, the pedal unguals are strongly curved.

Technical Session XIV, Wednesday 10:15
NOASAURID (THEROPODA: ABELISAUROIDEA) SKELETON FROM AFRICA SHOWS DERIVED SKELETAL PROPORTIONS AND FUNCTION
SERENO, Paul, University of Chicago, Chicago, IL, USA

An articulated skeleton of a noasaurid theropod from the Elrhaz Formation (Aptian-Albian) of Niger exhibits derived features in the axial and appendicular skeleton indicative of fossorial habits in addition to the unique features of the metatarsus and pelvis that unite later species from other landmasses. The dorsal vertebrae are unusually long (cena length more than twice diameter). The ribcage is reinforced to resist forces generated by the forelimb, in-
cluding long and robust posterior cervical ribs, five large uncinate processes, ossified sternal ribs and sternal plates, and an enlarged coracid. As in abelisaurids, the gnedon is directed posteriorly and only slightly laterally. The forelimb is directed postverotractorally, is very short (18% of hind limb length), has intralimb proportions similar to those in abelisaurids, is powerfully constructed (robust deltoskeletal crest and olecranion, broad interphalangeal joints), and has straight uanalgs. The forelimb cannot be flexed anteriorly beyond a coronal plane through the shoulder joint; it can effect a digging stroke that rotates the large-clawed manus toward the midline under the trunk. Digit II, the longest manual digit, is ossified to belong to the erinaceid Amphiuchen; the original attribution was evidently correct.
THE EVOLUTION OF TREMATOCHAMPSID CROCODYLIFORMS IN AFRICA: NEW EVIDENCE FROM THE MIDDLE CRETACEOUS GALUULA FORMATION, SOUTHWESTERN TANZANIA

SERTICH, Joseph, Stony Brook University, Stony Brook, NY, USA; O’CONNOR, Patrick, Ohio University, Athens, OH, USA

Recent fieldwork in the middle Cretaceous Galuula Formation, Rukwa Rift Basin, southwestern Tanzania has recovered a diverse assemblage of continental vertebrates including sauropod and theropod dinosaurs, turtles, fish, and mammals. Crocodyliform material has, until now, been dominated by well-preserved remains of a small mammal-like notosuchian. Remains of a larger taxa extend the morphological diversity of Galuula Formation crocodyliforms and represent the first large-bodied middle Cretaceous crocodyliform from sub-equatorial Africa. This new form, represented by a well preserved posterior skull, comprises closely with *Hamadasuchus reboulii* from the middle Cretaceous Kem Kem beds of Morocco. Features uniting the two taxa include straight lateral margins of the supratemporal fenestrae, prominent posterior projections of the supracapitaleal, and a broad suture for the palatine over the anteroventral surface of the pterygoid flange. The presence of a *Hamadasuchus*-like crocodyliform in Tanzania extends the range of trematocampshid crocodyliforms and provides one of the first faunal links between the Galuula Formation and potentially penecontemporaneous faunas in North Africa. Reevaluation of other, often problematic, middle Cretaceous African taxa (e.g., *Trematotchampsa, Stolokrosuchus*) reveals a number of shared derived cranial characters suggesting close phylogenetic relationships with the primarily South American Peirosauridae. A phylogenetic analysis with character sampling targeting trematocampshaid and peirosaurid interrelationships was conducted to assess the relationship of the Tanzanian taxon among Mesozoic crocodyliforms. The consensus of most parsimoni- ous trees places the Tanzanian form among a derived clade that includes *Hamadasuchus* and *Trematocampshaus* within a larger clade of Gondwana peirosaurid taxa. These results empha- size the need for further analysis and suggest that the historically overlapping clades Trematocampshaiidae and Peirosauridae and indicate a large degree of morphological diversity among these bio-geographically important basal mesoeucrocodylians.

Poster Session I, (Sunday)

PAWS FOR THOUGHT: THE LATE PLEISTOCENE FOSSIL VERTEBRAE FROM THE TALARA TAR SEEPS, PERU, AND CORRALITO, ECUADOR

SEYMOUR, Kevin, Royal Ontario Museum, Toronto, ON, Canada

A.G. Edmund collected more than 27,000 fossil bones from the Late Pleistocene tar seep deposit near Talara, Piura, Peru, in January 1958. Of the identified 26,873 specimens, 63.1% represent mammals, 34.7% birds and 2.1% reptiles, with trace amounts of amphibian and avian re- mains. Of the 16,960 mammal specimens, Carnivora represent over 79% of the specimens. Seven species of Carnivora have been identified (Minimum number of individuals, MNI, in parentheses): the canids *Lycalopex sechurae* (101) and *Canis dirus* (51), the felids *Smilodon fatalis* (20), *Panthera onca* (3), *Puma concolor* (3) and *Leopardus sp.* (2), and the mustelid *Conepatus talarae* (7). The MNI is usually based on podial elements. Although *Panthera atrox* was reported from Talara, this report was in error. This site compares well with the famous Rancho La Brea deposits in California, USA; they are of similar age, carnivorans dominate, a high proportion of juveniles and subadults are present (35% to 47% depending on the species), and a significant number of *Canis dirus* specimens show skeletal patholo- gies. A habitat with more water than is present today is indicated by this fauna. Edmund collected an additional 4,470 Late Pleistocene vertebrate fossils from the nearby Corralito site and several other minor locations in Guayas province, Ecuador in 1961. Of this total, 95% represent mammals and 5% reptiles, with trace amounts of amphibian and avian re- mains. Of the 4,225 mammal specimens, Carnivora represent less than 2% of the specimens, with only *Smilodon* (2) and *Lycalopex* (1) recorded. Species of extinct Xenarthra (90% of the specimens) and Artiodactyla (6.6% of the specimens) predominate in these faunas. Although seeped oil was present in these deposits, sedimentological and paleoecological evidence suggest that these Ecuadorian sites were fluvially deposited and did not function as carnivore traps as did the Talara tar seeps.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 8:00

TRACE ELEMENT COMPOSITION OF BONE IN RELATION TO THE ECOLOGY OF AFRICAN VERTEBRATES

SHABEL, Alan, U. C. Berkeley, Berkeley, CA, USA

Trace element analysis is an important tool in paleobiology. The success of trace element analysis is limited by diagnostic effects on fossils, as well as by the lack of comparative data on extant organisms. Here I present the results of a survey of trace element composition (Sr, Ba, Ca) in raw bone samples from 79 species of extant African vertebrates (472 individuals) including more than 75% of the native carnivoran mammal species. The primary goal was to study the effect of aquatic resource use on bone tissue chemistry. The ratio of strontium to barium (Sr/ Ba) was found to differentiate carnivoran species that foraged in freshwater, eutocalon, terrestrial, and marine ecosystems. This result was supported by data from non- carnivoran vertebrates, including boids (22 species), tenrecs (*Potamogale velox*), and monitor lizards (*Varanus spp.*). The influence of ocean chemistry on consumer tissue was particularly clear for those species that foraged on both the coastlines and in the interior. This is well illustrated by the strong negative correlation between Sr/Ba and collection distance from the ocean for specimens of *Aonyx capensis* (clawless otter) and *Atlas paludinosus* (marsh mongoose). The Sr/Ba proxy provides a new tool for the ecological reconstruction of fossil organisms and a robust technique for investigations of marine resource consumption in coastal archaeological contexts.

Poster Session III, (Tuesday)

SLOTS UP A TREE: ELUCIDATING SEMI-ABOREAL LOCOMOTION OF SMALL GROUND SLOTHS (SUPERORDER XENARTHRA, ORDER PILOSA)

SHAW, Barbara, 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 dispersed as far north as Alaska. Their modes of traveling include the unique trivaportal locomotion 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 pendulopolar (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 trivaportal ancestor should provide a clear marker in evaluating the move from trivaportal through semiarboreal to pendulopolar locomotion. This study reduced the limbs into levers, measuring the length of the lever, load, lift, and fulcrum of both the fore and hind limbs for 37 species of anteaters, ground and tree sloths. The results were analyzed using Principal Component Analyses, and then diagramed in a 2D and 3D scatterplots. The results place the smaller ground sloths from Caribbean islands within the 95% confidence ellipsoid with the semi-arboreal anteaters, supporting the small ground sloths’ transition towards trees.

Preparers’ Session, Monday 11:30

CREATION OF A LARGE SCALE INTERPRETIVE TRACKWAY DISPLAY

SHAW, Tyler, Peace Region Palaeontology Research Centre, Tumbler Ridge, BC, Canada; NYDEGGGER, Lindsey, Peace Region Palaeontology Research Centre, Tumbler Ridge, BC, Canada

On May 15, 2010 the Peace Region Palaeontology Research Centre (PPRPC) reopened its doors after seven months of renovations. These renovations were undertaken as a final step to transform the PP RPC from a decommissioned elementary school to fully functioning research museum. Previous renovations have focused on converting the classrooms into of- fices, preparation labs, and collections space; this round of renovations focused on convert- ing the former gymnasium into a public display area referred to as the Dinosaur Discovery Gallery. The main feature of this gallery is a 30’ by 60’ interpretive trackway display show- casing four genera of dinosaurs (replica mounts) and five ichnogenera. This scene depicts an Albian flood plain from the Gates Formation, shortly after the water has receded. During the planning stages several ideas were suggested to replicate a suitable track surface including modifying a latex peel of an actual ripple surface to create a plaster cast (replica mold). This idea was deemed unfeasible due to budget, size, and weight constraints. A suggestion from a local contractor resulted in the usage of expanded polystyrene (EPS). Expanded polystyrene has the benefit of being cost effective, light weight, and easily sculpted with heat. Ripple marks were crafted using a hand held propane torch; lightly brushing the surface with the flame. Several ponds and a small drainage channel were added by allowing longer contact between the flame and the EPS. Again several ideas were suggested as to how best craft the dinosaur tracks. Replica casts were produced using a modified lead casting technique. These pieces could then be heated and impressed into the EPS to create replica molds. To finish the surface, cracks between EPS sheets were filled with drywall mud and the surface painted to both match the natural rock and to highlight surface features. Lead stamps were crafted for multiple plant genera. These stamps were painted and pressed into the surface to replicate carbon impressions. Silicone molds were taken of each lead piece to be stored for future projects.

Poster Session I, (Sunday)

NEW DINOSAURS FROM THE LOWER CRETACEOUS KITADANI FORMATION OF THE TETORI GROUP, FUKUI, CENTRAL JAPAN

SHIBATA, Masateru, Fukui Prefectural Dinosaur Museum, Katsuyama, Japan; AZUMA, Yoichi, Fukui Prefectural Dinosaur Museum, Katsuyama, Japan

The Lower Cretaceous Kitadani Formation has been known to yield plentiful dinosaur bones from Japan. Two of the three dinosaur taxa known from Japan were unearthed from this for- mation. Dinosaurs from the Kitadani Fm include the carnosaurs *Fukuiraptor kitadaniensis* and the non-hadrosaurid iguanodontian *Fukusaurus tetoriensis*. For more than 20 years the Fukui Prefectural Dinosaur Museum has conducted an ongoing dinosaur excavation project at the Kitadani Quarry, where the Kitadani Formation crops out in Katsuyama, Fukui Prefec- ture. Since 2007, the 3rd dinosaur excavation project has made significant new discoveries. Here we report two new dinosaurs from this site.

New tetanurosauriform sauropod materials have been unearthed from the middle sandstone, approximately 7 meters above the known bonebed where *F. kitadaniensis* and *F. tetoriensis* were discovered. Recovered elements include humerus, ulna, femur, phalanges, cervical and caudal vertebrae. Elements were scattered and disarticulated, with some exhibiting heavy
weathering and deformation. According to characters of preserved bones, this Fukui sauropod is assigned to the basal titanosauriformes. The other new dinosaur comes from the very fine sandstone approximately 1.5 meters above the sauropod bone bed. This second new dinosaur is a dromaeosaurid dinosaur. Most elements of this specimen are disarticulated, but are found in close association, within a 1 square meter area. About 65% of body parts are preserved; these include maxilla, braincase, cervical, dorsal and caudal vertebrae, and fore and hindlimbs. This is the best-preserved dinosaur from Japan.

These two new discoveries, along with F. kitadaniensis and F. tetoriensis, imply that there was a diverse dinosaur fauna in the Early Cretaceous of Japan. Although few Japanese dinosaur records exist, dinosaurs from Fukui will help us understand their paleoecology and paleobiogeography in Japan.

Posters Session III, (Tuesday)
A MYSTERIOUS KING-SIZED MESOSOIC LUNGFISH FROM NORTH AMERICA
SHIMADA, Kenshu, DePaul University, Chicago, IL, USA; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA

Lungfishes (dipnoans) are lobe-finned fishes that geologically span from the Devonian to Recent. Here, we describe a previously unreported Mesozoic lungfish species assigned to the genus Ceratodus on the basis of an isolated upper tooth plate from Nebraska, U.S.A. The morphology of the tooth clearly suggests that it represents an undescribed taxon. However, this distinct species cannot be given a new taxonomic name because of its mysterious occurrence in the middle of Nebraska where exposures of Mesozoic rocks are not known in the vicinity. The specimen is interpreted to have been transported fluvially from Wyoming where Upper Jurassic–Lower Cretaceous strata representing floodplain-marginal marine depositional environments are common and often yield tooth plates of various Ceratodus species; however, it is equally possible that a Native American could have carried the tooth from the west or north to its discovery site. The specimen is noteworthy because, to our knowledge, it is the world’s largest dipnoan tooth reported to date, measuring 117 mm in maximum dimension. If one considers the skull and tooth-to-skull ratio of Ceratodus to be similar to those of the largest extant lungfish, the Australian lungfish (Neoceratodus forsteri) that reaches up to about 2 m in total length, the estimated total length of the undescribed Mesozoic taxon would be about 4 m in life. This discovery adds a remarkable new component to the paleoecology of the Western Interior of North America during the ‘Age of Reptiles.’

Posters Session IV, (Wednesday)
HIGH SHELL-CRUSHING PERFORMANCE OF TEETH FACILITATED BY UNIQUE FRACTURE PATTERNS
SHIN, Ji-Yeon, University of California, Davis, Davis, CA, USA; MOTANI, Ryoosuke, University of California, Davis, Davis, CA, USA

Vertebrates that feed on shells, or durophages, tend to have rounded tooth crowns. A common interpretation of this phenomenon is that the brittle nature of tooth materials mandates rounded shape to avoid breakage while shell-crushing performance may be sacrificed by this shape. However, the second segment of this statement is an untested hypothesis. We present observations from a range of durophagine species and utilities that our studies can clarify the debate. We tested ten species of durophages, including extant and fossil species, that are known to feed on shellfish. We characterized the crushing performance of these species using a custom-designed apparatus. The apparatus allowed each species to first crush pinacitic shells, which are soft and weak, and then to crush the shells that are much stronger. We found that species with more rounded teeth performed better than species with more elongated teeth. This suggests that species with more rounded teeth are better adapted to crushing hard shells, and that the rounded tooth shape is an adaptation to durophagy. We also observed that species with more elongated teeth had higher crushing forces than species with more rounded teeth. This suggests that species with more elongated teeth are better adapted to crushing soft shells. We conclude that the rounded tooth shape is an adaptation to durophagy, and that the crushing performance of these species is influenced by the shape of their teeth.

Preparators’ Session, Monday 9:15
USE OF RIGID, SEMI-RIGID AND TRANSPARENT CRADLES FOR PREPARATION AND LONG-TERM STORAGE OF DELICATE SPECIMENS
SHINYA, Akiko, The Field Museum, Chicago, IL, USA

The preparation of delicate fossils requires a balance of consolidating materials and a series of cradles that transition the specimen from its matrix to its long-term conservation. The use of a cradle made with plaster, ethoform, or thixotropic rubber, is a widely practiced method of preparing delicate specimens to prevent the specimen from collapsing during preparation. A common approach to stabilize the specimen is to apply consolidants to an unexposed specimen, but this slows the preparation of delicate specimens significantly as the matrix adheres to the specimen, requiring grinding and scraping of the matrix causing potentially damaging vibrations. A non-consolidated specimen must be kept in custom-fitted temporary cradles with appropriate liners and backing materials. A cradle with a tyvek liner and plaster or plaster bandage provides a time effective rigid support. Once the delicate morphology is exposed, a polytetrafluoroethylene (PTFE) sheet liner and woven cotton impregnated with thermal plastic provides a semi-rigid support and cushions against vibration. PTFE conforms to the specimen to provide an adequate liner. The thermal plastic can be remolded if adjustments are required. After the preparation of the specimen, the specimen must be consolidated. Then, a transparent, user-friendly cradle, made from an aqueous based polymer commonly used in the dental industry is constructed for long-term conservation to provide appropriate support and reduce the potential for damage during handling. A malleable material, such as cyclododecane (CDD), clay, or PTFE tape is used to build a cushion to protect delicate features and protrusions. This cushion prevents the specimen from contacting the cradle while the cradle is formed. Use of CDD for the cushion is an option due to its sublimation property. A clay block is another option, but is difficult to clean from the specimen. PTFE tape is flexible and has a low coefficient of friction that allows the specimens to not cling to the cushion. Clearly marked registration keys or placement marks can be added to the cradle to guide the proper orientation of the specimen.
Technical Session V, Monday 4:00

INFERRING ECHOLOCATION IN ANCESTOR BAT

SIMMONS, Nancy, American Museum of Natural History, New York, NY, USA; SEYMOUR, Kevin, Royal Ontario Museum, Toronto, ON, Canada; HABERSETZER, Jong, Forschungsinstitut Senckenberg am Main, Germany; GOSNELL, Gregg, Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA

Most living bats (Chiroptera) use laryngeal echolocation to form images of their surroundings and to detect and capture flying prey. Echolocation is considered a key innovation largely responsible for the evolutionary success of bats, which number over 1,100 extant species and inhabit all continents except Antarctica. Paleontologists have long sought osteological correlates of echolocation that can be used to infer behavior of ancient fossil bats, particularly Eocene taxa representing basal branches of the bat family tree. Four osteological traits have been postulated as indicators of laryngeal echolocation in bats: (1) an enlarged orobuccal apophysis on the malleus (one of the middle ear ossicles that transmit sound from the ear drum to the inner ear); (2) an enlarged cochlea (providing increased sensitivity to high frequency sounds in the inner ear); (3) an enlarged paddle-like or bifurcated cranial tip on the stylus; and (4) an articulation between the stylohyal and the tympanic (providing a direct chain of transmission between the larynx and the ear). We examine these traits in light of new evidence from bats and other mammals, including high-resolution CT scans of the holotype of the Eocene bat Onychonycteris. We conclude that an enlarged orobuccal apophysis cannot be considered an indicator of echolocation. The other traits remain good markers, but stylotypical modifications and an articulation between this element and the tympanic represent two parts of a single complex. Analysis of basirhinar morphology indicates that many Eocene bats were echolocators (e.g., Icynonycteris, Archaeonycteris, Palaeochiropteryx, Hasiacycteris, Tachypteran, Tanyonycteris). Contrary to recent suggestions that Onychonycteris was initially capable of echolocation, we believe evidence is best interpreted as indicating that it could not echolocate. Because postcranial morphological indicators of Onychonycteris could fly and phylogenetic analyses place it on the basal branch within Chiroptera, the “flight first” hypothesis for the origin of flight and echolocation in bats remains the best-supported hypothesis for the origins of these key features.

Technical Session III, (Tuesday)

ENDOCRANIAL ANATOMY OF LABIDOLEMUR KAYI AND ITS RELEVANCE TO THE EVOLUTION OF THE BRAIN IN EUARCHONTGLIRES

SILCOX, Mary, University of Toronto Scarborough, Toronto, ON, Canada; DALMYN, Claire, York University, Toronto, ON, Canada; HRENCUK, Andrea, University of Winnipeg, Winnipeg, MB, Canada; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BOYER, Doug, Brooklyn College, New York, NY, USA

Anatomical differences between the Paleocene and the Eocene in Europe and the Paleocene to Eocene of North America. Cladistic analysis of 240 craniodental and postcranial traits for a diversity of mammals suggests that apatemyids may be stem eurarchontognaths, relevant for understanding primitive states for that clade. The only endocranial reconstruction previously described for an apatemyid pertains to Carinella sigei from the Late Eocene of France. Here we present a composite virtual endocast of Labidolemur kayi derived from high resolution X-ray computed tomography data, based on partial cranial material from the late Paleocene (Clarkforkian) and Early Eocene (Wasatchian) of the Clark Fork Basin, Wyoming. In light of L. kayi’s phylogenetic position and greater age, this reconstruction may help to substantiate the primitive anatomy of the family. Like C. sigei, L. kayi had voluminous, transversely expansive olfactory bulbs, accounting for 11-13 percent of the endocranial volume. This is similar to Cretaceous eutherians (e.g., Astrapotheres), but contrasts with the relatively smaller olfactory bulbs in both the basal glirain Rhombomylus turpanensis and in primitive primates (Ignacius graybulianus, Microsyops annectens). This suggests some reduction in the relative size of the olfactory bulbs in glirain and eurarchontan or primate evolution. Similar to R. turpanensis, L. graybulianus, and the inferred ancestral condition for Microsyops, but unlike C. sigei, L. kayi exhibited exposed caudal colliculi, supporting the inference that this condition was primitive for Eurarchonta and Euchronta, and suggesting some independent expansion of the cerebrum in apatemyid evolution. The cranial capacity of L. kayi is estimated at 0.50-0.61 cc. Using a body mass estimate derived from the postcranial of a nearly complete skeleton of L. kayi, the estimated Encephalization Quotient (EQ) is 0.23-0.28 or 0.38-0.46 depending on the reconstruction and equation used. These values are much lower than estimates for C. sigei, but overlap with the range calculated for M. annectens and Plesiadapis cookei, suggesting that this may approximate the EQ of the common ancestor of Eurarchonta.

Poster Session II, (Monday)

EVIDENCE FOR AN EARLIER PRESENCE OF PLESIOSAURS (REPTILIA, SAUROPTERYGIA) IN ANTARCTICA

SIMÕES, Tiago, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; RIFF, Douglas, Universidade Federal de Uberlândia, Uberlândia, Brazil; GUILLO, Orlando, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; ROMANO, Pedro, Universidade Federal da Bahia, Barreiras, Brazil

Plesiosaurs in Antarctica have been reported from the López de Bertodano and the subjacent Snow Hill Island formations, which crop out along the insular area of the James Ross Island sedimentary basin, Antarctic Peninsula. These strata range from the late Campanian to early Maastrichtian in age. Here, we present a new plesiosaur specimen from the Lachmann Island sedimentary basin, Antarctic Peninsula. These strata range from the late Campanian to early Maastrichtian in age. Here, we present a new plesiosaur specimen from the Lachmann Island sedimentary basin, Antarctic Peninsula.

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well as some metapodial elements and many phalanges, mostly preserved at their epiphysial ends. Despite the badly preserved conditions, this is the most complete plesiosaur material from James Ross Island. Also, this is the first registered specimen from the stratigraphically older North-Western portion of that island. Thus, we hope this work will enable future findings on James Ross Island to be compared with this new material, contributing to further taxonomic knowledge and temporal distribution of Antarctica’s past vertebrate marine life.

Poster Session II, (Monday)

ANKYLOSAR FOOT MORPHOLOGY AND FUNCTION
SISSON, Robin, University of Alberta, Edmonton, AB, Canada

Aspects of biology and functional morphology of fore and hind limbs of ankylosaur dinosaurs are explored and analyzed using comparative morphology and finite element analysis. Reconstruction of the forelimb and posture of *Pinacosaurus grangeri* matches well with trackways attributed to ankylosaurs. The humerus is flexed and the elbow angled away from the body. The radius and ulna articulate perpendicular to one another, with little to no crossover. The metatarsus is upright and forms an arch at the proximal articular surface, resulting in a crescent configuration of the manus, and a semi-splayed posture relative to the main axis of the body. Ankylosaur hind limbs were adapted for bearing large amounts of weight, and finite elements analysis demonstrates that ankle morphology is derived. The ankylosaurid metatarsus has a twisted proximal articular surface, and metatarsals are optimally adapted for bearing weight at increasing angles from medial to lateral. Finite element analysis results, in conjunction with the twisted proximal articular surface, and other morphological features, suggest a rolling motion in the foot while pushing off in the locomotory cycle. This is perhaps an adaptation to cope with the wide hips associated with derived ankylosaurs, bringing the pes closer to the midline of the animal during locomotion to increase maneuverability.

Poster Session I, (Sunday)

REFINING ECOLOGICAL DIVERSITY ANALYSIS IN A PALEOEKOLOGICAL RECONSTRUCTION OF OLDUVAI GORGE BED II
SLEPKOV, Rebecca, University of Minnesota, Minneapolis, MN, USA; KOVAROVIC, Kris, Durham University, Durham, United Kingdom; MCNULTY, Kieran, University of Minnesota, Minneapolis, MN, USA

Ecological diversity analysis is a comparative method of paleoecological reconstruction that identifies similarities in the mammal community structure of modern and fossil assemblages. Community structure is quantified by the frequency of niche components such as positional repertoire, dietary adaptation, and body size. Difficulties with this technique center on eliminating taphonomic bias and determining appropriate methods of quantifying the similarities and differences within the comparative sample. We use a number of multivariate statistical tools to refine this type of analysis including multiple methods of ordination for principal components analysis as well as correspondence analysis, discriminant function analysis, and hierarchical cluster analysis. These methods were tested in a reconstruction of the palaeoenvironment represented by assemblages from Lower Bed II (1.79-1.74 ma) and Upper Bed II (1.74-1.2 ma) at Olduvai Gorge, Tanzania. By computing the eigendecomposition using the modern assemblages and applying this ordination to both the modern and the fossil data, taphonomic bias from the latter groups was minimized. The removal of small-bodied taxa from both the fossil and comparative sample limited the influence of preservation and collection biases against micromammals. Results from this research suggest that the Lower Bed II assemblage at Olduvai Gorge was a tropical arid bushland or mixed woodland/grassland. Upper Bed II is best reconstructed as a grassland. These results diverge from previous studies, which suggested a wooded habitat in Lower Bed II comparable to the more closed environment of Bed I. This implies that paleoecological reconstructions relying on single taxonomic groups, as opposed to the entire community structure, may miss significant components of the overall habitat.

Technical Session X, Tuesday 11:00

COMBINED PHYLOGENETIC ANALYSIS OF PAN-ALCIDAe (AVES, CHAARDIRIFORMES): THE CONTRIBUTION OF FOSSILS TO THE RESOLUTION OF AVIAN SYSTEMATIC RELATIONSHIPS AND DIVERGENCE ESTIMATION
SMITH, Adam, University of Texas Austin, Austin, TX, USA

Pan-Alcidae have the richest fossil record among Charadriiformes; however, previous phylogenetic analyses of alcid relationships have been overwhelmingly restricted to extant taxa. Inclusion of 25 extinct alcid species along with 52 extant species of alcid and charadriiform outgroup taxa represents the most inclusive taxon sampling of this clade. Systematic relationships were estimated through combined phylogenetic analyses of morphological characters (i.e., osteological, myological, integumentary, behavioral) integrated with mitochondrial and nuclear DNA sequence data (i.e., ND2, ND5, ND6, COI, cyt-b, 12S, 16S, RAG-1), and the results of different methods of phylogeny estimation (i.e., parsimony, Bayesian) were compared. Dense sampling of morphologic characters and extinct taxa resulted in a well-resolved phylogenetic tree that represents the most inclusive hypothesis of alcid relationships to date. The results of this analysis indicate that incongruence between previous analyses of alcid relationships is partly due to the exclusion of extinct taxa. Although many extinct alcid species are known from isolated skeletal elements, inclusion of these species facilitates investigation of the timing and sequence of morphological character changes, and demonstrates the potential of fossils for resolving contentious phylogenetic relationships. Additionally, the timing of cladogenetic events in Pan-Alcidae was estimated with a newly developed set of rigorously evaluated fossil calibration points for Charadriiformes. Combined molecular divergence estimates and comparison of minimum cladogram fit to the fossil record allowed for evaluation of previous hypotheses regarding extinction and radiation within Pan-Alcidae. Congruence between the estimated timing of cladogenetic events in Pan-Alcidae and the timing of Cenozoic climatic and geologic events was used a metric to evaluate the likelihood of causal relationships between these events.

Poster Session II, (Monday)

A PLESIOSAURID SKULL FROM THE TOARCIAN (LOWER JURASSIC) OF ALHADAS, PORTUGAL
SMITH, Adam, National Museum of Ireland - Natural History, Dublin, Ireland; ARAÚJO, Ricardo, Southern Methodist University, Dallas, TX, USA; MATEUS, Octávio, Universidade Nova de Lisboa & Museu da Lourinhã, Lourinhã, Portugal

During the early days of geological exploration in Portugal, a plesiosaurid skull was discovered in the marine beds of the Toarcian age São Gião Formation in the Lusitanian Basin, Alhadas. The specimen (MG33) was studied by H.E. Saugave who referred it to *Plesiosaurus sp*. This fossil has since been stored in the Geological Museum, Lisbon, where it has been largely forgotten by paleontologists for over a century. It consists of a partial isolated cranium with the premaxillary, suspensorium, and basioccipital regions missing. The dorsal surface of the skull is highly abraded so few sutures are visible. The palate on the other hand is well preserved. There are presently four valid plesiosaurid genera known from the Toarcian stage: *Seeleysaurus*, *Occitanosaurus*, *Hydrorion*, and *Microcleidus*. To assess the phylogenetic position of MG33, we coded it as an additional operational taxonomic unit in an existing data matrix and ran the cladistic analysis. In the resulting strict consensus of 15 equally parsimonious trees, MG33 forms an unresolved polytomy with *Hydrorion*, *Occitanosaurus* and *Microcleidus*. Further comparison of MG33 with these taxa indicates greater similarity to *Hydrorion*. MG33 has a flat parasphenoid between the posterior interpterygoid vacuities, whereas the paraphenoid in *Microcleidus* and *Occitanosaurus* is keeled. MG33 is a rare example of a plesiosaurian from Portugal and represents the westernmost occurrence of any European plesiosaurian.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

A MORPHOLOGICAL AND MORPHOMETRIC REDESCRIPTION OF TANTYRACHELOS ALYNS
SMITH, Amy, Virginia Tech, Blacksburg, VA, USA

*Tanyrachaeles alyns* is a small (approximately 21 cm long) aquatic protorosaur recorded from the Newark Supergroup. Most specimens are known from exposures of the Cow Branch Formation at the Solite Quarry on the Virginia-North Carolina border. Originally described on the basis of roughly 100 specimens, an additional 200 specimens have since been collected. The new material provides added insights into *Tanyrachaeles*. Although the vast majority of specimens are impossible to mechanically or chemically prepare from the sediment matrix, Computed Tomography has allowed anatomical details otherwise obscured by matrix to be revealed. The use of quantitative morphometrics has also provided a more quantitative description. The in-depth study resulting from these resources allows for the suite of characters missing for *Tanyrachaeles* in previous cladistic analyses of Protorosaurus and Archosauromorpha to be added so that future reanalyses may take place. Three hundred and fourteen specimens and two CT scans of *Tanyrachaeles* where studied to create a new qualitative description of its morphology. Additionally, 119 length measurements and four angle measurements of individual elements (from which seventeen variables were derived) were taken from these specimens for a quantitative description. The vertebral column of *Tanyrachaeles* is comprised of thirteen cervicals, thirteen dorsals, two sacrals, and at least thirty-two caudals. The few preserved skulls show rows of homodont, pleurodont teeth and an orbit that consistently occupies 11%-13% of the lateral area of the skull. The carpus contains an ulnar, radiale, and two distal carpals, and the tarsus contains a calcaneum, astragalus, and distal tarsals 3 and 4. The fifth metatarsal is significantly short, with a hooked dorsal surface to aid in propulsion. Unfused heterotopic bones are found in some specimens due to the pressure of subsequent vertebral fusion 4 and 5. Traces of soft tissue are seen in a select few specimens, including a remarkable juvenile specimen (measuring approximately 3-4 centimeters in length), which displays a nearly complete body outline.

Technical Session II, Sunday 9:45

THE TAXONOMIC DIVERSITY OF THE STEM MAMMAL MORGANACUDON (MORGANUCODONTA: MORGANOCODONTIDAE) FROM LATE TRIASSIC-EARLY JURASSIC FISSURE DEPOSITS OF GLAMORGANSHIRE, WALES, UK
SMITH, Andrew, University of Bristol, Bristol, United Kingdom; GILL, Pamela, University of Bristol, Bristol, United Kingdom; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom; RUTA, Marcello, University of Bristol, Bristol, United Kingdom; HOOKER, Jerry, Natural History Museum, London, United Kingdom

Triassic-Jurassic fissure fills from Glamorganshire, Wales, UK, offer a unique window into the evolution of Mesozoic mammals. Among the many fissures of this region, diverse assemblages have yielded a wealth of fossil vertebrate material, including a number of isolated
molariforms recently assigned to two new morganucodontan genera. A depauperate fauna is also observed in a number of fissures, and two early mammals, Morganucodon and Kuehneotherium, have been discovered therein. At present, all Morganucodon specimens from these fissures are attributed to a single species, Morganucodon watsoni. However, previous studies of the fissure material in this area have identified a taxonomically diverse population of Kuehneotherium, and we hypothesize that a similar diversity exists in Morganucodon. The abundance of disparate Morganucodon material from these depauperate fissures has allowed for rigorous morphometric analysis of dental material to quantitatively assess the presence of taxonomic diversity within these basal mammals. Morganucodon dental disparity was assessed via Principle Component Analysis (PVA) and Principle Coordinate Analysis (PCOA) using material from two- or three-fossil fissures, to investigate whether a similar taxonomic pattern to Kuehneotherium was present. Upper and lower molars cluster in morphospace relative to locality, and this separation is statistically supported by Discriminant Analysis of Euclidian and Manhattan values from PCOA (P > 0.001). Separation is most distinct in the second molars with a similar morphospace pattern present in the thirds. An increasing buccal salience distance and differing cusp proportions constitute the major morphological characters that define species position in morphospace. PCA loading values identified size and inter-cusp distances as significant components of these differences. We conclude from the observed differences in size and morphology that Morganucodon possesses a more taxonomic diversity, similar to that of Kuehneotherium. This represents further evidence of diversity in the earliest stem mammals, aided by changes in developmental dental patterning, which permitted subsequent ecological diversification.

Preparers’ Session, Monday 8:45
CSI KIMBERLY: FOSSIL CRIME SCENE INVESTIGATION PRIOR TO THE ESTABLISHMENT OF THE PALEONTOLOGICAL RESOURCES PROTECTION ACT
SMITH, Mathew, Petrified Forest National Park, Petrified Forest, AZ, USA

On May, 6 2007 a theft of fossil resources was reported by a staff member of the John Day Fossil Beds National Monument. Due to preparers’ specialization in the removal of in situ fossil materials from field settings, and knowledge of the marks that fossil collection and preparation leave on specimens, the preparation staff was asked to perform forensic analysis of material gathered at the crime scene. This study included gathering of evidence from the crime scene itself, analysis of photos, microscopically, analysis of associated fossil material, and analysis of negative impressions of the stolen fossil in the surrounding matrix. Preparation staff also helped to serve a warrant at the suspect’s house. During the warrant police seized digital photographs and videos that appear to match the crime scene and found additional fossil material and matrix that appears to be associated with matrix from the crime scene. Using all the material available we attempted to identify the genus of the stolen specimen and determine its “value”. Value was determined using the Archaeological Resources Protection Act protocols as a working model. Extensive photo documentation of the locality and physical evidence proved to be crucial to analyzing material collected at the suspect’s house. Also, our use of reversible glues in the museum sciences was found to lend itself to the legal process with little conflict. The evidence points to the conclusion that the suspect not only was at the scene of the crime on the day in question but that he had associated materials from the stolen fossils in his household when warrants were served later that year. Unfortunately, the case has yet to go to trial at this time. Regardless of the outcome the generalities of the crime scene analysis may prove to be an instructive example for law enforcement officials and museum staff gathering evidence at future fossil crimes scenes on federal land.

Technical Session IX, Tuesday 8:45
MAMMALIAN BODY MASS EVOLUTION OVER SPACE AND TIME
SMITH, Felisa, University of New Mexico, Albuquerque, NM, USA; Research COORDINATION NETWORK, IMPS, University of New Mexico, Albuquerque, NM, USA

The extinction of the dinosaurs at the K-Pg was arguably the seminal event in the history of mammals, opening the door for their subsequent diversification into the wide range of body masses seen today. Yet, with the exception of North America, the tempo and mode of body mass evolution over the Cenozoic has received little attention. Here we compile and analyze masses seen today. Yet, with the exception of North America, the tempo and mode of body mass evolution over the Cenozoic has received little attention. Here we compile and analyze mammalian body mass data from the fossil record and recent preserved specimens of fossil mammals. For each taxon, we estimate body mass using computed tomography (CT) at the Summit Regional Medical Center in Show Low, Arizona. In an effort to elucidate phytosaur cranial morphology, including the endocranial cavity and associated structures without destructive analysis, three specimens of Pseudopalatus were imaged using computed tomography (CT) at the Summit Regional Medical Center in Show Low, Arizona. High quality results were obtained from two of these, PEFO 382, a nearly complete skull with an intact braincase, and PEFO 34042, a partial braincase with auditory vestibules preserved. Pseudopalatus pristinus is a typical non-avian reptilian endocranial serial architecture, comparable to that previously described for Pseudopalatus pristinus. The cochlea of observed phytosaurs is notably short, are preserved in one or the other of the two successfully scanned specimens. The canal of observed phytosaurs is notably short, and is also observed in a number of fissures, and two early mammals, Morganucodon and Kuehneotherium, have been discovered therein. At present, all Morganucodon specimens from these fissures are attributed to a single species, Morganucodon watsoni. However, previous studies of the fissure material in this area have identified a taxonomically diverse population of Kuehneotherium, and we hypothesize that a similar diversity exists in Morganucodon. The abundance of disparate Morganucodon material from these depauperate fissures has allowed for rigorous morphometric analysis of dental material to quantitatively assess the presence of taxonomic diversity within these basal mammals. Morganucodon dental disparity was assessed via Principle Component Analysis (PVA) and Principle Coordinate Analysis (PCOA) using material from two- or three-fossil fissures, to investigate whether a similar taxonomic pattern to Kuehneotherium was present. Upper and lower molars cluster in morphospace relative to locality, and this separation is statistically supported by Discriminant Analysis of Euclidian and Manhattan values from PCOA (P > 0.001). Separation is most distinct in the second molars with a similar morphospace pattern present in the thirds. An increasing buccal salience distance and differing cusp proportions constitute the major morphological characters that define species position in morphospace. PCA loading values identified size and inter-cusp distances as significant components of these differences. We conclude from the observed differences in size and morphology that Morganucodon possesses a more taxonomic diversity, similar to that of Kuehneotherium. This represents further evidence of diversity in the earliest stem mammals, aided by changes in developmental dental patterning, which permitted subsequent ecological diversification.

Poster Session I, (Sunday)
SEXUAL DIMORPHISM IN TUSKS OF AMERICAN MASTODONS (MAMMUT AMERICANUM) AND AFRICAN ELEPHANTS (LOXODONTA AFRICANA, LOXODONTA CYCLOTTUS): A MULTIVARIATE COMPARISON
SMITH, Kathryn, University of Michigan, Ann Arbor, MI, USA; FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA

Characteristics of social structure, mating strategies, and parental investment can be inferred for mammalian species based on degree of sexual dimorphism, especially when males are substantially larger than females. African elephants (Loxodonta africana, Loxodonta cycloptus) exhibit marked dimorphism in tusks size and show behaviors typical of strongly protogynous species. American mastodons (Mammut americanum) also exhibit pronounced sexual dimorphism, but mastodons and elephants diverged from a most recent common ancestor over 25 Ma, so whether the two genera exhibit similarities in behavior must be inferred. Similar behavioral traits in mastodons and elephants could be supported if patterns of tusk dimorphism are consistent across the two genera. Separate discriminant function analyses (DFA) of 21 mastodon tusks of inferred sex (assessed in independent analyses) and 45 elephant tusks of known sex, using the same ten tusk variables, indicate that similar patterns of sexual change in tusk circumference, dimorphism, and growth, regardless of genus, may be effectively discriminate between sexes. Canonical variates analysis (CVA) of tusks from male and female mastodons and male and female elephants, using the same tusks and measurements as in DFA, shows that male tusks are larger than female tusks across all measurements, especially in maximum tusk circumference and pulp cavity depth, for both genera. CVA also emphasizes differences in tusk morphology between genera that imply mastodon tusks are, in general, more robust than elephant tusks, although this difference does not affect the nature of tusk dimorphism. Overall, this study illustrates that there is a characteristic male and a characteristic female tusk form shared by elephants and mastodons. This suggests selection pressures favoring tusk dimorphism remained relatively constant for these lineages since at least the time of their divergence. Thus, mastodons, like modern elephants, likely exhibited behaviors associated with strongly dimorphic species, and aspects of modern elephant behavior may have emerged prior to the divergence of elephants and mastodons.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)
REGIONAL DISJUNCTION IN PLEISTOCENE FAUNAS FROM INDIANA AND THE MIDWEST
SMITH, Michael, Indiana University, Bloomington, IN, USA

The mammal fauna from Harrodsburg Crevice, a Late Pleistocene site from southern Indiana, USA, has several anomalous occurrences, including a northernly occurrence of Panthera onca augusta (Pleistocene jaguar) and a late occurrence of Platypus venus (Pleistocene American beaver). Two published radiocarbon dates (25,050 ybp and 34,460 ybp) suggested that the Harrodsburg fauna belonged to an interstadial of the Wisconsinan (during Marine Isotope Stage 3), which if true would make the occurrence of P onca the northernmost of the
Phylogenetic Analysis of Palecaniformes (AVES) Based on Osteological Data: Implications for Waterbird Phylogeny and Fossil Calibration Studies

SMITH, Nathan, Field Museum of Natural History, Chicago, IL, USA

Debate regarding the monophyly and relationships of the avian order Palecaniformes represents a classic example of discord between morphological and molecular estimates of phylogeny. This lack of consensus hampers interpretation of the palecaniform fossil record, which has important implications for understanding patterns of character evolution, and for dating deep splits in higher-level avian phylogeny. The monophyly and phylogenetic relationships of the Palecaniformes were assessed through parsimony analysis of an osteological dataset encompassing 59 taxa and 464 characters. Palecaniform monophyly is rejected, with Prophaethonidae recovered as distantly related to all other members of the order, which are supported as a monophyletic Steganopodes. Incongruence length difference tests suggest that Phaethontidae recovered as distantly related to all other members of the order, which are supported as a monophyletic Steganopodes. Incongruence length difference tests suggest that these discrepancies are localized outside of Steganopodes, and some anatomical partitions of the dataset may possess different phylogenetic signals, and are primarily due to a few problematic taxa or poorly supported nodes. The Prohabrocygones, an extinct family of wing-propelled divers, are recovered as the sister group to Phalacrocoracidae, suggesting extensive convergence in the pectoral limbs of plotopterids and daeids, an extinct family of wing-propelled divers, are recovered as the sister group to Phalaenoptilidae. These results indicate distinct feeding motions and correlates of feeding mode. As an extant control for these interpretations, we check correlations of structure versus function in a merlin (Falco columbarius) and bald eagle (Haliaeetus leucocephalus). Contrary to expectations, tyran- nosaurs could deploy a rapid initial bite, with high kinetic energy and impact force to bone upon initial food contact. Results for Giganotosaurus carolinii suggest effective sagittal strikes and retraction, and a pincer and sycthe-like action of the slender mandible and teeth. In contrast, the cranium of Majungasaurus was resistant to torsion during lateroflexion and that of T. rex to forces in both yaw and roll. These results suggest alternating, lateral head retraction in Majungasaurus for slicing into prey. Control FEM of raptors signals caution for this inference: merlins, despite also having lateroflexion-resistant skulls, do not cut into prey by alternating retraction. However, finite element results confirm the validity of simpler structural comparisons. With the most geometrically authentic models yet of extinct reptiles and strict extant control, we can now better assess parameters influencing absolute performance and more confidently interpret the morphology of theropod feeding.

Technical Session XIII, Tuesday 2:00


SOLE, Floréal, Muséum National d’Histoire Naturelle, Paris, France

The carnassial placentals (Hyaenodonta, Oxyaenodonta and Carnivora) from the Early Eocene (MP7-MP10) of Europe have been recently studied. Most of them are known from the Paris Basin. The “Creodonta” are considered as a diphyletic group and are separated in Hyaenodonta and Oxyaenodonta. The Hyaenodonta are known from twenty-five to sixty species, the Oxyaenodonta by three species and the carnivorans by seven species. For the first time, carnivorans are described from Late Paleocene localities (Jibou, Romania; Petit Patis, France). The localities from Jibou and Petit Patis could represent an equivalent of the North-American Clarkforkian. The phylogenetic analysis of the earliest hyaenodontans results in the recognition of five major clades: Limnocyoninae, Koholotinae, Prototonomus-like “Provoirininae”, Arfa-like “Provoirininae” and Provieronidae-like “Provoirininae”. The Paleocene genus Tenerodon from Africa is not referred to one of these clades. The phylogenetic analysis of the earliest carnivorans causes us to question the validity of the Carnivoramorpha. Indeed, the specialized carnassial shear on P4 and M1 in the Viverravidae and Carnivora appears probably convergent. The concept of the “Hiacidae” must be abandoned. The study of the carnivorous mammals helps to understand the faunal dispersals that occurred near the Paleocene-Eocene boundary. The Carnivora appeared probably in Asia during the Late Paleocene and dispersed 1) during the Late Paleocene (from Asia to Europe and from Asia to North America) 2) at the P/E boundary from Asia to North America through Europe. The Hyaenodonta appeared in Africa during Late Paleocene and dispersed 1) from Africa to Asia during the Late Paleocene (Limnocyoninae) and 2) at the P/E boundary from Africa to Europe (Prototonomus-like “Provoirininae”) and Arfa-like “Provoirininae”). The Oxyaenodonta appeared in North America during Paleocene and dispersed to Europe at the P/E boundary.
Phans, including representatives of every available genus known from significant cranial or postcranial material. This species-level phylogeny is the most comprehensive attempt yet to investigate basal carnivoromorph evolution. This analysis tests, for the first time, monophyly of genera and the relationships between described genera. The genus Miacis reveals as polyphyletic in the most parsimonious phylogeny, with many species of Miacis having only distant relationship to the type species. This first comprehensive inclusion of postcranial characters permits an unprecedented examination of the evolution of locomotion within basal carnivoromorphs. Features previously hypothesized to be functional indicators can be determined to be apomorphic with potential functional significance or retained plesiomorphies. For example, the nimravids have newly acquired features more likely related to a terrestrial habit. The inclusion of a robust postcranial partial allows testing of hypotheses of carnivoromorph affinities for incomplete taxa and better elucidates their placement relative to other taxa.

Posters Session II, (Monday)

THE PHYLOGENETIC ABILITY OF PROBLEMATIC BASAL ORNITHISCANS

SPENCER, Marc, Department of Geoscience, University of Iowa, Iowa City, IA, USA
Monophyly of derived ornithischian clades such as Thyreophora, Ceratopsia, Iguanodontia, and Pachycephalosauria has been corroborated in numerous analyses. The relationships of these clades within Ornithischia, however, are less certain. Moreover, the placement of taxa such as Lesothosaurus diagnosticus, Heterodontosauridae, and traditional basal ornithopods (basal cerapodans and neornithischians) are unresolved. Lesothosaurus was generally considered one of the basalmost ornithischians; however, until recently, it was never included in a quantitative species-level phylogenetic analysis of all representative ornithischians. Heterodontosaurids have been recovered as basal ornithopods, basal cerapodans, basal ornithischians, and as the sister group to Marginoccephalia. Ornithopoda—traditionally considered a well-supported clade containing ‘hypsilophodontids’ and Iguanodontia—collapsed into a polytomy at the base of Cerapoda in several recent analyses and the relationships of these taxa to Marginoccephalia are unresolved. A phylogenetic analysis was performed on 42 ornithischians representing both basal and derived taxa and a matrix of 220 discrete characters. Lesothosaurus was recovered as the sister taxon to Thyreophora; a result noted in few analyses. Heterodontosauridae collapsed into a polytomy at the base of Ornithischia with Pisanosaurus merrii and Eocorax parvus. A monophyletic Ornithopoda was recovered; however, if traditional clade membership is considered (Ornithopoda sensu lato), then the taxon is polyphyletic (e.g. heterodontosaurids as basal ornithischians). The resultant phylogeny is poorly resolved with little support for most nodes and with little improvement in resolution using reduced consensus methods. The results presented here lend support to several hypotheses, both traditional and recent, of the placement of Lesothosaurus, heterodontosaurids, ornithopods, basal cerapodans, and basal neornithischians. Additionally, these results underscore the need for a larger taxonomic sampling to illuminate ornithischian relationships.

Posters Session I, (Sunday)

THE SPECIES-LEVEL TAXONOMY OF SPHENACODON FEROSIS S. FEROS (EUPELYCOSAURIA: SPHENACODONTIDAE) FROM THE LATE PENNSYLVANIAN-EARLY PERMIAN OF NEW MEXICO

SPIELMANN, Justin, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; RINEHART, Larry, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA, USA; HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, PA, USA

Sphenacodon is a pelycosaurian-grade synapsid, best known from the Lower Permian of Rio Arriba County, northern New Mexico. Of the two species (S. feros and S. ferocior), S. feros is known from comparatively little skull material, and the skulls historically assigned to the taxon are heavily reconstructed and composed of few actual cranial elements. In contrast, S. ferocior is known from numerous nearly complete skulls that have been extensively illustrated and described in the literature. Here, we report on a new, nearly complete skull of S. feros collected from the eastern wall of the Cañon del Cobre, New Mexico, in a Sphenacodon–mined unit of the Navajo Formation (NMNH 5379). Lithologically, the quarry is in a finely laminated, dark reddish brown, immature arkosic sandstone with pale, greenish-yellow banding at ~10 cm intervals and is within the upper vertebrate assemblage zone of the Cañon del Cobre (Seymourian land vertebrate faunichron). This new skull displays numerous cranial differences between S. feros and S. ferocior including: overall skull size; number of premaxillary teeth; number of premaxillary teeth; shape of the ventral maxillary margin; shape of the nasal aperture; development of the maxillary and pterygoid horns; and the thickness of the orbitonasal process of the frontal; shape of the anteroventral corner of the temporal fenestra; shape of the squamosal–jugal suture; shape of the parietals; and extent of the dental field on the palatal ramus of the pterygoid. Sphenacodon feros has a temporal range from the LatePennsylvanian (lateVirgilian: Coyotean lfv) through the Early Permian (late Wolfcampian: Seymourian lfv), whereas S. ferocior is restricted to the Coyotean lfv, but it does span the Pennsylvanian-Permian boundary.

Posters Session II, (Monday)

ASSOCIATED CRANIODENTAL AND POSTCRANIAL HYENA FOSSILS FROM THE TYPE LOCALITY OF PACHYCRUCUTA BELLAX, KROMDRAAI, STERKFONTEIN VALLEY, SOUTH AFRICA

SPIEGELMYER, Lauren, Penn State Altoona, Altoona, PA, USA; BOYD, Brittany, Penn State Altoona, Altoona, PA, USA; HARTSTONE-ROSE, Adam, Penn State Altoona, Altoona, PA, USA

Hyena fossils recovered from newly prepared breccia discovered in the hominid-bearing, Sterkfontein Valley (Gauteng, South Africa) site of Kromdraai are the first associated craniodental and postcranial remains of Pachyruco from South Africa. While this site is significant as the type locality of the hominid taxon Paranthropus robustus, it is also significant as a source of carnivore fossils and is the type locality for Pachyruco bellax. The validity of the latter taxon is debated—it may be synonymous with P. brevirostris—due in part to the scarcity of material that may be attributed to it. This study aims to describe these new fossils and contextualize them. To do this, they have been qualitatively and quantitatively compared to all of the fossil hyena material held at the Transvaal Museum ( Pretoria, South Africa) and the University of the Witwatersrand (Johannesburg, South Africa) as well as a wide sample of modern hyena specimens from all three species of dourugous Hyaeinae. These data have been supplemented with data from other African and European hyena fossils. While the paucity of hyena fossils from South Africa, especially those representing Pachyruco, makes it difficult to test the validity of the taxon P. bellax, this new set of associated specimens which compares very favorably to the type specimen is only the second specimen altogether and the first set of fossils containing postcranial material that may be readily ascribed to the taxon. Thus these important fossils may serve as a key specimen in identifying other postcranial remains (which would yield information about functional locomotion adaptations) and as another craniodental specimen on which to base assertions on the validity of the taxon especially in relation to the well known P. brevirostris.

Posters Session I, (Sunday)

TAPHONOMIC ANALYSIS OF THE SKELETAL AGGREGATION OF PANTEOLEICOSARUS (SPHENACODONTA, EUPELYCOSAURIA)

SPINDLER, Frederik, Institut für Geologie, TU Bergakademie, Freiberg, Germany; SCHNEIDER, Jörger, Institut für Geologie, TU Bergakademie, Freiberg, Germany; VOIGT, Sebastian, Institut für Geologie, TU Bergakademie, Freiberg, Germany

The only fossil material of Pantoeleicosaurus is a skeletal aggregation of six adult individuals from coal-bearing paludistine deposits of the Early Permian Döhlen Formation, Germany. The skeletons are articulated and complete, making them a unique discovery. However, neither the death of the animals nor the taphonomy of their carcasses has been studied in detail. During the re-evaluation of the taxon a taphonomic analysis was carried out that included parts of the specimens for which there is no previously published research, as well as lithologic samples of the host rock. Historically, the light greenish bone-bearing claystone has been interpreted as a lacustrine deposit in which the carcasses were successively accumulated over a significant period of time before a mudflow instantly buried the assemblage. According to our analysis, the bone-bearing rock of the Pantoeleicosaurus slab is triplicative. A dark pyroclastic claystone at the base is overlain by reworked ash fall deposits containing aligned plant remains and the Pantoeleicosaurus skeletons which show evidence of transport such as limb dragging, torsion, slight and incomplete disarticulation, and non-hierarchical stacking with reciprocal overlap. A dark brown claystone covers the aggregation. Based on our results we suggest the following scenario: (1) The animals were killed simultaneously by catastrophic carbon dioxide exhalation in an active volcanic area. (2) For a short time, initial decay affected the subaerially exposed carcasses. (3) During re-deposition of volcanic ash, the carcasses were completely and stacked. (4) Finally, a mudflow buried the bone assemblage. There is no reason to doubt that Pantoeleicosaurus was, at least occasionally, a common element of the terrestrial tetrapod fauna in the Döhlen Basin, but results of our taphonomic study indicate that the holotype specimen cannot easily be used to prove euclycosaur social behavior.
The objectives of the agreement were creation of a “site stewardship” program to engage the local community in the management of fossil resources within the CTA, allowing for hands-on involvement whereby the site stewards are actively participating in “citizen science” from discovery to the stabilization and/or collection of fossils localities. Site stewards, as keepers of public lands, act as palaeontologists by actively engaging in the collection of new data. Training included a two-day classroom and field workshop to orient future stewards on the geology and paleontology of the region, an introduction to GPS and maps, and an extensive primer on Federal laws regarding the protection of fossil resources, including the 2009 Paleontologic Resources Preservation Act. Stewards conducted an initial walk-through of assigned parcels and actively worked under supervision in an existing, previously disturbed quarry, doubly illustrating the need to protect the resource. Stewards are expected to cyclically visit their parcel quarterly. The SBCM has also created additional educational opportunities by producing exhibit content and fossils for exhibition in kiosks that will be public interpretation loci for the citizens of southern Nevada.

Using the Past to Predict the Future: Blue Grouse as a Model for Climate Change

STEGNER, Allison, Stanford University, Stanford, CA, USA; HADLY, Elizabeth, Stanford University, Stanford, CA, USA; LEHMANN, Thomas, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany

Since its first description in 1933 a limited number of specimens of Kopidodon macrognathus have been recovered from the Middle Eocene fossil locality of Messel, NE of Darmstadt, Germany. So far, twelve specimens ranging from a mandible fragment to more or less complete skeletons are housed in the Hessische Landesmuseum Darmstadt, the Senckenberg Museum Frankfurt and in private collections. Four of these have never been described. Two new specimens, recovered from the Messel Pit in 2004 and 2007 and housed at the Senckenberg Museum Frankfurt, are presented here and help us to implement the description of this rare paroxycaenidian. One is the nearly complete skeleton of an adult individual; the left side is visible. The second is the skeleton of a smaller, younger individual also visible from the left, but with a separated severed cranium and lacking some cervical vertebrae and parts of the arms. Both specimens show a body outline with a broad tapering tail. These two specimens yield some new information on the ossification rate and tooth replacement and enable a new morphological observation. For instance, the adult specimen has a complete vertebral column with 20 thoraco-lumbar vertebrae, three sacral ones fused by their centra but not their processes, and 31 caudal vertebrae, which most likely represent the complete tail. The first five caudal vertebrae show a posteriorly elongated transverse process decreasing in size caudally, which have not been described in other specimens. The 6th caudal shows a similar transverse process in the caudal part but bears an additional shorter anterior process merging with the posterior one at the level of the centrum. From the 7th caudal vertebra onwards, there are two clearly separated transverse processes but decreasing in size up to the 13th one. The atlas is not well visible but the axis is preserved in clear lateral view showing a very prominent spinous process. The scapula is particularly well preserved. It shows a very prominent and strong scapular spine as well as a second crest along the axillary border marked in the distal half and tapering off to the proximal rim. Unnoticed so far is the extension of the proximal third of the axillary border of the scapula towards the thorax. This area is the origin of the Musculus teres major. On the femur, the femoral head is set on a short neck and is at the same level as the great trochanter suggesting a somewhat limited mobility. Conversely on the humerus, the head is more elevated than the tuberosities allowing a great mobility. Thus it seems that Kopidodon was a rather arboreal animal with a highly specialised forelimb and a fairly generalised hind limb.

Clariﬁcation of the Skeletal Anatomy of Phytosaurs Based on Comparative Anatomy and the Most Complete Specimen of Angistorhinus

STOCKER, Michelle, The University of Texas at Austin, Austin, TX, USA

Despite recent phylogenetic analyses revising phytosaur ingroup relationships and taxon- onomy, many details of the anatomy, phylogeny, and diversity of basal phytosaurs remain unknown. Complete skeletons are exceedingly rare among phytosaurs, and only two basal taxa are known from multiple material. Little is known of the postcranial anatomy, and most descriptions focused on the skull. Because of this lack of data, there is no comprehensive understanding of the skeletal anatomy of any phytosaur. I address this problem by elucidating the skeletal anatomy and relationships of Angistorhinus. Specimens of Angistorhinus are common from the Otis Chalk Quarries (Dockum Group, Texas). Current diversity estimates within Angistorhinus range from one to possibly eight taxa. No phylogenetic analysis tested the specimen-level systematics or taxonomy. However, a newly prepared specimen of Angistorhinus is the most complete North American phytosaur specimen known. It is the only specimen of Angistorhinus that consists of more than cranial material. Preserved material includes the skull, partial mandibles, full vertebral column articulated for much of its length, a partial hindlimb, ribs, gastralia, osteoderms, and both forelimbs with digits. A comparative morphological examination of this new specimen elucidated additional characters for future phylogenetic analysis. In comparison to Smilosu-
chus gregori, the most common phytosaur taxon used in higher-level archosaur phylogenies, the osteoderms are mostly smaller and more rectangular with less ornamentation, the anterior notch of the coracoid is rounder and more extensive, and the olecranor process of the ulna is less expanded. In addition to clarifying Angistorhinus anatomy, all observable neurocentral sutures are open, indicating a probable juvenile stage despite a length of over three meters. This specimen represents a rare opportunity to clarify phytosaur postcranial anatomy, developing morphological characters from the entire skeleton for phylogenetic analysis, and explore phytosaur ontogeny in a single, complete individual.

Poster Session I, (Sunday)
MORPHOLOGY AND SYSTEMATICS OF DINOSAUR EGGSHELLS AND THE IDENTIFICATION OF PROBLEMATIC OOSPECIES
STOUT, Jeremy, East Tennessee State University, Johnson City, TN, USA; BOARDMAN, Grant, University of Nebraska-Lincoln, Lincoln, NE, USA

The identification of dinosaur species based on eggs and eggshell fragments has historically been tentative at best due to the unusual absence of skeletal remains either associated with, or embryonic within, the fossilized egg. We made thin-sectional slides of eggshell fragments from several dinosaur osteoderms, along with eggshell specimens of a modern emydid turtle, alligator, two species of ratite birds, and an anseriform bird. Under low microscopy, the specimens were analyzed using polarized light. A new data matrix was established based on shell morphology, and systematic analyses performed on the otoliths. Some of the fossil eggshells used do have known embryonic remains associated, and thus provide us with important calibrations in the cladograms generated by the systematic analysis. We hypothesized that to some degree, egg evolution has mirrored morphological evolution among archosaurian tetrapods and by applying this matrix to unknown osseous eggs, that at least a family level of identification can be confidently achieved. Preliminary results show a strong correlation between the evolution of egg morphology and overall archosaurian systematics. When properly utilized, this matrix has significant diagnostic ability for the identification of problematic dinosaur specimens.

Poster Session II, (Monday)
PALEONTOLOGICAL AND HISTORICAL SIGNIFICANCE OF THE LATE EOCENE EXPOSURES NEAR COPENHAGEN, CALDWELL PARISH, LOUISIANA
STRINGER, Gary, University of Louisiana at Monroe, Monroe, LA, USA; KING, Lorin, South Louisiana Community College, Lafayette, LA, USA

Late Eocene exposures, primarily the Yazzoo Clay, near Copenhagen along the Ouachita River in Caldwell Parish, Louisiana, have been known for fossil vertebrates for nearly 200 years. Renowned paleontologists and geologists have been involved with the investigation of the fossil marine vertebrates and have included Richard Harlan, Richard Owen, Robert Gibbs, Charles Lyell, Eugene Hilgard, Thomas Vaughan, Gilbert Harris, Arthur Veatch, Timothy Conrad, and Remington Kellogg. The area first received scientific notice in the 1830’s when Henry Brey discovered large fossil bones, mainly vertebrate, in marine strata along the Ouachita River. Brey first sent a letter relating his discoveries and later specimens to Harlan. Harlan mistakenly attributed the bones to a large, lizard-like, marine reptile similar to a plesiosaur. In 1834, Harlan described the specimens and proposed the name Basilosaurus ("king lizard") in reference to its reptilian features and size. This was the first discovery and description of an archaeocete in the paleontological record. Harlan later sent the specimens to Owen who recognized the mammalian characteristics and the cetacean affinities and pronounced the colossal creature as one of the most extraordinary mammals ever to live. Basilosaurus, with a length of approximately 20 meters, remains the largest fossil known from Louisiana. Later, a second and smaller archaeocete, Zygorhiza kochii, was recognized from the area. Studies of the exposures near Copenhagen have continued into the 21st century, and the localities are now recognized as having the most diverse marine vertebrates from Louisiana and one of the richest Paleogene faunas from the Gulf coastal plain. Studies of the marine vertebrates have revealed over 80 taxa with at least 14 sharks, 6 rays, 56 teleosts (based on skeletal remains and otoliths), 3 reptiles, 1 bird, and 2 mammals. In addition to Basilosaurus, eight teleostean fish (based on otoliths) and one ray have also been discovered there. New vertebrate species have been reported from there as recently as 2003, which is amazing considering that paleontological studies have been conducted there for almost 200 years.

Advances in Paleocology: Geochemistry, Microwear and Beyond, Sunday 11:30

WAS THE EVOLUTION OF HYPSODONTY IN SOUTH AMERICA A RESPONSE TO THE SPREAD OF GRASSLAND VEGETATION?: NEW PHYTOLITH RECORDS FROM GRAN BARRANCA, ARGENTINA
STROMBERG, Caroline, University of Washington, Seattle, WA, USA; DUNN, Regan, University of Washington, Seattle, WA, USA; KOMIN, Matthew, Boise State University, Boise, ID, USA; ADDEN, Richard, Duke University, Durham, NC, USA; CARLINI, Alfredo, Museo de La Plata, Buenos Aires, Argentina

Faunas from Patagonia, South America show incremental increases in hypodonty in several meridugulante lineages from the Middle Eocene (~38 Ma) onward. Hypodonty is generally assumed to have evolved as an adaptation to feeding on silica-rich grasses or in open, dusty habitats, so this pattern of faunal change has been thought to indicate that savanna grasslands spread ~20 million years earlier in South America than on any other continent. In contrast, paleobotanical data from Patagonia either indicate closed forests during the Eocene and Oligocene (macrofossils, palynofloras) or support the idea of open, grassy habitats by the Late Eocene [plant silica (phytolith) assemblages].

We tested the South American early grassland hypothesis through a high-resolution study of phytolith assemblages in the Sarmiento Formation at Gran Barranca, Chubut Province, Argentina. Spanning 42-18.5 Ma, this section is arguably the most complete and important record of South American faunal change, and contains a rich phytolith record. Our preliminary data show that various forest indicators, including palms and woody dicotyledons, dominated phytolith assemblages throughout the section. In particular, palms were very abundant in the Eocene and Oligocene. Grasses were present from the base of the section (42 Ma), but initially consisted primarily of what were likely bambaous grasses. Phytoliths typical of open-habitat grasses (pooids, PACMADs) do appear by 38 Ma, marking the earliest occurrence of these two clades, but are rare. Late Oligocene/Early Miocene grass phytoliths, now dominantly pooid open-habitat types, increased in abundance to >50% of the assemblages. This expansion of grasses coincided with a marked decrease in palm phytoliths, potentially indicating drier or colder climates. Nevertheless, this record rejects the notion that grass-dominated habitats spread in southern South America before at least the late Early Miocene (18.5 Ma). Instead, ingested grit from volcanic ash, rather than silica in grasses, may have been the proximal driver of hypodonty in South America.

SUBCHONDRAL AND TRABECULAR BONE MORPHOLOGICAL CORRELATES OF LOCOMOTOR BEHAVIOR
SU, Anne, Ohio University, Athens, OH, USA; PATEL, Biren, Stony Brook University, Stony Brook, NY, USA; CARLSON, Kristian, University of the Witswatersrand, Johannesburg, South Africa

Studies of the external morphology of fossil hominid postcrania commonly reveal a controversial mosaic of traits that are argued to suggest varying levels of obligate bipedal and arboreal abilities. In this study, we investigate whether the internal bone morphology of joints holds a locomotor signal that may further clarify the nature of early hominin locomotor repertoires. Using medical CT and micro-CT scans of several joint articular surfaces (e.g., distal tibia and talus) of Homo, Pan, Gorilla, Pongo, and Papio, this study quantified and compared the internal subchondral and trabecular bone morphology to determine which structural variables can discriminate among these taxa and may be considered correlates of different modes of extant hominid locomotion. Site-specificity and variation of structure within a joint was assessed by comparisons amongst several local anatomical regions. In the case of the ankle, each species was found to have distinct patterns of subchondral bone radiodensity across the joint that agree with current concepts of differences in habitual locomotor behavior. The great apes display greater radiodensity in the anterior aspect of the distal tibia and lateral aspect of the talus compared to humans, likely related to the high degree of dorsiflexion and obliquely oriented tibia and fibula over the ankle during habitual climbing. Mean subchondral radiodensity in each region was found to correlate well with mean subchondral bone thickness. Each species was also found to have distinct patterns of trabecular bone architecture. Bone volume fraction was found to be greater in the great apes compared to humans; however humans had greater degree of trabecular anisotropy, particularly in the lateral aspect of the talus. This study presents comparative data of subchondral and trabecular bone morphology in joints (e.g., the ankle) of extant hominids, and demonstrates the potential of these structures for inferring joint function from isolated fossil elements.
The functional repertoire of any joint is partly determined by the ability of muscles to generate torques about the joint’s various possible axes of motion. For the ankle, the gastrocnemius and other muscles on the posterior surface of the hind limb contribute to support and propulsion during terrestrial locomotion by producing plantarflexor (extension) torque about the joint. Dorsal structures may draw the moment arm of the gastrocnemius, such as the calcaneal heel of mammals, extreme among amniotes. Early crocodilians and other saurischian archosaurs have an analogous calcaneal process, and a calcaneal process was almost certainly primitively present within the archosaur crown group. However, the calcaneal process is absent in the other archosaur lineage that has survived to the present, the theropod dinosaurs. In most theropods the gastrocnemius moment arm is slightly increased by the tendency of the proximal ends of the metatarsals to expand in both the extensor and flexor directions. Some taxa have more distinct structures that enhance the moment arm, such as the flange-like hypotarsus of birds. An analogous flange exists on metatarsal I in ornithomimids, and in some theropods the distal tarsals protrude to form a slight heel. In all cases, however, the gastrocnemius moment arm is relatively small. The moment arm can be approximated as the depth (below the midshaft) of the proximal end of the metatarsals in theropods and the length of the calcaneal heel in suchians, and preliminary measurements indicate that the ratio of the moment arm to the length of the tarsometatarsus ranges from about 0.05 to 0.17 in the former group and 0.20 to 0.30 in the latter. The most extreme values at both ends of the theropod distribution occur in birds, probably reflecting their greater ecological range in comparison to non-avian theropods. The low values for theropods in general probably relate to their digitigrade posture, which would have reduced the moment arm of the ground reaction force and allowed the ankle to operate with lower torque. The evolution of digitigrady altered the functional context of the ankle and was accompanied by a change in its architecture.

OXYGEN ISOPTIC COMPOSITION OF VERTEBRATE PHOSPHATE FROM THE CEDAR MOUNTAIN FORMATION, UT: A TOOL FOR DECIPHERING BOTH GLOBAL AND SMALL-SCALE CLIMATE CHANGE AND ECOLOGICAL PARTITIONING

SUAREZ, Celina, University of Kansas, Lawrence, KS, USA; GONZALEZ, Luis, University of Kansas, Lawrence, KS, USA; LUDVIGSON, Gregory, Kansas Geological Survey, Lawrence, KS, USA; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, USA; CIFELLI, Richard, Sam Noble Oklahoma Museum of Natural History, Norman, OK, USA

Stable isotopic analyses of phosphate oxygen from continental faunas of the Early Cre-taceous (Barremian – early Cenomanian) Cedar Mountain Formation (CMF), UT, were conducted to determine differences in water utilization among taxa and changes in regional climate. We analyzed a robust data set of aquatic (fish scales), semi-aquatic (turtles and crocodiles) and terrestrial (dinosaur) taxa and compared them to pedogenic carbonates. Samples were grouped into four stratigraphic faunas (the lower Yellow Cat (YCM), upper YCM, Ruby Ranch (RRM), and Munsentuchit (MM) members). At the formation scale, turtles and crocodiles document water compositions within the zonal range for meteoric water (MW) at 34°N paleolatitude (-4.8 to -6.6‰) as established by pedogenic carbonates. Consistency between multiple MW proxies gives credence to the use of pedogenic carbonates for global paleohydrologic studies. Within the fauna (differences between taxa and faunas) turtles are recorded lowest, followed slightly higher than that recorded by pedogenic carbonates, which are slightly biased toward enriched local MW due to their formation under evapora-tive conditions. Crocodiles are isotopically more enriched than turtles, perhaps because they lived in shallower bodies of water affected by evaporative enrichment. Sauropods were isotopically enriched and sensitive to aridity because of hypothesized reliance on plants as a major source of water. Ornithischians and smaller theropods appear to have acquired much of their water from rivers and were more obligate drinkers than sauropods, while large theropods seem to have obtained water from a combination of river and food water (other di-no-saurs). The control on climate in the CMF is the Sevier Orogeny. We confirm presence of a rainshadow caused by the mountains, which caused aridity during upper YCM deposition, and reached sufficient elevations by the end of RRM deposition to allow seasonal snow accu-mulation. The rainshadow attenuated influences of Pacific moisture on the foreland basin. We combined paleoclimatic evidence from CMF and nearby areas to reconstruct moisture to the region, despite the continued rise of the Sevier Mountains.

A NEW BASAL THEROPOD DINOSAUR FROM THE COELOPHYSIS QUARRY (UPPER TRIASSIC) OF GHOST RANCH, NEW MEXICO

SUES, Hans-Dieter, National Museum of Natural History, Washington, DC, USA; NESBITT, Sterling, University of Texas at Austin, Austin, TX, USA; BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA, USA; HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, PA, USA; SULLIVAN, Robert, State Museum of Pennsylvania, Harrisburg, PA, USA

The initial evolutionary diversification of Dinosauria occurred during the early Late Triassic. The first members of this radiation of dinosaurs (such as Eoraptor, Herrerasaurus, and Pau-phagia) had simple body plans and, by the end of the Norian, these forms were replaced by members of more specialized groups (e.g., coelophysoids, more derived saurischians). We report on a new basal theropod dinosaur from the Upper Triassic (Rhaetian) “siltstone member” of the Chinle Formation of the Chinle Group, Coelophysis Quarry at Ghost Ranch, New Mexico. This find documents the presence of a second theropod taxon in the CMF. We analyzed a robust data set of aquatic (fish scales), semi-aquatic (turtles and crocodiles) and terrestrial (dinosaur) taxa and compared them to pedogenic carbonates. The control on climate in the CMF is the Sevier Orogeny. We confirm presence of a rainshadow caused by the mountains, which caused aridity during upper YCM deposition, and reached sufficient elevations by the end of RRM deposition to allow seasonal snow accumulation. The rainshadow attenuated influences of Pacific moisture on the foreland basin. We combined paleoclimatic evidence from CMF and nearby areas to reconstruct moisture to the region, despite the continued rise of the Sevier Mountains.
PATHOLOGY AND LIFE EXPECTANCY: RECOGNITION OF AN ANCIENT TUMOR
SUNDELL, Kent, Tate Museum, Casper College, Casper, WY, USA; ROTHSCCHILD, Bruce, University of Kansas, Lawrence, KS, USA

A preconceived notion, generally untested in the fossil record, is that pathology routinely shortens life span. Perspective has been generated by comparison of size of a given species through time. Comparison of healthy and “diseased” population samples (e.g., Mammutthus) is compromised by limited availability of sufficient numbers of associated skeletons for which age can be assessed. Outliers may not be representative of the population, but do illustrate disease acquisition and survival. Tate V15163 is a specimen of Mammutthus columbi found in northwest Converse County, Wyoming, standing 13’8” at the shoulder, with chronologic age estimated at 65-70 years (on the basis of last molar tooth worn to gum line). Radiocarbon and optical stimulation luminescence dating place its geologic age at 11,600 ybp. One tusk (4.5 feet in length) had been broken off and its tip polished. Erosion and reactive new bone formation supports diagnosis of spondyloarthropathy, as previously recognized in 16% of mammoths. While spondyloarthropathy produces erosion within joints, it does not explain those occurring adjacent to joints. The latter was recognized as a pressure erosion adjacent to a zygopophyseal joint.

Tumors (recognized on the basis of characteristic bone damage producing defects) have only rarely been suspected in the fossil record. Those that have been confirmed have demonstrated remarkable phylogenetic susceptibility. Common in hadrosaurs, apparently absent in other dinosaurs, the record for extinct mammals is quite limited. Malignant tumors typically have ill-defined margins, while benign tumors are well defined. While there are a variety of causes/diagnoses, few actually invade joints. Pressure erosions affecting articular surfaces have been observed in gout and pigmented villonodular synovitis (PVS). Those associated with gout are characterized by formation of new bone, producing a sclerotic margin. This contrast with PVS, in which there is no reactive bone formation and the margins are smooth. The damage from PVS is easily distinguished from the sharp margins noted with aseptic erosions and with hyalitis (echinococcal) cysts.

The zygopophyseal joint lesion in Mammutthus americanus, Tate V15163 is the first recognition of pigmented villonodular synovities in the fossil record. Occurrence in an individual with spondyloarthropathy is probably coincidental, given the background frequency of that pathology in Mammutthus. It is unclear how much longer Tate V15163 would have survived, if it had not had these diseases.

Technical Session XV, Wednesday 8:30
THE FIRST TRISTICHOPTERID (STEM-TETRAPOD) FROM THE MIDDLE DEVONIAN OF WESTERN NORTH AMERICA: FURTHER EVIDENCE OF PARALLELISM IN THE TETRAPOD STEM-GROUP
SWARTZ, Brian, Department of Integrative Biology, University of California, Berkeley, Berkeley, CA, USA

Devonian stem-tetrapods, including tristichopteroids and elpistostegids, are known from near global exposures on all major Devonian continental provinces. Elpistostegids, which include the first dipnoans or saccorhytus, are known from well-preserved trackways from the lower Middle Devonian of Poland, suggesting that the elpistostegid fossil record extends deeper in time than the body fossil evidence might otherwise suggest. By contrast, the stratigraphic range of tristichopterids (the elpistostegid sister group) begins in the upper Middle Devonian of Scotland, and subsequently underscores the lengthy ghost ranges implied by the trackway evidence. Here I report the first known tristichopterid from the upper Middle Devonian of western North America, a locality and time that extends and reinforces the biogeographic evidence. Here I report the first known tristichopterid from the upper Middle Devonian of western North America, a locality and time that extends and reinforces the biogeographic evidence. Here I report the first known tristichopterid from the upper Middle Devonian of western North America, a locality and time that extends and reinforces the biogeographic evidence. Here I report the first known tristichopterid from the upper Middle Devonian of western North America, a locality and time that extends and reinforces the biogeographic evidence.

This new taxon is known from six specimens, including a fully articulated individual measuring about 1m in length. A phylegetic analysis recovers this taxon as the earliest diverging tristichopterid. Moreover, its morphology reveals an interesting mosaic of previously unknown trait combinations. The cheek is fused into a plate and the internal caudal skeleton sharing numerous features with Seggeurius and Microhyraxes, which are the most primitive hyraxes yet recorded. Helioseus is however exclusive within the order by the plagiaulacoid modification of its hypertrophied and trenchant p1-4, which occlude with the corresponding gutter-shaped longitudinal basal of the massive P1-4. This premolar complex, convergent with that of some multituberculates, marsupials, and plesiadapiform primates, reveals an unexpected degree of dental adaptation and diversity among early Paleogene hyraxes.

Poster Session II, (Monday)
RAPID DIVERSIFICATION OF THE ODOBENIDS (CARNIVORA: PINNIPEDIA) IN THE LATE MIDDLE MIOCENE OF THE NORTH PACIFIC: IMPLICATIONS OF A NEW FOSSIL FROM HOKKAIDO, JAPAN
TANAKA, Yoshitomo, Hokkaido University Museum, Chiba, Japan; KOHNO, Naoki, National Museum of Nature and Science, Tokyo, Japan

The diversification of the crown group odobenids (i.e., walruses) of the family Odobenidae is thought to lie within the Late Miocene, and in fact, a number of fossil odobenids have been known from such a time period in the circum North Pacific. In contrast, the late Middle Miocene Pseudotaria muramotoi from Hokkaido, northern Japan, might be a possible an-cestor (i.e., metaxan) for the highly diversified Late Miocene odobenids because of the lack of any autapomorph that diagnoses the taxon itself and any synapomorphy of the later diversifying odobenids. However, a new fossil from the same period in the same locality area reported here may represent an earlier diversification of the later diversifying odobenids in the late Middle Miocene. The new fossil is a partial skeleton, evidently belonging to the Family Odobenidae based mainly on the cranial and dental characters. Phylogenetic analysis also revealed that the new fossil was nested with P. muramotoi and the later diversifying odobenids as a trinity. In addition, like P. muramotoi, the new fossil lacks any synapomorphy of the later diversifying odobenids. However, the new fossil differs from P. muramotoi in size and shape of the occipital condyle, foramen magnum and mastoid process of the cranium, and other postcranial characters, and therefore, they are not con-specific. Consequently, two...
closely related stem odobenids lived at the same area at the same time, approximately 12-10 Ma. Perhaps the rapid diversification of the stem odobenids might already have occurred in the late Middle Miocene in a restricted area, preceding the diversification of the later diversifying odobenids in the Late Miocene. It is well known that the Earth’s environment has been cooling during the late Middle Miocene. The new discovery implies that the diversification of the later diversifying odobenids including *Pseudodius* species might have started soon after and/or simultaneously with the global cooling during the late Middle Miocene.

Poster Session I, (Sunday)

**JAW MECHANICS IN LAMNIFORM SHARKS AND ITS EVOLUTIONARY IMPLICATIONS**

TANOUÉ, Kyo, National Museum of Nature and Science, Tokyo, Japan; SHIMADA, Kenshu, DePaul University, Chicago, IL, USA; RIGSBY, Cynthia, Children’s Memorial Hospital, Chicago, IL, USA; NICHOLAS, Angela, Children’s Memorial Hospital, Chicago, IL, USA

Jaw mechanics of lamniform sharks was examined three-dimensionally to understand the variability in jaw shape and the evolution of the masticatory system based on the following seven extant macrophagous species: *Mitsukurina owstoni*, *Caracharias taurus*, *Alopias vulpinus*, *Carcharodon carcharias*, *Iurus oxyrinchus*, *I. paucus*, and *Lamna nasus*. Bite forces calculated using two-dimensional analysis increase caudally. Input force remains constant because only working-side jaw adductor muscles are considered, and bite force varies only with distance from the quadratomandibular joint. In contrast, three-dimensional analysis uses input from both working- and balancing-side adductors. Input force varies along the jaw because the contribution by balancing side muscles is not constant. In three-dimensional analysis, the effect of mediolateral tooth position on bite force can also be discovered. This analysis allows more realistic bite force reconstruction. Our calculation of maximum bite force at each tooth position suggests that the phylogenetically basal most species, *Mitsukurina owstoni*, has the least efficient jaws, with bite force lower than that of derived lamniform taxa throughout the tooth row due to posteriorly positioned jaw adductor muscles. Jaws of *Caracharias* and *Iurus* are no more efficient than other examined taxa, especially in anterior dentition, owing to anterior extension of jaw adductor muscles. *Alopias vulpinus* has widely divergent jaws, resulting in low bite force because of longer output lever than in narrowly-diverging jaws. However, *A. vulpinus* has larger oral cavity to bite off larger parts of their prey in each bite compared to species of similar size with narrowly-diverging jaws. This study shows the increased efficiency of masticatory apparatus and diversity of feeding adaptations through lamniform phylogeny. This analysis also makes it possible to reconstruct the masticatory apparatus of fossil lamniform taxa.

Poster Session IV, (Wednesday)

**PRELIMINARY REPORT OF A WELL-PRESERVED PERISODACTYL TRACK SET FROM CENTRAL UINTAH BASIN, UT**

TEMMIE IV, Thomas, SWCA Environmental Consultants, Vernal, UT, USA; SROKA, Steve, Utah Field House of Natural History State Park Museum, Vernal, UT, USA; FINLAYSON, Heather, Utah Field House of Natural History State Park Museum, Vernal, UT, USA

Well preserved perisodactyl tracks were discovered 18 miles southeast of the town of Myton in the Gilsomite Draw area of the Ashley National Forest, Duchesne County, UT. The tracks occur on a sandstone slab approximately five feet by two feet, found at the base of a vertical outcrop of variegated beds of light tan, orangish tan and light yellowish gray, fine-grained sandstones, mudstones and shale interleaved with resistant beds of tan, medium-grained, parallel bedded sandstone. The track-bearing slab has been collected by and repositioned at the Utah Field House of Natural History State Park Museum in Vernal, UT. The Gilsomite Draw locality has traditionally been mapped as the Lower member of the Uinta Formation. Other mammal track sites have been reported from the delta facies of the Green River Formation, 40 miles to the west of the Gilsomite Draw locality and from two localities in the Uinta Formation, 18 miles to the northwest and seven miles to the northeast.

The tracks are complete natural casts of the left manus (tetradactyl) and right pes (tridactyl), with the manus in line to and preceding the pes by 12cm, centered on the slab. No other track casts are visible on the slab. The tracks are relatively large, the manus measuring 15.7cm long and the pes 11.9cm long. Both are about three centimeters in relief. The tracks have short (approximately five centimeters long) rounded digits with divarication angles of about 30 degrees and a rounded heel. Likely trackmakers for the specimen include brontothere and tapiroids of Uintan affinity. The specimen compares well with modern tapir tracks. Laterally extensive beds of tidal or coastal sandstones and mudstones with ripple marks and burrows and tapiroids of Uintan affinity. The specimen compares well with modern tapir tracks. The specimen of *Hypertragulus* shows a deep subarcuate fossa. However, unlike the reported morphology for *Hypertragulus*, and *S. cf. elephantoides*, *Ssc. orientalis*, *S. cf. insignis*, and at least three new species of *Stegodon*. These stegodont fossils are comparable to those found from Pakistan, China, and Myanmar. These stegodophodont and stegodont fossils may indicate the age of the Late Miocene to Pliocene and the Late Miocene to Pleistocene, respectively, though the stratigraphic position of these fossils in the sand pits are not known.

**STEgodONTID (PROBOSCIDIA, MAMMALIA) FOSSILS FROM THA CHANG SAND PITS, NAKHON RATCHASIMA PROVINCE, THAILAND**

THASOD, Vupa, Northeastern Research Institute of Petrified Wood and Mineral Resources, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, Thailand; SAEGUJA, Haruo, Museum of Nature and Human Activities, Sanda, Hyogo, Japan; RATANASTHIEN, Benjavan, Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand; JINTASAKUL, Pratueng, Northeastern Research Institute of Petrified Wood and Mineral Resources, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, Thailand; HANTA, Ratanaphorn, Northeastern Research Institute of Petrified Wood and Mineral Resources, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, Thailand

In the area of about 30 square kilometers of Tha Chang sand pit, Nakhon Ratchasima province, northeastern Thailand, many Neogene faunal and floral remains were found. The disarticulated teeth and skeletal elements of stegodontid were found from channel and flood plain deposits together with various mammalian fossils, including, *Khoratipticus piriya* and *Merycoptamus thachangensis*. The stegodontid fossils were studied based on the tooth morphology. They are composed of *S. cf. stegodontoides* and other four new species of *Stegolophodon*, and *S. cf. elephantoides*, *Ssc. orientalis*, *S. cf. insignis*, and at least three new species of *Stegodon*. These stegodont fossils are comparable to those found from Pakistan, China, and Myanmar. These stegodophodont and stegodont fossils may indicate the age of the Late Miocene to Pliocene and the Late Miocene to Pleistocene, respectively, though the stratigraphic position of these fossils in the sand pits are not known.

**PREDICTING SPECIES RESPONSES TO CLIMATIC WARMING: HINDCASTING THE PAST USING THE MODERN GEOGRAPHIC RANGE**

TERRY, Rebecca, Stanford University, Stanford, CA, USA; LI, Cheng, Stanford University, Stanford, CA, USA; HADLY, Elizabeth, Stanford University, Stanford, CA, USA

Forecasting how species will respond to ongoing environmental change requires knowledge of the processes that have shaped biodiversity in the past. In general, we expect species to track warming conditions by shifting their geographic ranges poleward. At a given locality this should be reflected by an increased dominance in the identity and abundance of more equatorial species. Here we test this hypothesis using time series data from the Holocene small mammal fossil record. More specifically, we evaluate how community dynamics over the last 7,000 years have been shaped by contrasting and variable local paleoclimates at two replicate caves in the Great Basin from the same latitude.

Counter to expectation, both records exhibit a constant proportion of southern species through both warmings. The proportion of southern species in both communities is, however, strongly and positively correlated with temperature and precipitation dynamics. This result is robust to temporal autocorrelation and time-averaging, and suggests that community-level responses occurred in situ rather than by the immigration of taxa.

Despite the predictability of community-scale dynamics, species-specific abundance-climate relationships were variable and poorly explained by a species’ geographic affinity. Nevertheless, species present at both sites exhibited the same response to climate at one site as at the other. Species life histories therefore play important roles in determining their responses to climatic warming. These results are corroborated by an analysis of functional groups: while the abundance of granivores shows a significant and positive relationship with warming, omnivores and herbivores show significant negative relationships. Further evidence suggests that species interactions may also be important. In summary, while community-level dynamics are consistent with expectations of species responses to climatic warming, species-level dynamics are less predictable. Although a species’ current geographic range may reflect many ecological and evolutionary factors, intrinsic biology and interspecific interactions may be more important for predicting responses to future warming.

Technical Session II, (Tuesday)

**MORPHOLOGY OF THE AUDITORY REGION OF HYPSODUS MINIMUS: IMPLICATIONS FOR THE EVOLUTION OF THE MASTOID FOSSA OF ARTHRODACTYLS**

THEODOR, Jessica, University of Calgary, Calgary, AB, Canada

Detailed Computed Tomographic (CT) scan study of the auditory region of the small hypertragulid *Hypisodus minimus* (AMNH-FM 9354) reveals previously undescribed anatomical features. Much of the basicranium is externally obscured by the greatly inflated hollow auditory bullae. The bullae meet in the midline, extending rostrally beyond the jaw articulation, and caudally to the occipital condyles. The bullae are partially subdivided by a horizontal septum, into a dorsal and ventral chamber caudal to the cochlea. As in *Hyparrhagus*, *Hypisodus* shows a deep subarcuate fossa. However, unlike the reported morphology for *Hyparrhagus*, there is also a deep and distinct mastoid fossa present. The mastoid fossa is known in *Banomeryx*, camélids, anoplotheres, caninothere and xiphodontids, and has been thought to represent a tylopod synapomorphy. Its presence in *Hypisodus* is the first reported occurrence of this feature within Ruminantia, and suggests that the mastoid fossa may be primitively present in basal ruminants, or might represent a convergent feature among artiodactyls with inflated auditory bullae.

The periotic shows a sharp crest dividing the cranial cavity into cerebral and cerebellar surfaces, as in other ruminants and procaprids. Endocerically, the periotics meet the basioccipital near the midline rostral to the cochlea, nearly obscuring it. The petrosal canal appears to run in a groove within the periotic, immediately lateral to the basioccipital.

AMNH-FM 9354 shows no evidence of an enlarged sinus venosus temporalis between the periotic and the squamosal, a feature shared by camélids, procaprids, *Leptotragulus*,...
Bunomerix, Cainothoeres and oreodonts.

Hypidius presents several features that are derived within rimantins, but also shares with more basal artiodactyls a deep subarcuate fossa. The deep mastoid fossa observed in AMNH FM 9354 suggests that the presence of a mastoid fossa may be a convergent feature in taxa with inflated auditory bullae.

Advances in Paleoecology: Geochemistry, Microwear and Beyond, Sunday 9:00

TOOTH USE AND DIET ACROSS THE ARTIODACTYL- CETACEAN TRANSITION
THAWWAS, J.G.M.; NE. Ohio Univ Coll of Med, Rootstown, OH, USA; SENSOR, Jennifer, NE Ohio Univ Coll of Med, Rootstown, OH, USA; CLEMNETZ, Mark, University of Wyoming, Laramie, WY, USA; BAJPAI, Sunil, Indian Institute of Technology, Roorkee, India

Tooth functional morphology is affected by at least three factors: crown morphology, mastication, and diet. Study of these can increase our understanding of the artiodactyl-cetacean transition and resolve the paradox that early whales, generally thought as being carnivorous or piscivorous, are derived from herbivorous or omnivorous artiodactyls. Eocene cetaceans have a highly derived lower molar morphology with a single high protoconid on the trigonid, and one (or a linear series of) small cusp(s) behind it. This morphology is derived from a bunodont quadrirubercular artiodactyl morphology. We studied the wear facets to determine the evolution of mastication in this lineage. Basal artiodactyls (dichobunids) have generalized molars showing a complex series of aboral and atrial facets, whereas Eocene cetaceans (pikidocids, most protocetids, and basilosaurids) have wear facets that indicate wear in Phase I of the masticatory power stroke only. Surprisingly, the cetacean sister group, Indohyus, has wear facets that trend toward the cetacean specialization in spite of having a molar morphology that is still firmly quadrirubercular. We collected diet information by analyzing the stable carbon and nitrogen composition of tooth enamel. Isotope values of cetaceans (pikidocids, ambulocetids) are extremely low and consistent with a carnivorous or piscivorous diet. This is in contrast to the stable isotopes of Indohyus, which are indistinguishable from those of the enamel of associated land mammals. These similarities suggest terrestrial herbivory, as do the values of dichobunids. Taken together, this implies that a change in dental function (wear facets) preceded the dietary shift documented by stable isotopes at the origin of cetaceans, even while crown morphology retained its archaic morphology.

Poster Session IV, (Wednesday)

A DESCRIPTION OF THE CRANIAL ANATOMY OF AN EXCEPTIONALLY WELL-PRESERVED SPECIMEN OF TERTNOSSAURUS TILLETI (ORNITHOPODA, DINOSAURIA) FROM THE ANTLERS FORMATION OF OKLAHOMA
THOMAS, D. Andrew, University of Oklahoma, Norman, OK, USA

Since the original description of a transversely compressed and highly fractured specimen, no cranial material of Tertnosaurus tillerti has been described. T. tillerti is a basal member of the Iguanodontia, an ornithopod clade which includes tenontosaurs and their allies, together with the highly derived and successful Hadrosauria. The last decade has seen an increase both in the amount of research conducted on Iguanodontia and in the number of taxa assigned to it, with increasingly fine phylogenetic resolution.

In the early part of this century, a beautifully preserved specimen of T. tillerti was found in the Antlers Formation (Aptian-Albian) near Atoka in southeastern Oklahoma. The specimen preserves nearly all elements of the skull (only the palpebrae and right premaxilla are absent and both hyoids are present), largely in their original orientation and relative position (right facial bones are detached, articulated, from the skull and the right pterygopalatine complex is shifted slightly anteromedially).

In the winter and spring of 2009-2010, the skull was taken to the High-Resolution X-ray Computed Tomography Facility at the University of Texas for CT scanning. Digital renderings of the skull and of its isolated elements were made, including an endocast. The renderings were then used to produce three-dimensional copies through the use of a rapid-prototyping machine at the University of Oklahoma. Both the renderings and the copies aid in further analysis of the paleobiological aspects of the animal, including the extent of cranial kinesis, the nature of the cranial musculature, and the operation of the dental apparatus.

The scans also illuminate the relative positions of the first three pairs of cranial nerves, along with the canals and foramina for the remaining cranial nerves and vasculature. The semi-circular canals and other portions of the vestibuulo-coclear apparatus are preserved as well. These features provide evidence crucial to furthering the phylogenetic resolution and evolutionary understanding of this particularly diverse and abundant group of dinosaurs.

Romer Prize Session, Monday 11:30

EVOLUTION OF HEAT RETENTION IN PENGUINS
THOMAS, Daniel, University of Cape Town, Cape Town, South Africa

Penguins (Sphenisciiformes) inhabit the most extreme range of environments of any avian group, breeding from equatorial deserts to polar sea ice shelves. Further, the 66°+ million year (Ma) fossil record of penguins spans dramatic temperature shifts in Cenozoic oceans, indicating a long and complex relationship between penguin evolution and environmental change. A major adaptation that allows penguins to forage in cold water is the humeral arterial plexus deep within the stem lineage of penguins. Fossil evidence reveals that the humeral plexus arose at least 49 million years ago during a “greenhouse Earth” interval, and is thus unrelated to global cooling or development of Antarctic ice. Oxygen isotopic reconstruction of CCHEs along fossil penguin wings further support this conclusion. It has been proposed that penguin CCHEs initially were an adaptation for foraging in subsurface waters in temperate latitudes. Though first arising under greenhouse conditions, the humeral plexus is considered the key to later invasion of thermally more-demanding environments.

Poster Session III, (Tuesday)

FIRST OCCURRENCE OF A TYRANNOSAURID (DINOSAURIA, THEROPODA) FROM THE NESLEN FORMATION (LATE CRETACEOUS), BOOK CLIFFS AREA, UTAH
THOMPSON, Richard, The University of Cambridge, Cambridge, United Kingdom; ASHBER, Robert, The University of Cambridge, Cambridge, United Kingdom

Although rich Campanian dinosaur assemblages are known from southern Utah, specimens are extremely rare from Campanian strata in central and eastern Utah that were closer to the paleoshoreline of the Western Interior Seaway. We report the discovery of a theropod dinosaur partial hindlimb from the Book Cliffs area northeast of Green River, Wyoming. The specimen was recovered from just beneath the Palisade Coal Zone in the Neslen Formation (Mesa Verde Group), which is dated to the mid-Campanian (75.19 ±0.28 Ma) based on its stratigraphic location within the Didymoceras nebrascense ammonite zone. This stratigraphic correlation includes the lower Kaiparowits Formation of southern Utah, the Dinosaur Park Formation of Alberta, and the Judith River and Two Medicine formations of Montana. The specimen comprises a partial fibula, the distal half of metatarsal II, and a complete metatarsal IV. The arctometatarsalian condition of the pes indicates its placement in the theropod clade Coelurosauria, and the specimen can be assigned to the clade Tyrannosauridae based on the presence of unambiguous synapomorphies such as a deep groove on the medial surface distal to the iliofibularis tubercle on the fibula, and a teardrop shaped articular surface for metatarsal III on the medial surface of the distal portion of metatarsal IV. The specimen is similar to Dacentrurus torosus in the presence of a slender ridge along the posterior surface of metatarsal IV proximal to the distal metatarsal III attachment site, in contrast to the flat or concave condition in Tyrannosaurus rex. This represents the first unambiguous evidence of a tyrannosaurid dinosaur from the Mesa Verde Group, and represents an important biogeographic record situated between southerly coeval strata in the Kaiparowits (southern Utah) and San Juan (New Mexico) basins, and equivalent strata in Montana and Alberta.

Poster Session IV, (Wednesday)

NEW SPECIES OF ALLOPTOX (OCHOTONIDAE; LAGOMORPHA), FIRST RECORD OF THE GENUS FROM JAPAN, AND SUBGENERIC DISTINCTION
TOMIDA, Yukinori, National Museum of Nature and Science, Tokyo, Japan

A nearly complete mandible with full dentition of a large ochotonid lagomorph was recently found from late Early Miocene (ca. 17.5 Ma) deposits (Akekkaya Formation, Mizunami Group) in central Japan. General morphology of p3 clearly indicates that the specimen belongs to the genus Alloptox. Five species of the genus from China (A. gobensis, A. minor, A. chinghainensis, A. siongenesis, A. sionganensis) and one from Turkey (A. anatoriensis) have been described. Direct comparisons with the holotypes and/or referred specimens of all these species

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indicate that the new specimen can be easily distinguished from all known species by the following characteristics: (1) largest in size, (2) protoflexid is deep, (3) hypoflexid is very deep, reaching about 1/2 of the tooth width, (4) lateral depth of paraphlexid is rather shallow, reaching about 1/3 of the tooth width, then bending posteriorly being centroflexid, (5) paraphlexid and centroflexid are wide, making the metaconid narrower in width, (6) anteroconid is relatively large in size, oval in outline, and its long axis is nearly perpendicular to the tooth axis. Thus, the new specimen from Japan is considered to be a new species of the genus. Except for the size, all six species from China and Turkey are similar to each other in morphology: (1) the protoflexid is very shallow, (2) the hypoflexid is shallow, reaching about 1/3 of the tooth width, (3) the paraphlexid is relatively deep, reaching about 1/2 of the tooth width, except for A. xihuensis, (4) the paraphlexid and centroflexid are narrow, and (5) long axis of the anteroconid is oblique to the tooth axis in most specimens. In the new Japanese species, all these characters are opposite in status, suggesting that it can be distinguished at subgeneric level. Geologic age of the new species is about 17.5 Ma, the late Early Miocene, which is almost the same as A. sихонensis, the smallest and probably earliest species in continental Eurasia, suggesting that the distinction between the new species and other species was present from the early stage of generic evolution.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

ORIGIN OF SHARK JAW PROTRUSIONS: EVOLUTION OF SUCTION FEEDING CAPABILITIES IN FOSSIL SHARKS RECONSTRUCTED FROM THEIR HYOID ARCHES

TOMITA, Taketera, University of Tokyo, Tokyo, Japan

Jaw-protrusion is a widely distributed feeding behavior in extant sharks. Evolutionary history of feeding strategies (suction- and ram-feeding) reconstructed by their hyoid arches suggested that the origin of jaw-protrusion mechanisms was related to the occurrence of suction-feeding. We reconstructed the feeding behaviors of fossil sharks based on the second moments of area of their ceratothyls. The results indicated that the cladodont sharks (*Cladoselache*, *Stethacanthus*, *Cephaloscyllium*, and *Enhydrorhinus*), the cartilaginous shark (*Hecale*, *Rhinobatos*, and *Elasmobranchii*), the ctenacanthid shark (*Hecale*, *Rhinobatos*, and *Enhydrorhinus*) were ram-feeding sharks, and hybodontid sharks (*Hybodus*) and fossil Squale (*Protosphyraena*) were suction-feeding sharks. Reconstructed evolutionary sequence of ram- and suction-feedings indicate that “Paleozoic sharks” (cladodont sharks and ctenacanthid sharks) were ram-feeding sharks and, from this state, suction-feedings evolved within three independent lineages; Hybodontiformes, Galeomorphi, and Squalea. These shifts of feeding strategies from ram- to suction-feeding coincide with the timing of the increases of jaw mobility. This suggests that jaw-protrusion was originally related to the evolution of suction-feeding. Some ram-feeding sharks (Lamniformes and Carcarchiniformes) have jaw-protrusive capabilities. Their jaw-protrusive capabilities were inherited from suction-feeding ancestors.

Poster Session II, (Monday)

NEW CARNIVORAMORPHS (MAMMALIA) FROM THE MIDDLE-EOCENE SANTIAGO FORMATION OF CALIFORNIA, U.S.A. AND PHYLOGENETIC IMPLICATIONS FOR THE ORIGIN OF CROWN-ORDER CARNIVORA

TOMIYA, Susumu, University of California Museum of Paleontology, Berkeley, CA, USA

Despite recent advances in the study of carnivoramorph evolution, the phylogenetic and ecological context of the origin of crown-order Carnivora remains elusive. The middle-Eocene Santiago Formation of San Diego County, California, has yielded taxonomically and ecologically diverse assemblages of carnivorous mammals from the Uintan and Duchesnean North American Land Mammal Ages, which likely constituted a critical period in the evolutionary history of carnivorans in North America. Parsimony analysis was conducted for 24 taxa of Paleogene carnivornorphans using recently-published character matrices and data and for a new genus from the Santiago Formation. The strict consensus tree for this dataset places within the crown-clade Carnivora several “miacid” carnivornorphans that were suggested by recent studies to lie outside this clade. In comparison to these previous studies, the new phylogenetic hypothesis reported here pushes back the minimum age of divergence between the two major branches of Carnivora (i.e., Caniformia and Feliformia) by 4-5 million years to approximately 48 million years ago, or prior to the first stratigraphic occurrence of *Miacis sylvestris* in the B2e substage of the Bridgerian NALMA. However, the nodal support values for the new cladistic topology are generally low as in previously-reported trees, and a substantial temporal gap remains between the minimum divergence age obtained from the fossil record and divergence age estimates based on molecular data for extant carnivorans. Further taxonomic work on Eocene carnivornorphans and reassessment of phylogenetically-informative traits—particularly in light of intraspecific morphological variations observed in extant carnivorans—are needed to resolve the early phase of carnivoran evolution.

Poster Session I, (Sunday)

THE NEW CENOMANIAN VERTEBRATE SITE ALGORA; (GUADALAJARA, SPAIN)

TORICES, Angelica, Universidad Complutense de Madrid, Madrid, Spain; BARROSO-BARCENILLA, Fernando, Universidad de Alcalá de Henares, Alcalá de Henares, Spain; CAMBRA-MOÓ, Oscar, Universidad Nacional de Educación a Distancia, Madrid, Spain;

PÉREZ GARCÍA, Adán, Universidad Complutense de Madrid, Madrid, Spain; SEGURA, Manuel, Universidad de Alcalá de Henares, Alcalá de Henares, Spain

A new middle-upper Cenomanian fossil site has been located in the Castilian Branch of the Iberian Ranges, in central Spain. This site corresponds with the upper part of the “Arenas de Utrillas” Formation. Vertebrate fossils from this period are scarce in Europe, so this finding is particularly noteworthy. The outcrop is located in a sandy interval with interbedded mudstones, interpreted as coastal deposits with subtidal and intertidal intervals. The beds contain numerous silicified remains of fish and terrestrial fauna. A new Cenomanian fish species can be identified, especially at the bases of the sandy intervals. Macrofossils show well preserved tissues and evidence of taphonomic alteration, probably due to transport or reworking events during fossilization. The diversity recognized in this site is high, with fish and reptiles as the best represented groups. Fish remains include scales and teeth. One morphotype of gnathoids could be attributed to the problematic taxon *Stromericichthys*, and another morphotype could be referred to *Neoselachius* or *Deania*. The teeth are very small and subcircular, which is typical of lepisosteids. Chelonian specimens include plates with granulation decorations that suggest the probable presence of representatives of *Solemydidae*. However, most chelonian specimens are assignable to *Pamplemorhia*, whereas *Dortokioidea* was previously the only group recognized in Cretaceous European outcrops before the Senonian. Crocodyliforms are represented by osteoderms, bones and teeth of a probable advanced taxon of *Neosuchia*, although the phylogenetic relationships of the basal radiation of this clade are currently poorly understood. Theropod teeth have been found and assigned to *Carcharodontosaurus* indet. They have rough enamel and arcuate wrinkles, similar to those found in southern France. This unique locality in the Iberian Peninsula is very significant because, due to its geographical position, it will be very important for establishing similarities with the few Cenomanian European sites and North African sites and will expand the relatively poor knowledge of the fauna for this period.

Poster Session I, (Sunday)

A MORPHOMETRIC ANALYSIS OF CRANIAL SEXUAL VARIATION IN THE EXTANT PHYLOGENETIC BRACKET OF THE DINOANIA: IMPLICATIONS FOR FOSSIL STUDIES

TREVETHAN, Ian, Montana State University, Bozeman, MT, USA; SCANNELLA, John, Museum of the Rockies, Montana State University, Bozeman, MT, USA

Sexual dimorphism has been proposed as a significant source of cranial variation in non-avian dinosaurs, potentially affecting systematic and ecological hypotheses. Here we present the results of a preliminary morphometric analysis of intrapopulation cranial sexual variation within the extant phylogenetic bracket. Principal component analysis and bivariate scatter plots of skulls from a single population of *Alligator mississippiensis* confirm that sexual variation in *Alligator* is fairly subtle, the major difference being size of the largest representatives of each sex. When the data are normalized by skull length, discrete grouping by sex is no longer apparent. *Ceratogygia aruata*, the black casqued hornbill, represents the opposite end-member of the spectrum of sexual variation and is truly dimorphic. Not only are males typically larger than females, but they possess a far more elaborate cranial casque. Hornbill genders plot in distinct clusters. When the data are normalized by skull length, sexual differences in the cranial casque still segregate males from females. Sexual variation in non-avian dinosaurs may range from being largely undetectable (as in *Alligator*) to being so extreme as the two sexes might easily be misinterpreted as separate taxas (as in *Ceratogygia*). If true dimorphism was present in the non-avian dinosaurs, once data are normalized to account for size the major differences between genders would likely be expressed in cranial ornamentation rather than linear measurements. Sexual dimorphism would inherently produce a radical divergence in ornamentation between genders. This degree of sexual variation in non-avian dinosaurs has yet to be demonstrated but is not untenable. It is thus critical to understand ontogenetic and stratigraphic morphological trends within taxa as once these dimensions of variation are accounted for, the possibility of sexual variation can be explored.

Technical Session IX, Tuesday 11:00

LATE QUATERNARY MAMMALS FROM RUSINGA ISLAND, KENYA: IMPLICATIONS FOR ENVIRONMENTAL CHANGE AND MAGAFAUNAL EXTINCTIONS

TRYON, Christian, New York University, New York, NY, USA; FAITH, John, George Washington University, Washington, DC, USA; PEPPER, Daniel, Baylor University, Waco, TX, USA

The Wasiiri Beds of Rusinga Island, Kenya, preserve a Pleistocene sedimentary archive containing abundant well-preserved fossil fauna in stratigraphic association with Middle Stone Age artifacts. AMS (accelerator mass spectrometry) radiocarbon dates on the carbonization of gastropod shells provide a minimum age of 33,000 – 45,000 calendar years ago for the fossil-bearing deposits. Alcalophina bovids dominate the mammalian fossil assemblage and suggest the prevalence of open grassland vegetation. In particular, the presence of oryx (*Oryx gazella*) and Grevy’s zebra (*Equus grevyi*), both of which are historically absent from this region, suggest a pre-Last Glacial Maximum (LGM) expansion of arid grasslands. This environmental reconstruction is further supported by the presence of several extinct specialized grazers that are unknown from Holocene deposits in eastern Africa. These include the giant long-horned buffalo (*Pelorovis antiquus*), the giant wildebeest (*Megalotragus sp.*) and a small, unnamed alcalophine antelope. Taken into consideration with sediment li-
thology, the available evidence indicates a local fluvial system and associated riparian wood-
land habitat within an arid grassland setting that differs substantially from the modern envi-
ronment. We propose that the pre-LGM expansion of arid grasslands supported a facilitating
grazing system similar to the grazing succession documented in the East African Serengeti
plains. This system provided ecological niches for multiple specialized grazers, characterized by
both large body size and/or extreme hypodonty. Both faunal and paleobotanical evi-
dence indicate wetter and more densely vegetated environments in the Lake Victoria basin at
the onset of the Holocene. This environmental change likely disrupted the Pleistocene graz-
ing succession and led to the extinction of both large and medium sized grazers.

Poster Session III, (Tuesday)
CHRONIC EXERCISE DOES NOT ALTER LIMB BONE MORPHOLOGY OR MICROSTRUCTURE IN THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) – Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

Bone microstructure has been a useful tool for paleontologists to infer preferred limb pos-
ture, amount of locomotor activity, and life history of extinct vertebrates. To date, most such
inferences were based mostly on limb bones of extant mammals and birds, and hence were
applicable to their close extinct relatives. In contrast, effects of exercise on bone microstruc-
ture in non-avian reptiles have received scant attention. We investigated the effects of long-
term exercise on a treadmill or in a flume on limb bones of the American alligator. Juvenile
female alligators were run or swum to exhaustion every other day for 17 months. Animals were
measured every other week, and received injections of fluorochrome dyes (calcein and
alizarin) to determine mineral apposition rates in the skeleton. We found no significant dif-
f erences in whole bone morphology, cross-sectional geometry and cortical bone deposition
rates in the humeral midshaft, regardless of exercise regimen. Similarly, we found no effects
of exercise on cancellous bone architecture (bone volume fraction, bone surface density,
bone specific surface, as well as trabecular number, thickness and separation) in the distal fem-
ur. Bone mineral fraction was similar across exercise groups. Altogether, this suggests
that long-term locomotor exercise has no discernible effect on bone microstructure and
material composition in alligators. These results stand in contrast to studies on mammals and
birds where limb loading is known to affect both macro- and microstructural architecture of
the skeleton. The disparity could be due to metabolic differences between ectothermic
and endothermic vertebrates. Alternatively, alligator limb bones are subjected to insufficient
strain levels or load cycles during short exercise bouts, which may account for their lack of
skeletal plasticity in response to exercise. We suggest that exercise habits cannot be inferred
from long bone microstructure of extinct crocodylians. Since non-avian dinosaurs are nested
within the extant phylogenetic bracket of crocodylians and birds, did they show skeletal
plasticity in response to exercise?

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

CHRONIC EXERCISE DOES NOT ALTER LIMB BONE MORPHOLOGY OR MICROSTRUCTURE IN THE AMERICAN ALLIGATOR (ALLIGATOR MISSISSIPPIENSIS) – Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

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within the extant phylogenetic bracket of crocodylians and birds, did they show skeletal
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Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

BONY OVERTROW IN PHALANGES OF A CAMARASAURUS (DINOSAURIA: SAUROPODA) INDICATES OLD ONGENETIC AGE AND PROVIDES INSIGHTS INTO THE PROCESS OF PHALANGEAL REDUCTION IN SAUROPODS – TSCHOPP, Emanuel, Universidade Nova de Lisboa, Lisbon, Portugal

Different types of bony overgrowth are known from various dinosaur taxa. While quite
common in the axial skeleton, bony spurs are rarely reported from appendicular elements.
They were often interpreted as indicating diseases like primary (age-related) or second-
ary (injury-induced) osteoarthritus when affecting appendicular bones or diffuse idiopathic
skeletal hyperostosis (DISH) when present in vertebræ. Four different types of osteophytes
(bony spurs) found in manual and pedal phalanges of a Camarasaurus sp. (SMA 0002) are
described. Comparisons to corresponding elements of other Camarasaurus specimens as
well as other sauropod taxa show that the observed degree of overgrowth in SMA 0002 is
unusual. The first type of osteophyte is present in almost every proximal phalanx: the bor-
ders of the proximal articular surfaces of the affected phalanges are expanded transversely
and dorsopalmarly, which is herein interpreted as the first occurrence of primary osteoar-thritus in dinosaurs. A second type at the proximal articular surfaces of the pedal unguals
projects proximally. It is located where the tendon for claw retraction inserts and most probably
represents a rare case of ossified tendon insertions (enthesophytes). The other two variants
affect only a single phalanx: the proximal phalanx of the left pedal digit IV has a knob-like
overgrowth at its lateraldistal edge, indicating secondary osteoarthritus, and the right manual
phalanx IV exhibits a distally projecting spur at its distal articular surface. Whereas osteoar-thritic overgrowth is widespread in vertebrae, and also enthesophytes are known at least in
humans and rats, such a distally extending osteophyte seems extremely rare. Together with
an unambiguous second vestigial phalanx in the left manual digit II, this last variant of oste-
ophyte implies that the phalangeal reduction in the sauropod manus was due to a degeneration
of the second phalanges, as known by the fusion with the preceding elements. These results are
supported by histological studies of SMA 0002, and corroborate hypotheses on the im-
portance of bone fusion as a driving force in the reduction of the sauropod wrist.

Technical Session XIV, Wednesday 11:45

A NEW TROODONTID (DINOSAURIA: THEROPODA) FROM THE LATE CRETACEOUS OF THE GOBI DESERT IN MONGOLIA – TSUIHIJI, Takanoabu, National Museum of Nature and Science, Tokyo, Japan; WATABE, Mahto, Center for Paleobiological Research, Hayashibara Biochemical Laboratories, Inc., Okayama, Japan; TSOGTBAATAR, Khishigjav, Mongolian Paleontological Center International, Ulaanbaatar, Mongolia; SUZUKI, Shigeru, Center for Paleobiological Research, Hayashibara Biochemical Laboratories, Inc., Okayama, Japan; BARSBOLD, Rinchen, Mongolian Paleontological Center, Ulaanbaatar, Mongolia

Remains of troodontid theropods, especially articulated skeletons, are extremely rare world-
wide. The Gobi Desert of Mongolia is no exception despite the fact that numerous remains
of other clades of dinosaurs have been found in this region. We here report on an articulated
skull of a new troodontid found from the Campanian Djamdakh Formation of the Dranxin
Khond locality in the central Gobi Desert. The specimen, missing only middle cervical verte-
brae, forelimbs distal to humeri, parts of hind limbs, and most gastralia, represents the most
complete skeleton of a Late Cretaceous troodontid presently known. With the total body
length approximately 160 cm, this specimen is comparable to Saurotheroides mongoliensis
in size. The skull, mostly undistorted and lacking only the tip of the snout, shows typical
troodontid features such as an enlarged maxillary fenestra and the anterior process of the
lacrimal much longer than the supraorbital process. The well-preserved postcranial skeleton
provides detailed information on poorly-understood anatomy of Troodontidae. For example,
its is confirmed for the first time that the proatlas is present in front of the atlas as in some

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other ceratosaurs. Anterior cervical ribs are thin and long unlike short posterior cervical ribs. 35 caudal vertebrae are preserved with the transition point located at around the tenth caudal. The ischium is short, with the length being 55% of that of the pubis. The present specimen shares such apomorphies as lateral teeth lacking serrations and presence of a shallow groove along the buccal margin of the maxilla with the coeval *Byronosaurus affinis*, with a similar clade analysis placing these two as sister taxa. Unlike in *B. jaffei*, however, the interenestral bar of the maxilla is recessed medially and the lacrimal lacks a laterodistal fossa at the posteroentral corner of the antorbital fenestra in the present specimen. Combination of these features thus indicates that this is a new, distinct taxon. This represents the third troodontid taxon discovered from the Djadokhta Formation, thus revealing a high diversity of this clade of theropods in the Campanian of Central Asia.

Technical Session XVIII, Wednesday 4:00

THE LATE PERMIAN REPTILE *EMEROLETER LEVIS* FROM RUSSIA AND THE PHYLOGENY OF THE NYCTEROLETER PARAREPTILES

TSUI, Linda, Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin, Berlin, Germany; REIZS, Robert, University of Toronto at Mississauga, Mississauga, ON, Canada; MÜLLER, Johannes, Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin, Berlin, Germany

The Kotel' nich locality from the Late Permian of central Russia has produced numerous well-preserved fossils from a diverse assemblage of taxa. This fauna includes multiple parareptiles; the paraisaur *Deltunajxia vitikens*, the enigmatic *Nicthyrhnoerus acutus* and, the nycteroleter *Emeroleter levis*. Known previously from only isolated skull material, new, complete and articulated specimens including postcrania of the latter taxon, have recently been recovered, for the first time allowing a complete description. The skull of *Emeroleter* is triangular and characterized by evanely-spaced, small, round pits. Despite the lack of preservation of other structures indicative of tympanic hearing, the presence of an otic notch of larger proportion than that of the morphologically similar *Macroleter poezicus* indicates that *Emeroleter* had sensitive hearing. The postcranial anatomy of *Emeroleter* shows limb elements that are remarkably gracile in comparison with its close relatives, with a highly reduced olecranon process of the ulna, and a slightly sigmoid curve to the shaft of the femur. The taxon also has a single element in the proximal tarsus. The presence of a lumbar sax that

Emeroleter

shape quotient in m1 do not show strong signs of an unidirectional change during each of the from the Bridger C to D although the precise rate of the decrease cannot be determined from the upper Bridger shows an abrupt increase within the Bridger C and a decrease in the upper Bridger (Twin Buttes Member).

N. robustior

in the upper Bridger is observed in the measurements of m1 crown area of classification is needed to produce the most reliable results.

**II. **POSTER SESSION II, (Monday)

**CARNIVORES FROM THE PIPE CREEK SINKHOLE (LATE HEMPHILLIAN), GRANT COUNTY, INDIANA**

TUCKER, Shane, University of Nebraska State Museum, Lincoln, NE, USA; FARLOW, James, IPFW, Fort Wayne, IN, USA

The Pipe Creek Sinkhole, located in Grant County, Indiana, is one of two Late Neogene localities in the interior of the eastern United States. This fossiliferous pond deposit occurred in a sinkhole developed in Silurian-age limestone and is unconformably overlain by Pleistocene glacial till. Several thousand identifiable botanical, invertebrate, and vertebrate specimens were recovered from spoil piles and in situ sediments over several field seasons. Carnivores make up a small percentage (<1%) of the overall vertebrate fauna yet are useful bioclimatic indicators. At least seven taxa representing four families are identified from two partial mandibles and isolated dental and postcranial elements. The Pipe Creek carnivore fauna contains three canids, one felid (*Lynx*, cf. *L. rexroadensis*), one ursid (*Pionuroctos cf.*), and two mustelids. Canids include the widespread taxa *Borophagus* and *Vulpes*. Mustelids remain belong to a badger and small mephitine, *Buisincts schoffi*. The co-occurrence of *Pionuroctos edensis*, *Buisincts schoffi*, and *Lynx rexroadensis* suggests a latest Hemphillian (early Pleocene) age which agrees with the bioclimatic age previously reported based on the rodents and associated fauna.

**ANALYSIS OF ENDEMICITY**

TULU, Yasemin, Michigan State University, East Lansing, MI, USA

Recent studies of the Judith River Formation (JRF) chondrichthyan fauna of Montana show that the fauna consists both of cosmopolitan and endemic members totalling 26-28 identifiable taxa, is homogenous, and similar to several contemporaneous faunas from the Western Interior Seaway (WIS) as shown by hierarchical cluster analyses and Parsimony Analysis of Endemicity (PAE). The fauna is diverse, composed of lamniforms and rajiforms that inhabited a shallow marine/estuarine environment of the WIS. When examined in the context of 18 other contemporaneous (Cenomanian to Maastrichtian) faunas of the WIS, the JRF fauna is most similar in composition to faunas of Campanian age, similar geography, and/or similar environment. The JRF is most similar to the “Mesaverde” Formation (Campanian) of Wyoming and the JRF (Campanian) and Dinosaur Park Formation (DFP) (Campanian), both of Alberta. These observations are corroborated with a PAE where at the generic level the JRF fauna forms a province, that is geographically and temporally defined, with the DPF, the “Mesaverde” Formation, and the Hell Creek Formation (Maastrichtian) in North Dakota implying more shared endemic genera between these formations than with the other formations studied. The remaining formations are similarly grouped. However, a PAE performed at the species level plots the JRF in a province that is more temporally defined, being grouped with the “Mesaverde” Formation, the Taylor Group of Texas (Campanian), and the Navarro Group of Texas (Maastrichtian), all at the end of the Late Cretaceous with the rest of the formations also grouped by time spanning from the Cenomanian to the Santonian. The addition of the species in the PAE seems to override any geographic grouping of shared endemic species and instead groups taxa temporally into provinces. This may demonstrate excessive splitting at the species level in previous studies, thereby overriding any concrete generic signal amongst the taxa of the JRF and of the WIS overall. These results would suggest that both generic and species level analyses should be completed in order to determine what level of classification is needed to produce the most reliable results.

**HIGH-RESOLUTION TEMPORAL VARIATIONS IN SIZE AND SHAPE OF MOLAR DENTITION AMONG NOTIARTHUS FROM THE MIDDLE EOCENE BRIDGER FORMATION, BRIDGER BASIN, SW WYOMING**

TSUKUI, Kaori, American Museum of Natural History, New York, NY, USA; MENG, Jin , American Museum of Natural History, New York, NY, USA

New dental morphometric data for middle Eocene *Notiarchus* specimens collected from a ~2 my interval (Bridger B - D) were binned into fourteen -0.15 my long intervals to elucidate temporal changes in size and shape variables of the lower molars. Mesial-distal crown length and buccal-lingual crown width of the lower molar dentition were measured on 241 catalogued specimens from the AMNH and YPM collections. The size measurements and morphology were used in conjunction with stratigraphic occurrence data to make species identification of the sample. Three species of *Notiarchus* were recognized: *N. pugnax* and *N. tenebrus* from the lower Bridger Formation (Blacks Fork Member) and *N. robustior* from the upper Bridger (Twin Buttes Member).

A replacement of the two smaller lower Bridger species (*N. tenebrus* and *N. pugnax*) by larger *N. robustior* in the upper Bridger is observed in the measurements of m1 crown area and is in agreement with a previous study. However, the current analysis adds more detailed information about the nature of the transition, at a finer temporal resolution than has been achieved previously. *N. tenebrus* shows a gradual increase in tooth area within the Bridger B, whereas *N. pugnax* shows a lack of unidirectional change during the same interval. *N. robustior* from the upper Bridger shows an abrupt increase within the Bridger C and a decrease from the Bridger C to D although the precise rate of the decrease cannot be determined because of sparser sampling within the Bridger D. Unlike the size variable, variations in shape quotient in m1 do not show strong signs of an unidirectional change during each of the three species’ durations, indicating that dental morphological changes in species of *Notiarchus* during the study interval involved mostly size changes without significant shape changes. This study suggests that near the peak of Cenozoic warming, *Notiarchus* exhibited an overall trend towards larger body size (as inferred by the molar size), although when viewed at a fine temporal resolution, the changes exhibited within each species of *Notiarchus* were more variable, both in direction and rate.
We have been working for ten years in an extensive Edmontosaurus bonebed in eastern Wyoming in the Upper Cretaceous Lance Formation. Our application of high-resolution GPS technology has enabled us to maintain precise positional information on all recovered objects. We have been able to reconstruct virtual quarries with centimeter accuracy in the computer using GIS software and field photographs of the bones. Although we have only examined a small percentage of the total extent of the deposit in detail, test quarries in remote areas have afforded an opportunity to evaluate the deposit as a whole. Based on examination of 500 of an estimated 250,000 square meters of bonebed in ten localities, we estimate the deposit contains the remains of more than 10,000 animals. The disarticulated bones appear pristine, exhibiting little evidence of weathering or abrasion. The association of numerous shed thoropod teeth suggests scavenging occurred prior to final transport and burial. The bonebed was deposited with a matrix of clay as a normally graded bed, possibly from a debris flow in relatively deep water. Contact with an overlying fine grained immature sandstone is sharp and flat. Extensive dewatering structures in the sandstone are consistent with rapid accumulation of these sediments. We are suggesting that an unknown catastrophe, perhaps volcanic in nature resulted in the rapid extinction of a large number of mature animals, whose carcasses accumulated on a shoreline where scavenging, rotting and disarticulation took place. Subsequent remobilization of the feint mass, along with the sediments encasing the bones, perhaps triggered by local or regional tectonics resulted in transport for an undetermined distance into deeper water where they were finally buried in a meter thick, normally graded bed.
crest are exactly as expected for female pterosaurs and contrast sharply with the relatively shallow and seemingly more convergent puboischiadic plates and prominent cranial crest found in other similarly sized, presumably male, individuals of *Darwinopterus*. These dimorphisms suggest that females had a deeper pelvic canal that, most likely, facilitated passage of the egg. They also add strong support for the idea that the principal function of cranial crests was for display, a hypothesis that best accounts for the widespread distribution of crests across Pterosauria, their remarkable variation in size, shape and position and their simultaneous presence/absence in particular species. This, in turn, points to sexual selection as the most likely explanation for the evolution of spectacular crests in several clades, most notably Pteranodonida and Azhdarchoidea. A preliminary reassessment of species taxonomy incorporating this improved understanding of anatomical variation in pterosaurs confirmed current hypotheses of sexual dimorphism in *Anhanguera*, *Pteranodon*, *Nyctosaurus*, and *Ctenochasma*, and identified another nine candidate examples of sexual dimorphism involving 19 species of pterosaur. By contrast to *Pteranodon*, little evidence was found for gender related size dimorphism or ‘harem’ in this group.

Technical Session XIV, Wednesday 8:15
NEW INFORMATION ON THE TAXONOMY AND PHYLOGENETIC RELATIONSHIPS OF MIDDLE AND LATE JURASSIC SAUROPODS FROM CHINA
UPCOURT, Paul, University College London, London, United Kingdom; BARRETT, Paul, The Natural History Museum, London, United Kingdom; XU, Xin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; LI, Kui, Chengdu University of Technology Museum, Chengdu, China
There are currently some 15 genera of sauropod dinosaur known from the Middle and Late Jurassic of China. Many of these comprise multiple species - up to 10 in the case of *Mamenchisaurus*. The diagnoses of these taxa are often problematic, partly because more recent discoveries have rendered previously diagnostic features ‘obsolescent’. Examination of type specimens and comparisons with non-Chinese forms provide a suite of new characters that help to diagnose the Chinese taxa, resolve some taxonomic issues, and contribute to phylogenetic analysis. One of the best known species of *Mamenchisaurus*, *M. hochuanensis*, can be diagnosed by 15 autapomorphies, including: (1) double prespygapophyseal and double centroprezygapophyseal laminae on anterior dorsal vertebrae; (2) large divided coels on the posterior surfaces of the diapophysial elements of anterior dorsal vertebrae; and (3) flattened stratified scars on the upper part of the neural arch in anterior caudals. *Klamosaurus* is characterised by 10 autapomorphies, including: (1) a spinodiapophyseal lamina joins the spinoprezygapophyseal lamina on anterior dorsals; (2) middle and posterior dorsals have prominent parapophyses placed on sheet-like centroparapophyseal laminae that project anterolaterally; and (3) an anterodorsally facing depression on the proximal end of the hemurals, close to its medial edge. Phylogenetic analysis indicates that characters (such as the presence of 3–4 coels on the lateral surfaces of cervical neural spines, a shallowly bifurcated neural spine in mid-presacrals, and strongly procerebral anterior caudal centra) support the existence of a monophyletic mammenchisaurid clade that contains *Mamenchisaurus*, *Klamosaurus* and probably *Bellucisaura*. This clade is placed among basal sauropods, lying outside of Neosauropoda. Cladistic biogeographic studies suggest that a group of sauropods dispersed across Eurasia prior to the formation of the Turgai Sea in the Middle Jurassic, which then resulted in endemism among the East Asian forms. These taxa became extinct by the Early Cretaceous and were replaced by an immigrant fauna dominated by titanosauriforms.

Poster Session II, (Monday)
A NEW TRUE SEAL MORPHOTYPE (PHOCIDAE, CARNIVORA) FROM BAHÍA INGLESA FORMATION, CHILE
VALENZUELA-TORO, Ana, Laboratorio de Zoología de Vertebrados, Facultad de Ciencias, Universidad de Chile, Santiago, Chile; GUTSTEIN, Carolina Simon, Facultad de Ciencias, Universidad de Chile, Santiago, Chile; COZZUOL, Mario Alberto, Departamento de Zoología, Inst. Ciencias Biológicas, Universidad Federal de Minas Gerais , Belo Horizonte, Brazil
Phocid remains have been previously recovered from the Bahía Inglesa Formation (middle Miocene-late Pliocene, Northern Chile), but only fragmentary remains of taxa already known from the Pisco Formation, *Piscophoca pacifica* and *Acropoha longirostris* (Monachinae, Pisco, Peru) have been recognized to this unit. Here we report a new dentary morphotype of a Monachinae (Phocidae). This specimen was recovered from the marine sediments of the “bonebed” level (late Miocene), corresponding to a complete right dentary ramus. Descriptive measurement and preliminary morphometric analysis were performed with seven specimens, *Piscophoca sp* (SGOPV 1080a), *Piscophoca sp* (SGOPV 1019 a y b), *Acropoha sp* (SGOPV 1019) and the new morphotype (SGOPV 1080c) from the Bahia Inglesa Formation, the holotypes of *P. pacifica* (MNHNAS 564) and *A. longirostris* (MNHNAS 563). The new morphotype differs from other fossil Monachinae species by being robust, having a high abrupt elevation of the coronoid process that spreads until half length of the dentary, overall dentary height, and by having a conspicuous V-shaped masseter fossa in contrast to the anteroposteriorly elongate and divided fossa for masseters found in *Piscophoca* and *Acropoha*. The dentary is laterally deviated from the very short symphysis, which must have an impact on mouth shape and mostly width, denoting a different morphotype from the contemporaneous narrow rostrum forms, mainly in *A. longirostris* but also when compared to *P. pacifica*. On the PCA (transformed to avoid size effect, PC1 explains 88.8% of variation) SGOPV 1080c appears distant from all other specimens, being more distant than the holotypes of *P. pacifica* and *A. longirostris* are from each other. Kruskal-wallis tests performed to test differences between taxa with pairs of measurements were significant to all. SGOPV 1080c also seems to correspond to an ecologically distinct form, at least due to its relatively wide and robust mouth, which could imply different prey sizes or types. The new morphotype suggests a greater diversity of Monachinae in the late Miocene of northern Chile.

Preparers’ Session, Monday 11:15
PREPARATION OF MICRO-FEATURES OF EOCENE GREEN RIVER SPECIMENS: METHODS AND MATERIALS
VAN BEEK, Constance, The Field Museum, Chicago, IL, USA
The locality known as Fossil Lake of the Eocene Green River Formation of Wyoming has yielded a wealth of exquisitely fossilized flora and fauna, 52 million years old. A fine-grained limestone matrix has preserved morphological features with impressive detail: from insect wings and fish embryos, to delicate veins on leaves. Micro-features have been beautifully preserved, such as bird feathers; body and skin impressions of mammals; and scales and fin rays of fishes, their jaws filled with teeth and denticles. These micro-features need special attention for proper preparation. In addition, the bones of birds, fishes and small tetrapods are often thin and hollow. Plant material is equally delicate: leaves, stems and flowers provide extraordinary detail, but may be easily damaged during preparation. These detailed specimens present a unique challenge: how to effectively remove matrix without damaging their micro-features or delicate structures. Air-abrasion is too forceful and leaves behind powder residue that cannot be removed completely. Acid preparation is a possibility, but the specimen must be permanently embedded in resin, and this method may still prove too damaging. Pneumatic and hand tools are often frustrating to use on such fragile material. Appreciable success was achieved in preparing and preserving a variety of these Fossil Lake specimens and their micro-features by refining hand tools and mechanical preparation techniques. Specialized pin vise tips were developed through alternative sharpening methods that proved useful in removing matrix without damage to the specimen. Blunted air scribes removed matrix effectively if oriented correctly to the specimen surface, and with ‘choked down’ air flow. Precision was maintained by holding tools in a manner that provided ultimate stability and control. Angled orientation of the specimen itself was extremely important. Finally, some consolidation was used to keep delicate surfaces and bones intact. By observing the unique challenges each specimen provided, and then applying and modifying these techniques, preparation of this material with little or no damage was possible. Implementation of these methods was an important part of uncovering the delicate features of specimens such as the ones found in this particular formation.

Poster Session IV, (Wednesday)
PRESERVATION OF ORGANIC MOLECULES IN A HADROSAUR DINOSAUR FROM THE HELL CREEK FORMATION, NORTH DAKOTA (USA)
VAN DONGEN, Bart, University of Manchester, Manchester, United Kingdom; WOGELIUS, Roy, University of Manchester, Manchester, United Kingdom; BUCKLEY, Mike, University of Bournemouth, Bournemouth, United Kingdom; LYSON, Tyler, University of Yale, New Haven, CT, USA; MANNING, Philip, University of Manchester, Manchester, United Kingdom
The recognition of dinosaur tissue structure and organic molecules preserved inside bone has been previously reported. In contrast, the presence of both organic structures and molecules in dinosaur soft tissues, such as skin, terminal ungual phalanx sheath, or tendon, has not been recognized. A recently discovered extremely well-preserved dinosaur (*Edmontosaurus sp.*), found in the Hell Creek Formation (Upper Cretaceous, North Dakota, USA) maintains soft-tissue structures which might help in these endeavours.

The presence of organic compounds in the soft-tissue is demonstrated by results from Fourier Transform Infra-red Spectroscopy (FTIR), Pyrolysis Gas Chromatography Mass Spectrometry (Py-GCMS), and amino acid composition analyses. FTIR of materials recovered from the skin and terminal ungual phalanx material indicates the presence of compounds containing amide groups. The position/appearance of the FTIR bands of the amide I and II groups were similar to what was measured in a modern 1–keratin sample taken from pigeon down and crocodile integument. Amino acid composition and racemisation analyses of a skin envelope sample exhibits a distinct composition clearly different from the surrounding matrix. High glycine/alanine concentrations were observed indicative of fibrous structural proteins such as collagens and keratins. However, intact proteins could not be obtained using protein mass spectrometry. Py-GCMS revealed the presence of an aliphatic polymer in the skin. The distinct n-alkanes/n-alken-1-ene homologues distribution pattern associated with this polymer differ considerably compared to the enclosing sediment. The observed differences are inconsistent with an origin solely via migration from enclosing sediment and are tentatively interrupted as being endogenous to the dinosaur. This suggests that the organics present in the skin envelope consist of a macromolecule that is in part aliphatic, presumably the result of a process of in situ polymerisation. Combined, the results suggest a preservation of soft-tissue organic material, probably caused by a rapid burial outpacing microbial decay processes.
A NEW SITE OF EOCENE WHALES AND SIRENIANS IN EGYPT

VAN VLIET, Henk Jan, Altrecht, Utrecht, Netherlands; ABU EL KHAIR, Gebely, EEAA

VANVLIET, Henk Jan, Altrecht, Utrecht, Netherlands; ABU EL KHAIR, Gebely, EEAA

VAN VLIET, Henk Jan, Altrecht, Utrecht, Netherlands; ABU EL KHAIR, Gebely, EEAA

A NEW SITE OF EOCENE WHALES AND SIRENIANS IN EGYPT

Poster Session IV, (Wednesday)

A NEW SITE OF EOCENE WHALES AND SIRENIANS IN EGYPT

VAN VLIET, Henk Jan, Altrecht, Utrecht, Netherlands; ABU EL KHAIR, Gebely, EEAA

Qaroun Protected Area Office, Shakshouk, Egypt

It is now nearly doubled, demonstrating how important this region is for the progress of our understanding of sirenian evolution and diversification.


TALIT AUTOTOMY IN THE FOSSIL RECORD: NEW INFORMATION ABOUT VOLUNTARY TAIL LOSS IN CAPTORHINID REPTILES

VICKARYOUS, Matthew, University of Guelph, Guelph, ON, Canada; REISZ, Robert, University of Toronto at Mississauga, Mississauga, ON, Canada; MODESTO, Sean, Cape Breton University, Sydney, NS, Canada; HEAD, Jason, University of Toronto at Mississauga, Mississauga, ON, Canada

Many lizards are able to voluntarily self-detach or autamotize a portion of the tail as a predation avoidance strategy. Various anatomical adaptations are associated with tail autotomy, including a specialized joint that transversely partitions the caudal vertebra and permits controlled breakage of the skeleton. Similar intravertebral joints have been reported in a number of Paleozoic and Mesozoic reptiles, but to date none have been investigated in detail. The oldest known reptiles to which caudal autotomy has been ascribed are captorhinids and me-sosaurids of the Early Permian. Whereas recent research on mesosauroids indicates that these reptiles did not have fracture planes facilitating tail autotomy, it has long been established that intravertebral joints are present in the captorhinid genera Captorhinus and Labidosaurus. We present new data on the intravertebral joints of small captorhinids (cf. Captorhinus sp.) from the Richards Spur fissure-fill locality of Oklahoma. The autotomous vertebrae form a short series in the middle portion of the tail and are absent from the proximalmost and distalmost segments. Where present the intravertebral joint divides the centrum but not the neural arch, suggesting that the latter structure is fractured during autotomy. Among modern lizards, progressive fusion and loss of the intravertebral joint often occurs during ontogeny, and in each vertebra fusion begins dorsally at the top of the neural arch and proceeds ventrally. This pattern is similar to the condition seen in the autotomous caudal vertebrae of captorhinids. The presence of intravertebral joints in captorhinids indicates that early in reptilian history (at least by the Sakmarian) the tail had evolved from an indispensible locomotory organ to an expendable appendage. Captorhinids are widely recognized as the most common reptiles in Lower Permian rocks of the American southwest. Indeed, captorhinids are usually locally abundant (e.g., Richards Spur, McCann Rock Quarry, Mitchell Creek) where they occur in Texas and Oklahoma. We propose that caudal autotomy was a key factor in the ecological success of these early reptiles.
Furthermore, we have used a canonical discriminant analysis to characterize modern bird feather color and found several variables that confidently characterize typical colors that can be determined in fossils. We used this to characterize colors of the Late Jurassic Anchiornis huxleyi. The colors and color patterns are clearly useful for display, but other aspects show potential functional diversity in durability. Plotting feather morphology and obscuring color in feathered theropods to the inferred phylogeny of dinosaurs suggest a coincident occurrence of more complex within-feather color patterns and the appearance of pinnate feathers in pre-aerodynamic dinosaurs. This suggests that a driving force in early feather evolution could be the utility for display rather than aerodynamics subsequent to insulation. Continued studies of fossil melanosomes and the resulting color patterns will be valuable to understand avian evolution and its colorful history.

Technical Session X, Tuesday 9:30

FOSSILIZED COLORS OF BIRDS AND OTHER DINOSAURS: IMPLICATIONS FOR UNDERSTANDING THE EVOLUTION OF FEATHERS

VINTHIER, Jakob, Yale University, New Haven, CT, USA; D’ALBIA, Liliana, University of Akron, Akron, OH, USA; LI, Quanguo, Peking Natural History Museum, Beijing, China; CLARKE, Julia, University of Texas, Austin, TX, USA; GAO, Ke-Qin, Peking University, Beijing, China

Feathers are complex integumental appendages in birds and their stem groups. Recent discoveries indicate an earlier appearance than theropods in the common ancestor to ornhithians or maybe even pterosaurs. Studies of the nature of early feathers have primarily been restricted to their shape and distribution. Recent discoveries indicate the ubiquitous presence of color imparting melanosomes in fossilized feathers. This has interesting implications for further understanding of the evolution and function of feathers. Melanosomes can provide pigmented and structural colors, also rigidity to the feather and color patterns provide display and camouflage. The studies of color patterns in the avian stem group therefore have obvious importance for understanding the functional evolution of feathers.

We have used a canonical discriminant analysis to characterize modern bird feather color and found several variables that confidently characterize typical colors that can be determined in fossils. We used this to characterize colors of the Late Jurassic Anchiornis huxleyi. The colors and color patterns are clearly useful for display, but other aspects show potential functional diversity in durability. Plotting feather morphology and obscuring color in feathered theropods to the inferred phylogeny of dinosaurs suggest a coincident occurrence of more complex within-feather color patterns and the appearance of pinnate feathers in pre-aerodynamic dinosaurs. This suggests that a driving force in early feather evolution could be the utility for display rather than aerodynamics subsequent to insulation.

Continued studies of fossil melanosomes and the resulting color patterns will be valuable to understand avian evolution and its colorful history.

Poster Session I, (Sunday)

COMPLEX TETRAPOD BURROWS FROM THE TRIASSIC TIMEZGADIouNE FORMATION (ARGANA BASIN, WESTERN HIGH ATLAS, MOROCCO)

VOGT, Sebastian, TU Bergakademie Freiberg, Freiberg, Germany; SCHNEIDER, Jing, TU Bergakademie Freiberg, Freiberg, Germany; SABER, Hadi, Chouaib Doukkali University, El Jadida, Morocco; KLEIN, Hendrik, TU Bergakademie Freiberg, Freiberg, Germany; HIMINNA, Abdelkhir, Chouaib Doukkali University, El Jadida, Morocco

An occurrence of remarkably abundant, complex tetrapod burrows was recently discovered in fluvial red beds of the middle part of the Timezgadioune Formation (Aglagal Sandstone Member, T4). Closely associated, well preserved tetrapod footprints assigned to Chirotherium, Ichiosthenurus, Synaptichnium, Rotodactylus, Rhynchosaurus, Proscolophichnium, and Apatopus suggest a Middle Triassic age for the studied horizon. These commonly flattened, emarginate burrows occur in several discrete layers of interbedded tabular sandstone and sandy siltstone we interpret as sheet-flow and overbank deposits of ephemeral rivers in a generally dry area with periodic or episodic, heavy rainfall. All recorded burrows appear to start from the top of decimetre thick sandstone beds and step down as moderately inclined (10°-30°), partially spiral, coiled tunnels to enlarged terminal chambers that are laterally extended in the underlying sandy siltstone. Individual tunnels are usually uniform in cross-section and represent mostly plan-convex structures up to 20 cm in width and 12 cm in maximum height. Slightly sinusuous courses (r = 35-45 cm, f = 10-20 cm) observed for numerous tunnel segments seems to be a peculiar feature of these systems. Winged to gallery-like extended terminal chambers, some with possibly more than one access, and horizontal clustering of cross-cut burrow segments suggest cohabitant networks of multiple occupants. Based on the architecture and depositional context, the described burrows most likely served as seasonal shelter from environmental extremes. Although similar burrows from Late Palaeozoic and Early Mesozoic occurrences have primarily been attributed to theropod origin we explicitly include procolophonids as potential producers considering some unique burrow features and the local footprint record. However, skeletal fossil remains, which could be used to clarify the systematic position of the potential producers, are unlikely to be recovered from the sandy siltstone burrow fills inasmuch as lamination and lithology indicate some incremental burial by overbank deposits rather than catastrophic flooding.
The salt gland structure did not extend internally to the nasal region. The interior and exterior portion of the external nares are intact, and display paired structures of rugose, ridged bone at the posterior border of the external nares on the exterior surface of the lacrimal. The funnel-shaped structures face anteriorly and are probably not involved in breathing nor as a support for a nasal valve. These features may increase drag on the streamline skull of an ichthyosaur and facilitate the removal of excess sal as a concentrated solution via a laterally oriented, post- nares structure that can be flushed with water. The exit point from the gland would have been through a single, short duct as noted in Lepidosaurus. The nares in basal ichthyosaurs are dorsally situated, but on derived forms are laterally oriented and split. The orbits are more reduced in basal ichthyosaurs and it has been suggested that salt glands were situated at the parietal/frontal contact. Expansion of the eyes in derived forms may have moved the glands forward to the vomeral/usual region anterior to the orbit.

Poster Session II, (Monday)

PHYLOGENETIC IMPLICATIONS OF ARCTOMELES DIMOLODONTUS USING CRANIAL MORPHOLOGY

WALLACE, Steven, East Tennessee State University, Johnson City, TN, USA; SCHUBERT, Blaine, East Tennessee State University, Johnson City, TN, USA

Relationships within fossil Melinae (Carnivora: Mustelidae) have traditionally been difficult to interpret due to the fragmentary nature of most specimens. For example, similarities in the dental morphology of extant genera Arctonyx (hog badgers) and Meles (Eurasian badger), to that of the extinct Arctomeles (woodland badger), have made phylogenetic placement of the latter within the subfamily problematic. Arctomeles may in fact represent a common ancestor for Arctonyx and Meles, however this hypothesis could not be adequately tested given the available material. Consequently, when originally described based on the upper dentition only, little new insight was offered. Subsequently, the recovery of two partial crania from the type locality (Gray Fossil Site of eastern Tennessee) provides an opportunity to revisit the systematic placement of the genus. Both skulls preserve the complete upper dentition allowing direct comparison to the holotype, and in combination, provide details on nearly every portion of the cranium. Of particular importance is the 3D preservation of both auditory bullae on one individual: the left bulla is intact, whereas the right is broken into three sections, affording a detailed examination at the interior. Additionally, a single lower jaw with complete (and unworn) dentition was recovered in direct association with one of the skulls, providing additional characters for the species. Cladistical analysis utilizing this material provides new insight on the phylogenetic relationships of these badgers.

Poster Session IV, (Wednesday)

INFERRING THE FLIGHT STYLES OF EARLY BIRDS AND FLIGHT EVOLUTION FROM PRIMARY FEATHER LENGTH

WANG, Xia, University College Dublin, Dublin, Ireland; DYKE, Gareth, University College Dublin, Dublin, United Kingdom; NUDDS, Robert, University of Manchester, Manchester, United Kingdom

Functional wing length in birds is comprised of the forelimb bones (humerus, ulna/radius and manus) and primary feathers. While research has described the phylogenetic distribution and functional morphology of components of the avian bony wing skeleton, the contribution of feather length to wing length among birds has been largely ignored. Here, we examine the scaling relationship between primary feathers and total arm length (sum of humerus, ulna and manus) in fossil birds from the Mesozoic and show that there are significant differences in the composition of the wing between lineages of basal birds. Primary feathers are significantly shorter in Archaeopteryx and enantiornithines than in living birds and Confuciusornithidae. In contrast, although falling within the range of modern birds (Neornithes), primary feathers of Confuciusornis are significantly longer than those of any other Mesozoic fossi l bird. Based on outgroup comparisons with non-avian theropods that had forelimb primary feathers, we show that the possession of relatively short primary feathers is the primitive condition for Aves. There is also a trend towards a broadening of the range of primary feather length to total arm length ratios, which coincides with the enormous evolutionary radiation and ecological niche diversification at the base of modern birds. Understanding changes in the ratio of primary feather length to total arm length is important because the length of primary feathers relative to the whole wing relates to both flight ecology and performance in birds. Comparison of wing proportions amongst early birds suggests that the early Cretaceous Confuciusornis, in particular, had a flight style distinct to other extant taxa.

Technical Session XVIII, Wednesday 3:15

POLYDACTYLY IN A MESOZOIC SALAMANDER FROM CHINA

WANG, Yuan, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; DONG, Liping, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; EVANS, Susan, Research Department of Cell & Developmental Biology, University College London, London, United Kingdom

Polydactyly is an aberrant condition in extant tetrapods, and is only rarely documented in the fossil record of the group. With the exception of the earliest Devonian tetrapods, which typically had more than five digits, only a few fossil tetrapods (e.g. members of Ichthyosau ria and Huphestuscia) have been recovered with polydactylous autopodals. Here we report polydactyly in a Middle/Late Jurassic salamander, Chunerpeton tianyiensis, a neotenic and
updated Asian paleocene mammalian biochronology and its implications to intercontinental faunal interchange

Wang, Yuan-Qing, 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; LI, Qian, Key Laboratory of Evolutionary Systematics of Vertebrates, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

Paleocene Asian land mammal ages (ALMA) have been widely accepted to include three ages: the Shanghuang, the Nongshanian, and the Gashatan. Absence of age constraint has hampered the intercontinental correlation as well as the understanding of faunal interchange. Recent investigation in both northern and southern China provided further information to constrain the boundaries of the Paleocene ALMAs. Paleomagnetic study provided evidence to correlate the Shanghuang/Nongshanian boundary with the chron C27r-C26r transition of the geomagnetic polarity time scale (GPTS). A comprehensive discussion of the biochronological frameworks of Paleocene mammalian faunas in Asia and North America is outlined as follows: 1) At the To2, Asian originated Pantodonta and Mesonychidae dispersed to North America and gave their first appearance there. 2) Carnivora that originated in North America migrated into Asia and first appeared at late Shanghuang, roughly equivalent to To3. 3) At the Ti5, Arctostylopidae dispersed from Asia to North America and first appeared at late Shanghuang, roughly equivalent to To3. 4) At the beginning of Clarkforkian, Asian origianated Rodentia and Tillodontia entered the North America, while Coryphodontidae probably migrated into Asia from North America.
In the fall of 2008, a project was started in cooperation between the University of North Dakota (UND) and the Pioneer Trials Regional Museum (PTRM) in Bowman, North Dakota. The fossils for this study were collected from White River Group sediments in southwestern North Dakota and are curated within the PTRM collections. Over 2000 White River Group specimens are present in the PTRM collection representing a diverse assemblage containing fish, reptiles, and mammals. The PTRM White River collection includes approximately 75 specimens representing marsupial and insectivore taxa. These specimens are primarily from the Brule Formation, although some specimens have been recovered from the Arikaree Formation. Fossils from the Chadron Formation in North Dakota are extremely rare, with no insectivores reported in this collection. At present, seven species have been identified from the PTRM White River Group specimens. Two marsupial taxa are present, Herpetotherium sp., and cf. Pseudalopex sp. Insectivores include: Leptictis sp., Ankylodon progressus, Certainodon marginalis, Dominina gradata, and cf. Proscolopus sp. To date, this project is the most detailed and comprehensive study of the Oligocene insectivores in North Dakota. Besides adding to the general knowledge of Oligocene insectivores, Ankylodon progressus, Certainodon marginalis, Dominina gradata, and cf. Proscolopus sp. are first occurrences in North Dakota and represent biogeographic range extensions. This study will provide a basis to compare the Oligocene diversity in North Dakota with that of other Oligocene Northern Great Plains localities. Also, this study provides support and corroboration with earlier studies as to the Orellan age designation of the Brule Formation in North Dakota, especially with occurrence of the Orellan index taxon Ankylodon progressus.

Poster Session I, (Sunday)

A NEW VERTEBRATE FOSSIL LOCALITY IN THE UPPER TRIASSIC CHINLE FORMATION OF NORTHEASTERN ARIZONA

WEINBAUM, Jonathan, Southern Connecticut State University, New Haven, CT, USA; MARTZ, Jeffrey, Petrified Forest National Park, Petrified Forest, AZ, USA

A new and important fossil locality was discovered on private land just outside of the Petrifed Forest National Park in northeastern Arizona during the 2009 summer field season. This collaborative effort between Southern Connecticut State University and the Petrified Forest National Park discovered a previously undocummented Triassic fossil site within the Sonsela Member of the Chinle Formation. The abundance of pedogenic carbonate nodules and unionidal bivalves, the presence of yellowish sandstones and light blue-gray mudstones, and the presence of a thick sequence of monotonous purple mudstone just above the localities, suggests that these are in the uppermost Sonsela Member, with an age probably between 215-210 Ma. The fossiliferous strata are two gravelly, yellowish sandstone layers with abundant uniosnids, indicating a freshwater stream or river environment. These layers produced at least five vertebrate taxa, including skeletal elements of metoposaurids, phytosaur, aetosaur, “ruisichids” including Postosuchus and dinosaurs. Phytosaur and aetosaur material referable to the taxa Pseudalopites and Typothorax indicate a Revueltian age for the localities, consistent with their referral to the Martha’s Butte beds, and the site contains the only known occurrence of a theropod at this stratigraphic level in northeastern Arizona. A partial phytosaur skeleton including a complete skull was discovered and still awaits retrieval. This site is important as it expands our knowledge of Triassic vertebrates and the environments they lived in as well as how changing environments affected the evolution and extinction of various taxa.

Technical Session XI, Tuesday 4:00

WHAT ARE WE MISSING? GEOLOGICAL COMPLETELESS OF PALEONOTOLOGICAL SAMPLING IN THE TERRESTRIAL CENOZOIC OF NORTH AMERICA

WEINSTEIN, Deborah, University of Wisconsin-Madison, Madison, WI, USA; HEIM, Noel, University of Wisconsin-Madison, Madison, WI, USA; PETERS, Shanan, University of Wisconsin-Madison, Madison, WI, USA

Paleontologists study evolution based on physical evidence preserved in the fossil record, which varies in its fidelity due to unequal sampling and the vagaries of preservation. Recent analyses of the geological completeness of the North American fossil record documented a long-term increase in completeness during the Phanerzoic. The extent to which marine vs. terrestrial completeness differs and varies over time remains, however, unknown. Using the Macrostrat Database (MD; a comprehensive geologic compilation for the entire continent, including lithologic and depositional information for most known lithostratigraphic units) and the Paleobiology Database (PBDDB; fossil collections with taxonomic and geologic data), we measured the geologic completeness of paleontological completeness in the Cenozoic of North America. The total number of lithostratigraphic units and gap-bound terrestrial sediment packages remains largely stable during the Cenozoic until the Holocene, when the total number increases substantially. The contrast between the marine and terrestrial Cenozoic sedimentary records suggests that much of the variability in total geologic completeness is due to variability in the marine record. Geologic completeness of paleontological sampling in the terrestrial fossil record is approximately 35% for lithostratigraphic units and ~45% for gap-bound sediment packages. For comparison, mean Phanerzoic completeness for the entire fossil record is approximately 22%. To determine the cause of geological incompleteness in the terrestrial fossil record, we generated a list of all the named formations in MD that do not have any PBDDB collections matched to them, and then performed a literature search for fossil data on a random sample of those formations. Preliminary analysis indicates that between 47% and 68% of the named formations without any fossil collections in the PBDDB have literature sources that have not yet been entered into the database. Our results have important implications for understanding the history of terrestrial evolution in North America and for helping to accelerate the pace at which the PBDDB can acquire truly new palaeontological information.

Poster Session III, (Tuesday)

DIVERSITY OF CAUDAL FIN MORPHOLOGY IN LOWER TRIASSIC COELACANTH FROM BRITISH COLUMBIA, CANADA

WENDROFF, Andrew, University of Alberta, Edmonton, AB, Canada; SCOTT, Bradley, University of Alberta, Edmonton, AB, Canada

Coelacanths first appear in the fossil record in the Upper Devonian and were cosmopolitan throughout much of their fossil record. Coelacanths have been known from the Lower Triassic Sulphur Mountain Formation in British Columbia since 1976. Within this formation, there is a broad range of morphological diversity in coelacanth caudal fins. We observed three distinct tail morphologies amongst the coelacanths of the Sulphur Mountain Formation: a general broadly, rounded Latimeria-like tail, a forked tail, and a longer, rounded tail with a broad, extended supplementary lobe. This diversity remains undescribed to this day. Little is known about how coelacanths used their tails which exhibit a wide array of morphologies in the fossil record. Most coelacanth tails have broad, rounded dorsal and ventral lobes. Between these is a supplementary lobe, a small terminal fin that varies in length and size among taxa. Based on direct observations of modern coelacanths (Latimeria), we know that they are slow moving, only using the caudal fin for rapid acceleration to catch prey. The new forked-tailed coelacanth is interpreted as being a relatively active, fast predator, while the other two morphologies suggest ambush predator lifestyles. The fin rays of the forked-tailed coelacanth are mostly unsegmented, a feature that likely stiffened the tail. The wide span of the fin and the unsegmented fin rays suggest a stiff, high aspect ratio tail adapted for rapid swimming that has not been previously attributed to coelacanths. In the other two morphologies, the aspect ratio is much lower. These tails have segmented fin rays as in the majority of coelacanths. The segmented fin rays create a more flexible tail that allows for greater acceleration during escape or predation. Both tail morphologies denote a more diverse locomotory repertoire than was previously known in coelacanths supporting the idea that morphological diversity peaked in the Early Triassic.

Evolution of the Modern African Fauna, Wednesday 11:45

HOW ADEQUATE IS THE NEogene FOSSIL RECORD OF AFRICA? AN ANALYSIS BASED ON CARnivora

WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden; PEIGNÉ, Stéphane, Museum National d’Histoire Naturelle, Paris, France

The known African Neogene fossil record has expanded enormously in the past 30 years. Thus, its quality must have improved. But is it then adequate for analytic work on long-term trends in e.g., richness, extinction, and other evolutionary phenomena? We have compiled data on occurrences of Carnivora in the African Neogene record. Carnivores, though never common, are useful in this context because of their species richness and because they are readily identifiable at least to family level from quite small fragments. Our compilation shows the record to have increased from ca 300 occurrences in 1978 to over 1000 today. It is well known that the data are geographically biased, but how biased are they temporally? We plotted the data into 1 Ma bins and analyzed richness, origination, and extinctions over the past 20 Ma. The results of these analyses were compared to the available record (here defined as the number of localities sampled) in each time slice. Regressing diversity against number of localities shows that the number of taxa per time slice is almost entirely explained by the number of localities available (r^2 = 0.84 for raw data). Thus, the diversity curve as a whole is largely a reflection of sampling effort. However, the residuals from this regression still provide interesting, seemingly true, signals. For example, the 7-8 Ma time slice has a much greater and the 20-19 Ma time slice a lower than expected richness given the number of localities. It is encouraging that neither per capita originations nor extinctions are significantly correlated with number of localities. The absolute values of these parameters may be influenced by regression to the mean, but the fluctuations around the mean are still of significant interest, especially as their distributions differ in a way expected for originations and extinctions. Thus, although the record is still not adequate, we are cautiously optimistic that some phenomena can be validly analyzed today and that the record is improving so that more detailed analyses will be possible in the near future.

Technical Session VII, Monday 1:45

RECONSTRUCTING THE ONTOGENY OF THE TRIASSIC BASAL ARCHSAUROMORPH Trilophosaurus USING BONE HISTOLOGY AND LIMB BONE MORPHOMETRICS

WERNING, Sarah, University of California, Berkeley, CA, USA; IRMIS, Randall, University of Utah, Salt Lake City, UT, USA

Despite extensive research on the evolution of bird-line archosaur growth strategies, the basal condition for archosaurian growth rates, bone histology, and ontogenetic changes in osteohistology remain undescribed. The basal archosauromorph Trilophosaurus buettneri is well-known from hundreds of individual elements from a monodominant bonebed near Otsi Chalk, Texas, in the lower portion of the Upper Triassic Dockum Group. This large sample size across multiple ontogenetic stages presents an unusual opportunity to examine the growth strategy of a proximal outgroup to Archosauria. We measured over 300 humeri, October 2010—PROGRAM AND ABSTRACTS 185A
ulnae, femora, and tibiae across all sizes of *Trilophosaurus*, and constructed allometric growth curves for each element. Increases in the robusticity of muscle attachments and epiphyses generally do not occur until at least 2/3 total adult length for most bone features, several years after hatching. Furthermore, we histologically sampled ontogenetic series of femora and tibiae, as well as a representative adult ulna and humerus, and constructed growth curves for the hindlimb elements based on histological data. Throughout ontogeny, *Trilophosaurus* bone histology is characterized by a lamellar tissue organization, low-to-moderate levels of vascularity, and radially-organized simple longitudinal canals with few anastomoses. Osteocytes occur at moderate levels, but they are always well-organized in rows along the lamellae. We found growth lines (sometimes double or triple lines) in some of the smallest specimens we sampled, and external fundamental systems in the largest specimens (indicating cessation of skeletal growth). The growth curves and bone histology suggest slow growth throughout ontogeny for *Trilophosaurus*, and that the high growth and bone deposition rates achieved by more derived archosaurs are not characteristic of all members of Archosauria. Our results help characterize the basal condition for growth, bone histology, and limb ontogenetic morphology for Archosauria.

Poster Session III, (Tuesday)

**FIRST OCCURRENCE AND SIGNIFICANCE OF MAHIGRITIA STEVENSI IN A LATE MIDDLE EOCENE (LATE UNTIAN) TETHYAN-INFLUENCED GULF COAST COMMUNITY**

WESTGATE, James, Lamar University, Texas State University System, Beaumont, TX, USA; COPE, Dana, College of Charleston, Charleston, SC, USA; BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, USA

*Mahigritia stevensi* is here reported for the first time in the late middle Eocene (late Untian) Casa Blanca community from the Laredo Formation in Laredo, Texas, based on a nearly unworn right M2. *M. stevensi* is a cercomeric adapid primate which displays traits of middle Eocene European (*Europolemur*, Germany) and late Eocene Egyptian (*Aframomias*, Fayum) adapids rather than typical North American notharctids. It has been reported previously from early Cretaceous strata in the Devil’s Graveyard Formation (DGF), Brewster County, Trans-Pecos, Texas. Earlier workers suggested *Mahigritia* entered the Trans-Pecos region following colonization of a hypothetical area in eastern North America after dispersal from the Old World. The presence of *M. stevensi* in the Casa Blanca community suggests a more specific dispersal route. Associated taxa such as *Nysa* (Old World mangrove palm), cf. *Allaescelus* (caracchoelid turtle from the European Eocene including Messel, Germany), *Phyroopaemus* (giant snake known from the Tethyan Fayum region), *Galeoerco euglesnemi* (tiger shark), *Dipplesodus* (wrasse), and an unnamed megalodip (tarpon), indicate the coastal Texas community had significant Tethyan influences. Although the Gulf Trough and Suwanee Straits of Florida and Georgia were barriers to some benthic and stenohaline Tethyan marine species which ranged west to the carbonate banks of Florida, the Gulf Trough would not have blocked euryhaline and arboreal species which dispersed westward via Gulf Coast estuaries. The appearance of *Mahigritia* on the Texas coast suggests it used a coastal route to colonize New World lowland tropical rain forests and estuarine mangroves. *Notharctus* is known from the early Untian-age Lower Member of the Devil’s Graveyard Formation, but no notharctine primates are known from late Untian or Duchesnean strata of the DGF. *Mahigritia’s* presence in the late Untian Casa Blanca fauna and in the early Duchesnean Bandolera Member of the Devil’s Graveyard Formation, suggests that *Mahigritia* may have occupied the vacated adapid ecological niche of *Notharctus*.

Romer Prize Session, Monday 11:45

**EVOLUTION OF SALT-WATER TOLERANCE IN THE CROCODYLIA AND RELATED CROCODYLOMORPHS: NEW INSIGHTS FROM STABLE ISOTOPES**

WHEATLEY, Patrick, University of California, Santa Cruz, Santa Cruz, CA, USA

Nearly all populations of living crocodilians are limited to freshwater habitats. However, many extant crocodilians have demonstrated a physiological ability to tolerate and/or excrete excess salt derived from drinking saline water in laboratory experiments. These experiments indicate that crocodilians can tolerate higher salinity waters than many fresh-water fish. Oxygen and carbon isotopic compositions of modern crocodilians from freshwater to brackish and marine habitats indicate that crocodilians can tolerate salinities that vary by 2.5 times the salinity of modern oceans. Stable isotopic compositions of modern crocodilians range from δ18O values of ~3% in fresh waters to ~7.6% in marine environments. Furthermore, these data suggest that certain crocodilian species are more successful in fresh-water habitats than in marine environments. Stable isotopic compositions of modern crocodilians range from δ13C values of ~1.7% in fresh waters to ~0% in marine environments. These results have implications for our understanding of the evolution of salt-water tolerance in the crocodylians.

Poster Session IV, (Wednesday)

**WHO’S TRASH STASH? USING GEOMETRIC MORPHOMETRICS TO DIFFERENTIATE BETWEEN NEOTOMA MOLARS FOUND IN PALEOMIDDENS**

WHITLOCK, John, University of Michigan, Ann Arbor, MI, USA; D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA; FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA; SMITH, Kathryn, University of Michigan, Ann Arbor, MI, USA; WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA

Neotoma leave behind environmental records in the form of paleomiddens. These middens, found in dry caves, commonly contain plant macrofossils, fecal pellets, pollen, archeological debris, and skeletal material. The first steps in any analysis of these middens are to determine the size of the animal, which correlates well with environmental temperature. However, this method is only effective if we are confident what species created the midden. We use molars found in the middens in order to confirm our identification of species. In this study, we photographed *Neotoma* molars from the collections of the Smithsonian Institution National Museum of Natural History, Division of Mammals. We included 396 individuals from nine species of *Neotoma*, plus a sister species. We used both outline and landmark methods of geometric morphtometrics to discriminate between species in this data set. Disparate species, such as *N. cinerea* and *N. lepida*, are easily distinguished using only landmarks. However, as more species are considered, more detail is required to differentiate species. We used these criteria to identify molars found in middens from Death Valley, CA, and compare this to using size to distinguish between species.

Technical Session XIV, Wednesday 8:30

**TRENDS IN SAUROPOD TOOTH SIZE, SHAPE AND REPLACEMENT RATE**

WHEATLOCK, John, University of Michigan, Ann Arbor, MI, USA; D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA; FISHER, Daniel, University of Michigan, Ann Arbor, MI, USA; SMITH, Kathryn, University of Michigan, Ann Arbor, MI, USA; WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA

Sauropods evolved from small, bipedal omnivores (e.g., *Panphagia*). Over time these sauropods became more reliant on herbivory and achieved larger body sizes, eventually becoming obligate quadrupeds. With increase in body size and dietary shift came an increase in tooth wear, which reduced dental effectiveness. Sauropods responded to increased tooth wear by increasing crown volume and/or increasing tooth replacement rate. Here, we present data describing both responses and place them in a temporal and phylogeographic context. Replacement rate data are based on histological study when possible. In all other cases rate is approximated using a proxy, the height-corrected ratio (HCR), calculated as: (average height ratio of successive teeth in a family) * (1 cm / maximum tooth height in cm). Higher HCRs indicate less time between tooth formation events and correspond to faster replacement rates. Basal sauropodomorphs (e.g., *Plateosaurus*) had low-crowned, leaf-shaped teeth and one replacement tooth per family. Spatulate tooth crowns with greatly increased volumes (~5x that of *Plateosaurus*) evolved in basal sauropods (e.g., *Tazoudasaurus*), which were more resistant to wear but resulted in slower replacement (HCR ~0.2) in these taxa. Replacement rate first increased in more derived eusauropod taxa on the stem leading to Neosauropoda (e.g., *Mamenchisaurus*). These taxa possessed up to two replacement teeth per family and higher HCRs (~0.4). A second increase in replacement rate occurred in Late Jurassic neosauropods. These taxa (e.g., *Camarasaurus*, *Diplodocus*) are observed to have three or more replacement teeth per family, which were replaced at least every 62 days. Within Neosauropoda, at least two secondary reductions in crown volume occurred, in the clad *Diplodocoidae* and *Titanosauriformes*. This reduction in volume (~14%) that of spatulate crowns) was coupled with an increase in replacement rate in both instances (HCR 1.2×). Narrow-crowned taxa often have five or more replacement teeth per family, in diplodocids (e.g., *Diplodocus*), replacement occurred twice as fast (30–35 days) as in spatulate-crowned neosauropods.

Advances in Paleoecology: Geochemistry, Microwear and Beyond, Sunday 9:30

**DEFINING THE ECOLOGICAL NICHE OF PROBOSCIDEA AND BISON DURING THE LATE QUATERNARY THROUGH STABLE ISOTOPE ANALYSES (MIDWESTERN NORTH AMERICA)**

WIDGA, Chrs, Illinois State Museum, Springfield, IL, USA

Defining the ecological niche of megafaunal landscape elements is critical to understanding regional scale extinction processes during the terminal Pleistocene. Specifically, climate-induced changes in dietary niche overlap between competing herbivores or the seasonality of food resources could strongly affect the viability of stressed animal populations. This paper presents isotopic data (C, O, Sr) from Midwestern *Mammuthus*, *Mammut*, and *Bison* to understand patterns in late Pleistocene landscape-use of both extinct and surviving taxa. Serial enameled stable isotope samples of *Mammuthus jeffersonii* spanning the last glaciation, and *Bison* from terminal Pleistocene and Holocene contexts exhibit similarities in overall landscape-use. At an evolutionary time-scale both taxa exhibit a flexible niche structure that would better habit to rapid climate change events. Dietary niche breadth, as defined by variability in δ13C at multiple scales (e.g., annual, millennial), is similar between the two taxa. 87Sr/86Sr analyses also indicate limited seasonal mobility (~50 km) with somewhat larger inter-annual ranges in both species. Lastly, 18O values of bone collagen from Midwestern proboscideans show an increase in inter-taxonomic niche overlap after the last glacial maximum. Although preliminary, these results demonstrate the potential of isotopic research in furthering our understanding of late Quaternary landscapes and extinction processes.
The phylogenetic position of thalattosuchians (Crocodylomorpha) and the importance of outgroup choice
WILBERG, Eric, University of Iowa, Iowa City, IA, USA

Crocodyliform evolution spans over 200 million years and includes many major adaptive radiations. The evolutionary history of the group was traditionally based on development of the bony secondary palate through three evolutionary grades: “Protosuchia”-, “Meso- suchia”, and Euasuchia. The earliest phylogenetic analyses supported this progression with “proto- suchians” as the basal-most clade. The late Triassic sphenosuchians as sister to the crocodyliforms. One of the earliest occurring groups of “mososuchians”, Thalat- tosauia, was highly adapted to the marine environment. The phylogenetic relationships of this group are contentious—they are recovered in either a basal position or are nested high up in the tree. Thalattosuchians lack several crocodyliform apomorphies, but share several characters with highly derived forms sharing a similar ecological habit, suggesting their derived position may be more recent. A new analysis of broad taxonomic scope recovers the thalattosuchians as sister group to Crocodyliformes outside of the “proto- suchians” and all other crocodyliforms. These results suggest that rooting trees on a “proto- suchian”, as in previous analyses, may be obscuring basal relationships as well as affecting topology higher in the tree. When previously-published data sets are modified to include non-crocodyliform outgroup taxa, thalattosuchians move outside of Crocodyliformes or into a basal polytomy with the “proto- suchians”. This illustrates a case where analyses may have been constrained by prior assumptions. The relaxation of these assumptions allows for a more robust test of evolutionary relationships. If thalattosuchians are the sister group to the crocodyliforms, this brings into question traditionally accepted evolutionary scenarios for Crocodyliformes.

Romer Prize Session, Monday 12:00

OSTEOLOGICAL EVIDENCE FOR A TAIL FIN IN CRYPTOCLEIDOID PLEIOSAURS AND THE ROLE OF THE TAIL IN PLEISOSAUR LOCOMOTION
WILHELM, Benjamin, Marshall University, Huntington, WV, USA

The presence of a tail fin in plesiosaurs has been suggested for more than a century, but with little supporting evidence. Recent examination of two exceptionally well preserved caudal skeletons of the cryptoclidid plesiosaur Cryptoclidus eurymerus and Murenansaurus eodei has revealed a number of osteological features indicating that a tail fin was present in both taxa. These features include an increase in the height of the posterior caudal neural spines, with long and wide distal ends for articulation with cartilage. There is also a change in neural spine direction, resulting in a continuous surface for articulation of a large cartilagi- nous element. These cartilaginous extensions of the neural spines could have supported the soft tissues associated with a tail fin. Comparisons to the caudal region of thalattosuchians indicate that a change in neural spine direction is below the highest point of the tail fin, allowing some inference of shape in the plesiosaur fin. In addition to features indicating the presence of the fin, other vertebral features indicate the function of the tail during locomotion. Antero-posteriorly compressed centra with rounded ends and short caudal ribs at the base of the tail indicate increased flexibility in this region. Flexibility is also increased just before the start of the tail fin by the loss of interlocking syntyphyses. This pattern of flex- ibility is nearly identical to that seen in cetaceans that have two joints in the spine; one just below the dorsal fin and one anterior to the start of the tail fluke. An increase in caudal rib length between these two regions of flexibility in the plesiosaur is similar to the increase in chevron length between the two joints in whales. These long processes are muscle attach- ments in the plane of the direction of movement. Taken together, these data strongly suggest that the tail fin evolved, along with the limbs, in active thrust production during plesiosaur locomotion. This study is the first to document clear osteological evidence for a tail fin in plesiosaurs, and to infer its function via comparison to modern analogs.

Poster Session IV, (Wednesday)

APPENDICULAR JOINT RECONSTRUCTION IN SAUROPOD DINOSAURS BASED ON COMPUTED TOMOGRAPHY OF A MAMMAL, A BIRD AND A CROCODILIAN
WILHITE, Ray, Auburn College of Veterinary Medicine, Auburn, AL, USA; BONNAN, Matthew, Western Illinois University, Macomb, IL, USA; SANDERS, Richard, University of Utah, Salt Lake City, UT, USA

The exact nature of the joint surfaces in extinct archosaurs cannot be precisely measured due to the loss of articular and epiphyseal cartilage during fossilization. However, possible modern analogs can be examined and measurements used to generate theoretical joint mor- phologies. In this study, a preserved adult domestic cat (Felis catus), freshly deceased adult chicken (Gallus gallus), and a living sub-adult alligator (Alligator mississippiensis) were scanned at high resolution using computed tomography. Three-dimensional models of the in situ joint surfaces were rendered to examine the distances between the ossified portions of the appendicular joint surfaces. The relative distance between ossified joint surfaces was used to generate three possible appendicular joint configurations for the North American Upper Jurassic sauropod, Apatosaurus. Felis catus was used to show a “best case” scenario for joint articulation as the joints of mammals have limited articular cartilage over an ossi- fied epiphysis. The bird analog yielded similar results to the mammal analog, with limited space for cartilage between the closest joint surfaces allowing for a good approximation of the range of motion of the appendicular joints. Conversely, the crocodilian model results in a large space between the ossified joint surfaces and, therefore, greater uncertainty regarding the range of motion in the limbs. As a sub-adult alligator was scanned for this study, adult specimens of deceased alligators were also examined and showed a similar large space be- tween ossified joint surfaces. The vast differences in appendicular joint reconstructions based on these extant taxa shows the importance of choosing the best extant analog when recon- structing fossil archosaur appendicular joints. Further comparison between the ossified joint surfaces of birds and crocodilians with those of sauropods is necessary to determine which, if any, of these models best approximates those of a non-avian dinosaur.

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Poster Session III, (Tuesday)

A NEW JUVENILE TYRANNOSAURUS AND A REASSESSMENT OF ONTOGENETIC AND PHYLOGENETIC CHANGES IN TYRANNOSAURAOID FORELIMB PROPORTIONS
WILLIAMS, Scott, Burke Museum of Natural History, Rockford, IL, USA; BRUSATTE, Stephen , American Museum of Natural History, New York, NY, USA; MATHEWS, Joshua, Augustana College, Rock Island, IL, USA; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada

Tyrannosaurid theropods, including Tyrannosaurus and its closest relatives, are characterized by abnormally atrophied forelimbs. Little is known, however, about the evolution of this unusual feature, or whether small forelimbs were present throughout ontogeny or only in large-bodied adults. A new specimen of a juvenile Tyrannosaurus from the latest Maastrichtian Hell Creek Formation of Carter County, Montana helps address these questions. The partial associated skeleton is comprised of dorsal vertebrae, ribs, gastral, front limb (scapu- locoracoid, humerus, ulna, manual unguals) and hindlimb bones (femur, tibia, fibula, pedal ungual). Derived characters support referral to Tyrannosauridae (most likely Tyrannosaurus) and histological examination indicates that the specimen was a juvenile when it died. Most notably, several features of the forelimb show marked differences with adult tyrannosaurs. The humerus is longer in relation to the femur and more gracile when compared to adults, and has a slender, blade-like deliptopectoral crest. The manual unguals, which include the first relatively complete second ungual described for Tyrannosaurus, are enormous. The large hu- merus and unguals indicate that the entire forelimb was relatively longer than in adults, demon- strating that forelimb proportions exhibited negative allometry during ontogeny. Juveniles, therefore, had larger forelimbs than adults, and the ontogenetic development of atrophied forelimbs occurred in concert with the development of the large, deep, and robust adult skull optimized for strong bite forces. This indicates a behavioral and dietary shift during ontoge- ny, which has not previously been documented in Tyrannosaurus. A similar trend of forelimb reduction is also seen in tyrannosauroid phylogeny. Small-bodied and gracile basal tyran- nosaurids, such as Guaunlong and Dilong, possess large arms and hands. Forelimb material is poorly known for most tyrannosaurooids intermediate between basal forms and derived tyrannosaurs, but one such taxon, Dryptosaurus, has a small humerus but enormous hands, indicating that the proximal limb was reduced first in tyrannosauroid evolution.

Poster Session II, (Monday)

PHYLOGENY OF CRETACEOUS-PALEOCENE METATHERIANS: IMPLICATIONS FOR THE METATHERIAN RADIATION AND SURVIVORSHIP OF LINEAGES ACROSS THE K/PG BOUNDARY
WILLIAMSON, Thomas, New Mexico Museum of Natural History and Science, Albuquerque, NM, USA; BRUSATTE, Stephen, Columbia University, New York, NY, USA; WEIL, Anne, Oklahoma State University Center for Health Sciences, Tulsa, OK, USA

Metatheria experienced a major radiation in North America during the Late Cretaceous but endured a pronounced extinction at the Cretaceous – Paleogene boundary. The pattern of this radiation is poorly understood, but crucial for understanding the origin of Paleogene metatherians and crown group Marsupialia. As a first step to understanding the metatherian radiation and survivorship patterns across the K-Pg, it is necessary to have a robust phylog- eny. We conducted a parsimony analysis based on a broad sample of North American, South American, and European Cretaceous and Paleogene metatherians scored for 83 dental charac- ters. The presence of multiple clades that contain both Cretaceous and Paleogene metath- erian taxa indicate that several metatherian clades successfully crossed the K-Pg boundary. Although previous workers have suggested that only two major metatherian clades were present in the early Paleogene of North America (Peradectidae and Herpotheriidae) our analysis suggests the presence of a third major group composed of Thylacodon and Swan- delphys. This analysis also indicates that the Late Cretaceous, European Maustrichtidelphys is closely allied with the "didelphoids" Pseudadelphus and Salandia rather than herpetotheriids. A close relationship is also supported between the latest Cretaceous Gladishia of North America and the early Paleocene Roberthoffstetteria of South America. Our results do not support a close relationship of Nortodelphys and Herpotheriidae. Peradectids, and therefore also presumably crown clade Marsupialia, are not known with certainty prior to the Paleo- cene. However, the lack of an obvious Cretaceous sister taxon to Paleogene metatherian taxa in western North America suggests that earliest Paleocene metatherians (“Peradectes,” Thylacodon) originated elsewhere.
MAMMALIAN EXTINCTION, SURVIVAL, AND RECOVERY DYNAMICS ALONG THE CRETACEOUS-PALÉOGENE BOUNDARY IN NORTHEASTERN MONTANA

WILSON, Gregory, University of Washington, Seattle, WA, USA

The Cretaceous-Palæogene (K-Pg) interval was arguably the most critical transition in mammalian evolution. The well-documented and temporally-constrained succession of vertebrate microfossil localities from the Hell Creek Formation and Tullahoma Member of the Fort Union Formation of Garfield County, northeastern Montana, provides a ~3.2-yr window into this interval. Using an extensive database of 4,769 mammalian specimens from the study area, I quantified high-resolution temporal patterns of taxonomic diversity and community structure that shed light on (i) the last ~1.9 myr of the Cretaceous; (ii) the K-Pg extinction and survival; and (iii) the Early Palæocene recovery and radiation of placentalts. Mammalian communities remained relatively stable for most of the last ~1.9 myr of the Cretaceous, but the ecological abundance of metatherians and evenness of mammalian faunas from the Deccan Traps began declining ~500-600 ky before the K-Pg event. The ecological instability inferred from these changes may foreshadow the local extinction of 75% of species at or near the K-Pg boundary. The Pu1 survival fauna, from the first ~100-200 ky of the Palæocene, is characterized by low species richness, a few locally-derived “blooming taxa”, and an influx of immigrants. The species-rich Pu2-3 fauna implies mammalian recovery occurred within ~600-700 ky after the K-Pg event. The Pu2-3 and To1 faunas document the beginning of the radiation of placentals as the waning of “blooming taxa” and mulitituberculatates, an increasing richness and abundance of “archaic ungulates” and primates, and the first appearances of other placental groups that expand the taxonomic and ecomorphological diversity of mammalian faunas.

Technical Session XIV, Wednesday 9:00

A NOMENCLATURE FOR VERTEBRAL FOSSAE IN SAUROPODS AND OTHER SAURISCHIAN DINOSAURS

WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, USA; D’EMIC, Michael, University of Michigan, Ann Arbor, MI, USA; IKEJIRI, Takehito, University of Michigan, Ann Arbor, MI, USA; MOACDIEH, Emile, University of Michigan, Ann Arbor, MI, USA; WHITLOCK, John, University of Michigan, Ann Arbor, MI, USA

The vertebrae and ribs of extinct saurischian dinosaurs (e.g., theropods, sauropods, prosauropods), like living birds, were pneumatized by epithelial outpocketings of the respiratory system. Pneumatic signatures in the vertebra column of fossil saurischians include complex branching chambers within the bone (internal pneumaticity) and large chambers visible externally that are bounded by neural arch laminae (external pneumaticity). Although general aspects of internal pneumaticity are synapomorphic for saurischian subgroups, the individual internal pneumatic spaces cannot be homologized across species or even along the vertebral column, due to their variability and absence of topographical landmarks. External pneumatic structures, in contrast, are defined by ready topological landmarks (vertebral laminae), but no comprehensive nomenclatural system exists that is flexible enough to accommodate a wide variety of morphologies and taxa. This deficiency has fostered confusion and precluded use of these character data in phylogenetic analysis. We present a simple system for naming external pneumatic fossae that parallels the one developed for the vertebral laminae that bound them. The nomenclatural system identifies pneumatic fossae by pointing to reference landmarks (e.g., neural spine, centrum, costal articulations, zygapophyses). We standardize the naming process by creating tripartite names from “primary landmarks”, which form the zygo-diaphyseal table, “secondary landmarks”, which orient with respect to that table, and “tertiary landmarks” that delinate a given pneumatic fossa. The proposed nomenclatural system for lamina-bound pneumatic fossae adds clarity to descriptions of otherwise complex vertebral and allows these structures to be sourced as character data for phylogenetic analyses. These anatomical terms denote homologous pneumatic structures within Saurischia, but they could be applied to any vertebrate with vertebral laminae that enclose spaces, regardless of their developmental origin or phylogenetic distribution.

Technical Session X, Tuesday 11:45

NEUROANATOMY, SKULL MORPHOLOGY AND THEIR BEHAVIORAL IMPLICATIONS FOR THE REMARKABLE, RECENTLY EXTINCT “PLATYPUS-DUCK” TALPANAS LIPP(AVES: ANSERIFORMES) FROM KAUAI, HAWAII

WITMER, Lawrence, Ohio University, Athens, OH, USA; RIDGELY, Ryan, Ohio University, Athens, OH, USA; JAMES, Helen, National Museum of Natural History, Washington, DC, USA; OLSON, Storns, National Museum of Natural History, Washington, DC, USA; IWANIUK, Andrew, University of Lethbridge, Lethbridge, AB, Canada

Divergent evolution of island birds is well documented, and Talpans lippa, from ~5400-year-old lake deposits in Kauai, may be among the strangest cases. Talpans has synapomorphies of Anasite and potentially oxyurines. Postcranial bones indicate that Talpans was probably flightless and terrestrial. We microCT scanned the preserved skull elements followed by 3D visualization of the brain endocranial and inner ear. We also microCT scanned heads of other ducks (Anas, Mergus, Oxyura), as well as those of potential analogs (kiwi, platypus), and generated brain cast, inner ear, eyeball, and skull models. The neuro-anatomy of Talpans was like that of no other known bird. The visual system was extraordinarily reduced, as evidenced by the small optic nerves and the almost indiscernible optic lobes, which, consistent with the small eyeball size as judged by orbital osteology, suggest that Talpans was not very reliant on sight. Kiwis (Apteryx) also have very reduced visual systems, but not to the extent seen in Talpans. Kiwis, on the other hand, have dramatically expanded the olfactory apparatus, but, in Talpans, the olfactory bulbs were unexpanded and comparable to those of other anatids. Without question, the major sensory modality used by Talpans was the somatosensory (touch) system, as shown by the unparalleled expansion of the trigeminal system. Kiwis and, to a lesser extent, oxyurines have enlarged trigeminal ganglia, but in Talpans they were enormous, dominating the ventral aspect of the brain cast and excavating the skull internally and externally. Perhaps a better extant analog for Talpans is the platypus (Ornithorhynchus), which likewise has reduced vision, moderate olfaction, and is a somatosensory specialist with an expanded trigeminal system. The palate and braincase indicate that Talpans had a broad low bill that was richly supplied with tactile nerve endings. Muscle scars and mandibular differences may signal a feeding apparatus that also diverged from its duck heritage. The picture of Talpans that emerges is of a very different duck: a flightless, weakly-sighted, nocturnal animal foraging with its broad sensate bill in the moist underbrush of Kauai.
ARCHAEOPTERYX CHEMISTRY REVEALED VIA SYNCHRONOTH RAPID SCANNING X-RAY FLUORESCENCE

WOEGELIUS, Roy, University of Manchester, Manchester, United Kingdom; BERGMANN, Uwe, Stanford Linear Accelerator Laboratory, Menlo Park, CA, USA; SELLERS, William, University of Manchester, Manchester, United Kingdom; LARSON, Peter, Black Hills Institute of Geological Research, Hill City, SD, USA; MANNING, Phillip, University of Manchester, Manchester, United Kingdom.

No detailed chemical analysis has ever been completed on any fossil of Archaeopteryx, despite its iconic status in the field of vertebrate paleontology. Ideally such analysis would measure and map the chemistry of bone, soft tissue structures, and the embedding rock matrix. Mapping the fossil in situ would place constraints on mass transfer between the limestone and the preserved specimen, and therefore aid in distinguishing taphonomic processes from original chemical zonation remnant from the Archaeopteryx itself. Conventional non-destructive chemical methods such as XRF and most modern techniques have been targeted at developing nanometer-scale rather than decimeter-scale capabilities. However, the recent development of Synchronochron Rapid Scanning X-ray Fluorescence (SRS-XRF) at the Stanford Synchronochron Radiation Lightsource (SSRL) now allows large paleontological specimens to be non-destructively analyzed and imaged using major, minor, and trace element concentrations. Here we present high-resolution maps covering an entire Archaeopteryx specimen (Thermopolis), along with large sections of the limestone matrix for Si, P, S, Cl, Ca, Ba, Mn, Fe, Zn, Cu, Br, and Pb. As a complement to the maps, spatially resolved point analyses provide quantitative results and have been used to convert mapped intensities to concentrations. Our results unequivocally show that the feathers in this Archaeopteryx specimen are not simply impressions. Several rachis are clearly visible in maps of both phosphorus and sulfur; thus, indicating that feather chemistry has been partially preserved. Furthermore, zinc and copper levels in the bone are similar to concentrations in extant avian species. We therefore conclude that part of the original bone composition is preserved in these critical macronutrients. Curation artefacts have also been resolved. Supplementary X-ray absorption spectroscopy showed that sulfur in the bone is dominantly present as fully oxidized sulfate. These results indicate that SRS-XRF provides a powerful new tool for the study of ancient life.

A NEW VARANOPID SYNAPSID FROM THE LOWER PERMIAN OF OKLAHOMA, WITH EVIDENCE OF HYPERCARNIVORY

WONG KAI, University of Toronto Mississauga, Mississauga, ON, Canada; REISZ, Robert, University of Toronto Mississauga, Mississauga, ON, Canada; MAY, William, Sam Noble Oklahoma Museum of Natural History, Norman, OK, USA.

Varanopids, a long-lived clade of Paleozoic synapsids, includes small to medium sized species ranging from 30 cm to more than 2 m in total length. Recent studies of several anomiotes that were once considered to be diapsid reptiles have shown them to be varanopids, increasing dramatically the temporal range of this clade and its taxonomic diversity. Varanopids are now known from various parts of the world, including Russia, Europe and South Africa, and known to extend from the Late Pennsylvanian to the Middle Permian. Previous studies of this clade have suffered from a paucity of specimens, with most of the smaller, basal taxa being known only from single partial skeletons, resulting in a poor understanding of their cranial anatomy and phylogenetic relationships. The well-known Lower Permian fissure fossil of the Dolese Brothers Limestone Quarry in Oklahoma are well known for the excellent preservation of terrestrial tetrapods, including numerous taxa of temnospondyly and lepospondyl tetrapods as well as euryapsid archosaurs. The known diversity is now augmented by the discovery of small Varanopidae in addition to the Dolese Brothers Quarry, a discovery that fills at the Dolese Brothers Limestone Quarry in Oklahoma are well known for the excellent preservation of terrestrial tetrapods, including numerous taxa of temnospondyly and lepospondyl tetrapods as well as euryapsid archosaurs. The known diversity is now augmented by the discovery of small Varanopidae in addition to the Dolese Brothers Quarry, a discovery that fills at the Dolese Brothers Limestone Quarry in Oklahoma are well known for the excellent preservation of terrestrial tetrapods, including numerous taxa of temnospondyly and lepospondyl tetrapods as well as euryapsid archosaurs. The known diversity is now augmented by the discovery of small Varanopidae in addition to the Dolese Brothers Quarry, a discovery that fills...
genetic reanalysis of sauropod clades where neural spine bifurcation is a critical synapomorphy, particularly when data is derived from small individuals.

Technical Session III, Sunday 3:00

**DISPARITY AND EVOLUTIONARY NOVELTY IN TWO PALEOGENE PRIMATE RADIATIONS**

WOODRUFF, Emily, University of Bristol, Bristol, United Kingdom; RUTA, Marcello, University of Bristol, Bristol, United Kingdom; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; BENTON, Michael, University of Bristol, Bristol, United Kingdom

Primates, including extant lemurs, monkeys, apes, and humans encompass many diverse forms. A unique suite of features including a large brain, well-developed stereoscopic vision, and arboreal locomotion characterize the order but the rate and timing of the evolution of these features is uncertain. Understanding the relationship between taxonomic diversity and morphological disparity of fossil primates may help explain the biodiversity in modern primate clades. Forty-six species of euth values in the outer cortex. This is the first report of an EFS in crocodylians and thus adds to existing knowledge in the field.

Technical Session VII, Monday 2:00

**CRETACEOUS CHORISTODERAN REPTILES GAVE BIRTH TO LIVING YOUNG**

WU, Xiao-chun, Canadian Museum of Nature, Ottawa, ON, Canada; JI, Qiang, Institute of Geology, Beijing, China; CHENG, Yen-nien, National Museum of Natural Science, Taichung, China

Choristodera is a lineage of semi-aquatic diapsid reptiles, with a fossil record from the Middle Jurassic, or ambiguously the Late Triassic, to the early Miocene. The crocodile-like Choristoderans are the best known of choristoderans and typify the group. Recently, two long-necked and aquatic choristoderan genera (Hypalosaurus and Shikawa) were described from the Lower Cretaceous of China and Japan. Since Champsosaurus (the first known choristodier) was described, all known choristoderan reptiles are thought to have lived in freshwater ecosystems. As reptiles, all choristoderans may have retained oviparity, laying eggs in the manner of turtles, crocodiles, and dinosaurs. However, clues have been found as to the reproductive habits of the group until the relatively recent discovery of the second species of Hypalosaurus, Hypalosaurus baijiaguensis from China.

H. baijiaguensis is known from thousands of specimens. It was originally established on the basis of a skeleton with 11 associated eggs of which show embryos. Later others suggested possible viviparity in H. baijiaguensis but had no firm evidence to support the view. In the summer of 2007, another skeleton of H. baijiaguensis was collected from the Lower Cretaceous Jiufotang Formation in the same area where the holotype of the species was discovered. It is an exceptional specimen, not only due to its well-preserved nature but also that it carries up to 18 embryos arranged in pairs. Size comparison with small free-living individuals and the straight posture of the posterior-most pair suggest that these embryos were at term and probably reached parturition. This remarkable specimen is very significant because: 1) it provides the first firm evidence to elucidate the reproductive pattern of the long-necked Hypalosaurus; 2) it reveals a new fossil group of reptiles with viviparous capability; and 3) the new species represents the first reptilian group to have evolved viviparity within a freshwater ecosystem. Viviparity is a practical mode of reproduction, which may have facilitated the aquatic or semi-aquatic radiation of choristoderan reptiles.

Technical Session XII, Tuesday 3:45

**OSTEOHISTOLOGICAL ANALYSIS OF ALLIGATOR MISSISSIPPIENSIS INDICATES ABSENCE OF FIBROLAMELLAR BONE IN CROCODILIANS AND CONFIRMS DETERMINATE GROWTH WITH FIRST REPORT OF EXTERNAL FUNDAMENTAL SYSTEMS; IMPLICATIONS FOR TETRAPOD OSTEOHISTOLOGY**

WOODWARD, Holly, Montana State Univ Museum of the Rockies, Bozeman, MT, USA; HORNER, John, Montana State Univ Museum of the Rockies, Bozeman, MT, USA

Two common assumptions about alligators are that on occasion they deposit fibrolamellar bone tissue, and that their growth is indeterminate. Thin sections from skeletal elements of 80 alligators, both captive and wild, were examined for the presence of fibrolamellar tissue. In many cases samples displayed the lamellated pattern typical of crocodilians. However, tissues from some samples resembled those described elsewhere for alligators as fibrolamellar. These were compared with examples of fibrolamellar tissue from extant endotherms and non-avian dinosaurs demonstrating that the loosely parallel collagen fibers from the alligator tissue referred to as fibrolamellar lack the disorganized woven nature of fibrolamellar collagen fibers as well as the typical osteocyte arrangement within the lamellae of primary osteons. In addition, a subset of adults from the larger sample of 80 alligators, both captive and wild and of various ontogenetic status, were examined for the presence of determinate growth. In addition, a subset of adults from the larger sample of 80 alligators, both captive and wild and of various ontogenetic status, were examined for the presence of determinate growth.

Technical Session XII, Tuesday 3:45

**POSTER SESSION II**

**TAXONOMIC REVISION OF FUKANGICHITHYS (ACTINOPTERYGI) SCANILEPIFORMES) FROM THE MIDDLE TRIASSIC OF XINJIANG, CHINA**

FU, Rong, Institute of Vertebrate Paleontology and Palaeoanthropology, CAS, Beijing, China; GAO, Ke-Qin, School of Earth and Space Sciences, Peking University, Beijing, China

Characterized by a long-based dorsal fin and other associated features, the Scanilepiformes are an extinct group of the Actinopterygii confined in the Triassic. They mainly inhabited freshwater ecosystems of northern continents except a Late Triassic genus (Scanilepis) from the marine deposits of Scania, Sweden. Although relatively abundant, most of this group has not been well studied. Fukangichthys is the first scanilepiform described from the Middle Triassic of China, and it has remained a special problematic taxon with serious anatomical uncertainties since its original publication in 1978. The previous poor knowledge of this taxon led some researchers to question its assignment to the Scanilepiformes, but this assertion is not supported by our recent studies. A lot of anatomical characters that were undescribed or misidentified previously are revealed during our restudy of Fukangichthys. A new reconstruction is provided and its diagnosis is thoroughly revised. This study confirms that Fukangichthys is a scanilepiform rather than a paracanthus. Implicated from the form-function correlation of extant actinopterygians, the Scanilepiformes are supposed to have a good performance in precise maneuvering and low-speed stabilizing by a rhythmic undulation of their long-based dorsal fin which probably functions as a discrete thrust-generating propulsor independently from the body.

Edwin H. and Margaret M. Colbert Poster Prize Competition (Monday)

**CHARACTER WINNOWING: A NEW CHARACTER SELECTION PROTOCOL BASED ON PHYLOGENETIC SIGNAL**

WORTHINGTON, Steven, New York University and New York Consortium in Evolutionary Primatology, New York, NY, USA

Phenotypic characters are the product of a complex interface of functional, phylogenetic and developmental processes. As a result, many of these traits carry mixed ‘signals’ that increase the degree of ‘noise’ in phylogenetic inference. One of the main goals of morphology-based systematics is to increase the signal to noise ratio in character matrices. A new method of achieving this is presented here, based on selecting characters according to their phylogenetic signal for a group of taxa. Metric data on 100 morphological characters were collected for 60 taxa including an anthropoid primate, several prosimians and marsupials. Our method is based on the property to recover phylogenetic information (topology and branch lengths) independently inferred from molecular data. Ranks were derived from maximum likelihood and parsimony-based null models (using the software R, Matlab and Mesquite), representing hypotheses of no phylogenetic signal in each character for the sampled taxa. Characters deemed to exhibit high-signal levels were then used preferentially in tree inference. Character matrices constructed from only highly-ranked traits performed significantly better than those composed of all traits. Preferentially selecting characters that are conserved over a phylogeny provides an effective means of winnowing a set of characters. Excluding traits that reflect more proximate influences demonstrably improves the resolution of tree inference (the most parsimonious trees have shorter lengths and greater support). This new technique can be applied to any taxonomic group for which there is a robust molecular-based tree. Although signal is measured for groups comprising only extant taxa, the method can be employed to identify primate clades with the potential to recover the phylogeny of closely related fossil forms. The technique should be of wide utility in phylogenetic systematics, since winnowed character matrices will likely exhibit a better signal to noise ratio for any sample of taxa.

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RARE EARTH ELEMENTS AS AN INVESTIGATIVE TOOL INTO THE SOURCE, AGE AND ECOLOGY OF LATE MIOCENE TO LATE PLEISTOCENE FOSSILS FROM THE TUNICA HILLS, LOUISIANA

YANN, Lindsey, Louisiana State University, Baton Rouge, LA, USA; SCHIEBOUT, Judith, Louisiana State University, Baton Rouge, LA, USA

RARE earth elements were investigated for the potential to determine provenance and depositional environments of float vertebrate fossils from creeks in the Tunica Hills region of Louisiana. The rare earth element analysis was used to test the hypotheses that fossils span multiple time periods, from late Miocene to late Pleistocene and that elemental profiles can distinguish terrestrial depositional settings from possible estuarine deposits. The fossils present were used to test the hypothesis that the Tunica Hills had environmental conditions much like the modern Great Lake region in the late Pleistocene. Bone and tooth dentine replace calcium with similar-sized rare earth elements very quickly (10,000-30,000 years) and the signature is largely altered by in situ natural diagenetic effects. The change in source of sediment supply from the Tennessee River, a postulated source during the Miocene, to the average Midwest continental signature, during the late Pleistocene, would have affected the overall rare earth element compositions available during fossilization. The loess material may not have been in the ground long enough to complete the uptake of REE, which would have an influence on the profiles seen. The 38 fossils analyzed from the Pascagoula Formation, Peoria Loess and intermediate beds included horses, mastodons, ground sloths, a rhinoceros, a large feld, a giant armadillo, and a grousse. The first occurrence of Synodontosaurus in Louisiana is represented in the analyzed fossil samples. Cluster analysis separated in situ fossils from loess deposits based on the old Pascagoula Formation based on rare earth element profiles. The results on lithologically diverse and stratigraphically complex intermediate deposits, including reworked Citronelle Formation, are less clear, and shell material and nodules analyzed were not useful for stratigraphic control. In situ samples from the Pascagoula Formation support an estuarine depositional environment in the Tunica Hills during the late Miocene or early Pliocene. Rare earth element analysis shows promise, and needs to be applied to more sites, and fossils, within the Gulf Coast region, to help unravel its history.

NEW, POSSIBLY RELICTUAL, BASAL SAUROPODOMORPH DINOSAUR FROM THE EARLY JURASSIC OF SOUTH AFRICA

YATES, Adam, BPI, University of the Witwatersrand, Johannesburg, South Africa; BONNAN, Matthew, Western Illinois University, Macomb, IL, USA; NEVELING, Johann, Council for Geoscience, Tswana, South Africa

A new basal sauropodomorph dinosaur is described on the basis of a partial, disarticulated but associated skull and dispersed cranial and postcranial elements from at least two individuals. The new taxon is part of a distinctive local fauna from the upper Elliot Formation (Lower Jurassic) in the Senekal District, Free State, South Africa. It can be diagnosed by various details of the premaxilla, nasal, dentary and distal caudal vertebral. The taxon displays an unusual mix of characteristics. It lacks several synapomorphies of Plateosauria (Plateosaurus + Massospondylus and all descendants of the most recent common ancestor) but does display other derived characteristics that are otherwise known only from less inclusive clades within Plateosaurus. In a cladistic analysis a position outside the clade of Efraasia + more derived sauropodomorphs (including Plateosaurus) is supported, however this position was not found to be significantly better explanation of the data than a relatively basal position within Archosauria. If the basal position for the new taxon is accepted then a divergence from other sauropodomorphs in the middle Norian and a ghost lineage up to 35 ma is implied. No other non-plateosaurian sauropodomorphs are known from the Jurassic, making the new taxon a potentially relictual taxon in the Early Jurassic.

NEW MATERIALS OF ESTESIA MONGOLENISIS (REPTILIA: SQUMATA) FROM THE LATE CRETACEOUS OF MONGOLIA CAST DOUBT ON THE MONOPHYLY OF THE MONSTERSAURIA

YI, Hong-yu, American Museum of Natural History, New York, NY, USA; NOREL, Mark, American Museum of Natural History, New York, NY, USA

Estesia mongoliensis was the earliest Asian record of the Monstersauria, a lizard clade whose common groups are the only living lizards with venom delivering apparatus (Heterodermia). Fossil monstersaurans date back to the Early Cretaceous, and they were distributed in North America, Europe, and Asia. First discovered from the Late Cretaceous of Mongolia, Estesia was reported to be related to varanid lizards, but was later assigned to the Monstersauria. We report a new nearly-undistorted skull and a partial axial skeleton of Estesia from Ukkha Tolgod of Mongolia, which reveals three new diagnostic characters of the species: lateral projections at the base of the nasal process of the premaxilla, “venom groove” appearing at the posterior surface of marginal teeth instead of the anterior surface as in Heterodermia, and the presence of longitudinal striation on the labial surface of dentinal teeth forming a sharp cutting edge with the “venom groove”. Phylogenetic analysis of Estesia in the Plateovar was based on a matrix of all monstersaurans species and 27 other major platanotan taxa coded with 389 morphological characters. The strict consensus of 35 most parsimonious trees placed Estesia as the most basal varaniform (squamates sharing a more recent common ancestor with Varanus varius than with H. suspectum or Mosasaurus hoffmanni) based on the following synapomorphies: forking of the medial surface of postfrontal-postorbitals, and the elongated nasal process of the premaxilla that is about two-thirds of the length of the nares. The new phylogeny rejects a monophyletic “Monstersauria” because of the polytomy between three species of Heloderma (Miocene – recent, North America), Loewesaurus (Oligocene – Miocene, North America), and Eurhododerma (Eocene/Oligocene of Europe), and varaniforms. The polytomy of “monstersaurans” are primarily due to a large amount of missing data in highly incomplete fossil taxa, which demands further analysis and future discovery of fossils. Consequently, we provisionally retain the definition of the “Monstersauria” as “squamates sharing a more recent common ancestor with H. horridium than with Varanus varius”, but we exclude Estesia from the group.

CRANIAN OF A NEW OLGOCENE PRIMATE FROM SAUDI ARABIA AND THE DIVERGENCE OF APES AND OLD WORLD MONKEYS

ZALMOUT, Iyad, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA; ALL, Mohammed, Saudi Geological Survey, Jeddah, Saudi Arabia; MACLATCHY, Laura, University of Michigan, Department of Anthropology, Ann Arbor, MI, USA; SANDERS, William, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA; GIERINGER, Philip, University of Michigan, Museum of Paleontology, Ann Arbor, MI, USA

A partial cranium of a new, medium-sized catarhine was recently recovered by a Saudi Geological Survey-University of Michigan expedition, from the middle unit of the Shumaysi Formation at Harrat Al Uyayfa, Al Hijaz Province, western Saudi Arabia. Radiometric dating of intrusive volcanic dykes and basaltic covering the top of the Shumaysi Formation indicates that the geological age of this new primate predates the Miocene. Biochronological correlation of associated terrestrial mammals (paenungulates and anthracotheres) refines the age of the middle Shumaysi Formation and the new primate to 29-28 Ma. The new species possesses substantial facial, palatal, and dental morphology, predominantly resembling male crania of the propelopithecoid Aegyptopithecus, with very broad molars, low hafting of the molar occlusal facet, and a postcanine that is elongated and moderately low crowned. The presence of reproductive colonies in the basement islands proposed in paleoenvironmental reconstructions of the “bonobed” genesis, but in a deep sea environment as suggested by independent bimatric data. It is also possible that the presence of reproductive colonies in the basement islands proposed in paleoenvironmental reconstructions of the area could explain the high number of fossil primate species.

DIVERGENCE OF APES AND OLD WORLD MONKEYS

SCHNITZER, Michael, American Museum of Natural History, New York, NY, USA; SCHIEBOUT, Judith, American Museum of Natural History, New York, NY, USA; HANNAN, Matthew, Western Illinois University, Macomb, IL, USA; NOREL, Mark, American Museum of Natural History, New York, NY, USA

Our results indicate that the last common ancestor of these catarrhines had a long, projecting face on the neurocranium, snout-like midfacial projection, and a frontal trigon. It lacks the male crania of the propliopithecoid Pachyptila (Miocene – recent, North America), but associated skull and dispersed cranial and postcranial elements from at least two individuals. The new taxon is part of a distinctive local fauna from the upper Elliot Formation (Lower Jurassic) in the Senekal District, Free State, South Africa. It can be diagnosed by various details of the premaxilla, nasal, dentary and distal caudal vertebral. The taxon displays an unusual mix of characteristics. It lacks several synapomorphies of Plateosauria (Plateosaurus + Massospondylus and all descendants of the most recent common ancestor) but does display other derived characteristics that are otherwise known only from less inclusive clades within Plateosaurus. In a cladistic analysis a position outside the clade of Efraasia + more derived sauropodomorphs (including Plateosaurus) is supported, however this position was not found to be a significantly better explanation of the data than a relatively basal position within Archosauria. If the basal position for the new taxon is accepted then a divergence from other sauropodomorphs in the middle Norian and a ghost lineage up to 35 ma is implied. No other non-plateosaurian sauropodomorphs are known from the Jurassic, making the new taxon a potentially relictual taxon in the Early Jurassic.
ICHTHYOSAURS OF AUSTRALASIA: A REVIEW OF DIVERSITY AND DISTRIBUTION
ZAMMIT, Maria, University of Adelaide, Adelaide, Australia

Ichnthysaurs have a worldwide distribution, but the remains from Australasia are poorly known when compared to their European and North American counterparts. To date, most studies have reviewed ichthysaurs remains from individual countries only, rather than discussing the region as a whole, resulting in many specimens remaining largely unknown outside their country of origin. Four countries in Australasia have produced ichthysaur fossils – Australia, New Caledonia, New Zealand, and Timor – with finds occurring throughout the known stratigraphical range of this marine reptile group. In New Zealand, ichthysaurs have been recorded mainly from Triassic and Cretaceous deposits, although a new specimen is here reported from the Jurassic. In contrast, documented discoveries from Timor and New Caledonia are of Triassic age, and Australia has so far yielded only Cretaceous material. Several specimens exhibit diagnostic features that allow three genera to be identified: Shonisaurus from New Caledonia, Mississaurus from Timor, and Platypterygius from Australia and New Zealand. All three genera have been recorded from deposits worldwide. The Australian fossils are the only ones specifically identifiable and represent a single apparently endemic species, Platypterygius australis.

Poster Session III, (Tuesday)
QUANTITATIVE ANALYSIS OF HERBIVOROUS ECOMORPHOLOGY IN THEROPOD DINOSAURS: PATTERNS OF CHARACTER CORRELATION AND PROGRESSION
ZANNO, Lindsay, The Field Museum, Chicago, IL, USA; MAKOVICKY, Peter, The Field Museum, Chicago, IL, USA

Trophic interpretations of extinct taxa are generally derived from observing suites of skeletal traits with analogues in living species. Whereas in some instances this approach is based on explicit comparisons, in others – particularly, fossil taxa spanning an inferred trophic shift, utilizing diverse dietary resources, or possessing ambiguous or novel features – such analogues are too indefinite to apply. One group for which diet is particularly problematic to interpret is Coelurosauria; an extraordinarily diverse clade of feathered theropods encompassing modern birds and several closely related lineages. Although a recent increase in the morphological disparity of the clade has sparked a renewed interest in their ecology, to date, interpretations of coelurosaurian herbivory are still founded on analogous models. Here we use three character correlation techniques within a phylogenetic framework to investigate whether skeletal traits purported to indicate an herbivorous diet in theropods based on anologous models (PHI) correlate with extrinsic evidence of herbivory (EEH) such as stomach contents and gastroliths in clade members. Our results identify 21 craniodental, axial, and pelvic features that exhibit statistically significant correlation with EEH (p-value < 0.05) on multiple tree topologies. Such PHI clusters form the first quantitative, extrinsically founded proxy for identifying herbivorous ecomorphology in theropods and are robust despite uncertainty in phylogenetic relationships among major subclades. We further apply rank-based correspondence analyses to investigate whether herbivorous traits evolve with a common progression in coelurosaurian lineages. Our analyses detect a statistically significant pattern in the order of PHI accrual between Ornithomimosaura and Oviraptorosauria, marking a common pathway of increasing specialization to herbivory. Progressive ecomorphological trends of this kind may ultimately substantiate the presence of intrinsic constraints to the evolution of plant eating in theropods.

Poster Session II, (Monday)
INTERRELATIONSHIPS OF CREATACEOUS AND PALEOGENE NEOPLAGIAULACIDAE (MULTITUBERCULATA, MAMMALIA)
ZHANG, Yan, Ohio State University, Columbus, OH, USA; HUNTER, John, Ohio State University, Newark, OH, USA

Neoplagiaulacid multituberculates were a dominant group of small-bodied terrestrial omnivores-herbivores, analogous to muroid rodents, in the Cretaceous and Paleocene, and include several features unreported in Early Cretaceous orithurines. The new specimen preserves a forked tail composed of elongate rectrices medially separated by a deep notch. This discovery reveals new diversity and specialization among Early Cretaceous orithurines. This tail morphology in modern birds decreases aerodynamic efficiency relative to the fan-shaped tail, but increases chance of sexual reproduction. This discovery suggests that this tradeoff may have convergently evolved in basal members of Ornithurae, and is consistent with the wooded environment inferred for the Jehol.

Technical Session X, Tuesday 8:45
A NEW TOOTHLESS ORNITHURINE BIRD FROM THE LOWER CREATACEOUS OF CHINA
ZHOU, Shanq, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ZHOU, Zhonghe, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; O’CONNOR, Jingma, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

We report on a new species of basal orithurine bird based on a well-preserved specimen from the Lower Cretaceous Jufotang Formation in Jianchang, western Liaoning, China. The new specimen preserves a suite of characters that distinguish it from other known orithurines, including several features previously unreported in Early Cretaceous orithurines. This new species possesses a fairly v-shaped furcula with a short hypochileum, the first definitively known among Early Cretaceous orithurines, a rostrocaudally elongate unperforated sternum with deep caudal notches absent, a deltoid-pectoral crest that extends for half the length of the humerus, and an elongate manus with a reduced major ungual, previously unreported among Early Cretaceous orithurines. The specimen preserves an excellent skull that indicates the species was toothless and preserves details of the skull anatomy such as the premaxilla-frONTAL articulation. Most notable of this specimen is the preservation of a tail morphology previously unknown among Mesozoic birds, and the second tail morpholgy known among early orithurines, which have until now only preserved fan-shaped tails. The new specimen preserves a forked tail composed of elongate rectrices medially separated by a deep notch. This discovery reveals new diversity and specialization among Early Cretaceous orithurines. This tail morphology in modern birds decreases aerodynamic efficiency relative to the fan-shaped tail, but increases chance of sexual reproduction. This discovery suggests that this tradeoff may have convergently evolved in basal members of Ornithurae, and is consistent with the wooded environment inferred for the Jehol.

Technical Session X, Tuesday 8:30
VERTEBRATE DIVERSITY OF THE EARLY CREATACEOUS JEHOI BIOTA
ZHOU, Zhonghe, Key Laboratory of Evolutionary Systematics, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; WANG, Yuan, Key Laboratory of Evolutionary Systematics, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

Intensive collecting and study of the Early Cretaceous Jehol lagerstätte in the past twenty years have added significantly to our understanding of its biodiversity, and contributed greatly to reconstructing the Lower Cretaceous terrestrial ecosystem. An updated survey of valid taxa of Jehol vertebrates indicates that the Jehol vertebrate assemblage currently comprises, at the generic count, at least 33 birds, 30 dinosaurs, 16 pterosaurs, 13 mammals, 5 lizards, 5 choriostoderes, 2 turtles, 8 amphibians, and 7 fishes as well as 1 agnathan, totaling 120 genera. All of them have been recognized as members of extinct genera and species, and only a few of them (e.g., some fishes and amphibians) can be referred to extant vertebrate families. Although 141 vertebrate species are currently regarded as valid, we estimate this number will increase with more detailed morphological and systematic study in the future. The recorded Jehol vertebrate diversity already exceeds that of such well-known contemporaneous lagerstätten as from Santana of Brazil and Las Hoyas of Spain. And to some degree, it is no less remarkable than that of the Late Jurassic Solnhofen lagerstätte in which more than half of the vertebrate species are fishes, or the Eocene Messel lagerstätte, of which only the bird diversity is greater than that of the Jehol Biota. In addition to its taxonomic diversity, the Jehol vertebrate assemblage also displays remarkable differentiation in diet, size, locomotion and habitat, all of which may account for evolution of the vertebrate diversity of the biota. A high percentage of arboreal or scansorial forms characterized the birds, pterosaurs, dinosaurs, mammals, and lizards of the biota. In particular, approximately 75% of the avian specimens are of an arboreal life, finding against a complex geological, palaeoecological, and paleoenvironmental background, the interactions among various vertebrate groups as well as among the vertebrates, invertebrates, and plants had definitely played a key role in the succession of the Jehol ecosystem.

Technical Session VIII, Monday 3:30
PLACODERM JAW BONES FROM THE XIAOLIANG FAUNA (UDLOW, SILURIAN) AND THE DENTITION OF EARLY GNATHOSTOMES
ZHU, Min, Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Chinese Academy of Sciences, Beijing, China; ZHAI, Wen-jin, IVPP, Chinese Academy of Sciences, Beijing, China; JIA, Lian-tao, IVPP, Chinese Academy of Sciences, Beijing, China

The dermal element jaws of placoderms were considered to comprise only the supragnathal and infragnathal (upper and lower toothplates), which form the inner dental arcade like other gnathostomes (acanthodians, chondrichthysans, and osteichthysans). However, whether placoderms have true teeth as in other gnathostomes has been a subject of controversy, partly due to the large morphological gap between dermal jaw bones of placoderms and...
osteichthyan. Recently, we reported the Xiaoxiang Fauna from the Ludlow (Silurian) of China, which is characterized by the early diversification of gnathostomes. In addition to several osteichthyan forms exemplified by *Guiyu oneiros*, rich placoderm remains including disarticulated jaw bones were known from the Xiaoxiang Fauna. The anterior supragnathals are found in articulation with the endocranium at the level of orbits. One toothplate, bearing a denticulated biting portion anteriorly and a slender non-biting portion posteriorly, can be directly compared to the infragnathal of buchanosteid arthrodires. The rest of the jaw bones are equipped with clustered conical teeth along the jaw margin, and densely set tubercles on the external surface. They are very suggestive of the dentary or maxillary of primitive osteichthyan such as *Lophosteus* and *Androcleps*, indicating the presence of the outer dental arcade in placoderms. The presence of the outer dermal jaw elements in placoderms, comparable to the dentary and infradentary bones of osteichthyan, is supported by an articulated placoderm specimen from the Xiaoxiang Fauna. All these novel data provide further morphological links between placoderms and other gnathostomes, and offer new insights into the dentitions among early gnathostomes.

Poster Session III, (Tuesday)

**A NEW GLYPTODONTINAE (XENARTHRA, GLYPTODONTIDAE) FROM NORTHERN SOUTH AMERICA: ITS IMPLICATIONS IN THE GREAT AMERICAN BIOTIC INTERCHANGE**

**ZURITA, Alfredo,** Centro de Ecología Aplicada del Litoral (CECOAL-CONICET) and Universidad Nacional del Nordeste, Argentina; **CARLINI, Alfredo,** Paläontologisches Institut und Museum, Universität Zurich, and Departamento Científico Paleontología de Vertebrados, Museo de La Plata, LaPlata, Argentina; **GILLETTE, David,** Museum of Northern Arizona, Flagstaff, AZ, USA

The population dynamics of the Glyptodontinae (Glyptodontidae) during the Great American Biotic Interchange (GABI) has been reinterpreted as a bidirectional process, with the reentry of some North American taxa in the latest Pleistocene into Venezuela. The first records of Glyptodontinae in North America are *cf. Glyptotherium* from the Pliocene of north-central Mexico. A new Glyptodontinae from the late Pliocene of northern Venezuela (San Gregorio Formation), prior the GABI, presents significant paleobiogeographical and phylogenetic implications. The material is represented by numerous osteoderms of the dorsal carapace. From a morphological perspective a comparison with the North American taxa (Pliocene-Late Pleistocene; *Glyptotherium* spp.) and with the southern South American taxa (Late Miocene-Early Holocene; *Glyptodontidium tuberifer, Paraglyptodon chapulmalensis, P. aquienensis,* and *Glyptodon*), reveals a closer relationship with *Glyptotherium* than to the southern South American forms. Some of these characters could be interpreted as primitive for the Glyptodontines. Shared characters include: 1) the sulci that delimit the central figure are shallower and narrower than observed in the southern South American taxa; 2) the dorso-ventral diameter of the osteoderms is less than in *Paraglyptodon, Glyptodontidium and Glyptodon;* 3) the exposed surface of the osteoderms is clearly rough and punctate; and 4) the central figure in the exposed surface is bigger. The available evidence suggests: 1) that this new late Pliocene Glyptodontine from northern South America is closely related to those that participated in the GABI and the ancestry of *Glyptotherium;* 2) in turn, that the southern South American taxa, especially the Miocene and Pliocene ones (*i.e.*, *G. tuberifer* and *Paraglyptodon*) are clearly more closely related to the Pleistocene genus *Glyptodon;* and 3) finally, it is possible that the northern (*Boreostemma* spp. and the new Glyptodontinae presented here) and southern taxa (*Glyptodontidium, Paraglyptodon and Glyptodon*) of South America represent distinct lineages, separated from, at least, the Late Miocene-early Pliocene.
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